SPECIFICATIONS AND CONTRACT DOCUMENTS

FOR THE

CONSTRUCTION OF

RINCONADA WATER TREATMENT PLANT RESIDUALS REMEDIATION PROJECT

Project No. 93294058

Contract No. C0671

APRIL 2021

Valley Water

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FOR THE CONSTRUCTION OF

RINCONADA WATER TREATMENT PLANT
RESIDUALS REMEDIATION PROJECT

PROJECT NO.: 93294058

CONTRACT No.: C0671

SANTA CLARA VALLEY WATER DISTRICT

Prepared by:

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3/30/2021
Date

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4/13/2021
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4/13/2021
Date

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4/13/2021
Date

MARCH 2021

DISTRICT BOARD OF DIRECTORS

John L. Varela	**District 1**	**Nai Hsueh**	**District 5**
Barbara F. Keegan	**District 2**	**Tony Estremera, Chair**	**District 6**
Richard P. Santos	**District 3**	**Gary Kremen, Vice Chair**	**District 7**
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Date

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3/22/2021
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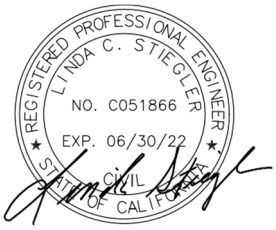

Albert Lee, Licensed Architect
Architect
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3/22/2021
Date

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3/26/2021
Date

David Whitbeck, PE
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3/22/2021
Date

DISTRICT BOARD OF DIRECTORS

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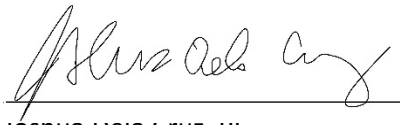

Joshua Dela Cruz, PE
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3/29/2021
Date

Philip Atkinson, PE
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Stantec

3/26/2021
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DISTRICT BOARD OF DIRECTORS

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STANDARD PROVISIONS

SECTION 1. DEFINITIONS

Whenever in these Specifications and other Contract Documents the following abbreviations and terms or pronouns in place of them are used, the intent and meaning shall be interpreted as follows:

ABBREVIATIONS

AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
AISI	American Iron and Steel Institute
AIEE	American Institute of Electrical Engineers
AISC	American Institute of Steel Construction
ANSI	American National Standards Institute
API	American Petroleum Institute
AREA	American Railway Engineering Association
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing and Materials
AWG	American Wire Gage
AWPA	American Wood Preservers' Association
AWS	American Welding Society
AWWA	American Water Works Association
BAAQMD	Bay Area Air Quality Management District
Cal EPA	California Environmental Protection Agency
CCR	California Code of Regulations
CFR	Code of Federal Regulations
CIH	Certified Industrial Hygienist
CWA	Federal Clean Water Act
DHS	California Department of Health Services
HSC	California Health and Safety Code
IEEE	Institute of Electrical and Electronics Engineers
NEC	National Electric Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NPDES	National Pollution Discharge Elimination System
NTP	Notice to Proceed
RWQCB	California Regional Water Quality Control Board
SAE	Society of Automotive Engineers
SDS	Safety Data Sheet
SWPPP	Storm Water Pollution Prevention Plan
SWRCB	California State Water Resources Control Board
UBC	Uniform Building Code
UL	Underwriters Laboratories
USEPA/EPA	United States Environmental Protection Agency
WCLB	West Coast Lumber Inspection Bureau
WWPA	Western Wood Products Association

DEFINITIONS

Acceptance: The formal, written acceptance of the Contract by the District's Board of Directors, as documented in a recorded Notice of Completion of Contract and Acceptance of Work. Acceptance indicates that all Work has been completed in all respects in accordance with the Drawings and Specifications and with any modifications thereof previously approved.

Activity Hazard Analysis (AHA)/Job Hazard Analysis (JHA): A form used to identify the task and break it down into steps, identify the hazards associated with each step, and identify the control measures used for each step to protect the worker, environment, or public. This form is also commonly referred to as a Job Safety Analysis (JSA).

Addendum: Written or graphic instruments issued prior to the opening of Proposals that make changes, additions, or deletions to the Bid Documents, or Contract Documents.

Agreement: The written document executed by the parties formalizing the Contract.

Approved, Directed, Ordered, or Required: Whenever these words or their derivatives are used, it is the intent, unless otherwise clearly stated, that approval or direction by the Engineer is indicated.

Article: A numbered subsection of a Section.

Bid: The completed Proposal and all associated Bid Forms, including Bidder's Bond or other Bidder's security. Bids not accompanied by the required documents are considered incomplete bids and are nonresponsive.

Bid Documents: All documents to be considered when preparing a Bid. The Notice to Bidders, Instructions to Bidders, Proposal and all accompanying Bid Forms, Bidder's Bond or other Bidder's security, and Contract Documents.

Bidder: Any individual, firm, partnership, corporation, or combination thereof, submitting a proposal for the Work contemplated, acting directly or through a duly authorized representative.

Board, Board of Directors: The Board of Directors of the District.

Certified Industrial Hygienist: A professional who is certified by the American Board of Industrial Hygienists as trained to evaluate safety and health hazards and to determine safety measures necessary for personnel working under hazardous conditions.

Code: The terms Government Code, Labor Code, etc., refer to codes of the State of California.

Competent Person: A person capable of identifying existing and predictable hazards in the surroundings or working conditions that are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt, corrective measures to eliminate those conditions.

Construction Equipment: Equipment used for the performance of work but not incorporated into the Project.

Contract: The written Agreement between the Contractor and the District comprised of the Contract Documents.

Contract Documents: Refer to Article 2.01. Contract Documents and Precedence.

Contract Time(s): The time (Days) allowed for completion of the entire Work or portion thereof as defined by specified Milestones that meets the requirements of the Contract Documents and is accepted by the Engineer. See also Project Completion and Milestone Completion.

Contract Price(s): The price (dollars) for completion of the entire Work set forth in the Contract Documents.

Contractor: The entity or person with whom the District has executed the Contract and has identified as such therein and referred to throughout the Contract Documents as singular in number and neuter in gender. The term “Contractor” means Contractor, its employees or its authorized representative(s).

Controlling Item of Work: Any feature or combination of features of the Work considered at the time by the Engineer, which if delayed, will delay the completion of Work associated with a specified Contract Time(s).

Days: Calendar days, unless otherwise designated.

Delay: An increase in the duration or length of time for performing the Work that is caused by any event, action, inaction, or factor. The five types of delay are defined in Article 3.08. Change in Contract Time(s).

Definable Feature of Work: A task that is separate and distinct from other tasks and that has separate control requirements.

District: The Santa Clara Valley Water District. Also referred to as “Valley Water” throughout the Contract Documents.

Drawings: The official Drawings, working Drawings, detail Drawings, and supplemental Drawings, or reproductions thereof, that show the location, character, dimension, and details of the Work to be done and that are to be considered as part of the Contract.

Engineer: The designated Engineer as defined in Article 3.02. Engineer of the Standard Provisions who, acting either directly or through a properly designated representative, assumes all duties and responsibilities, and has all rights and authority in accordance with the Contract Documents.

Equipment: Equipment incorporated or to be incorporated into the Project.

First Chargeable Day: The first day of Contract Time allowed for completion of the entire Work. The First Chargeable Day will be specified in the Notice to Proceed.

Fixed Costs: Any necessary labor, Material, and Equipment costs directly expended on the item or items under consideration that remain constant regardless of the quantity of Work done.

Hazardous Material: (A) Any substance, product, waste, or other Material of any nature whatsoever that is or that becomes listed, regulated, or addressed pursuant to any Federal, State, or Local Statute, Law, Ordinance, Resolution, Code, Rule, Regulation, Order, or Decree regulating, relating to, or imposing liability (including, but not limited to, response, removal, and Remediation costs) or standards of conduct or performance concerning any hazardous, toxic, explosive, corrosive, flammable, infectious, radioactive, carcinogenic, mutagenic, or as otherwise dangerous waste, substance, or Material; (B) any substance, product, waste, or other Material of any nature whatsoever whose presence in and of itself may give rise to liability under any of the above Statutes or under any statutory or common law theory based on negligence, trespass, intentional tort, nuisance, strict, or absolute liability or under any reported decisions of a State or Federal court; (C) any substance without limitation that contains petroleum or crude oil, including, but not limited to, petroleum and petroleum products.

Hazardous Waste: Any substance or Material as defined in the California Hazardous Waste Control Act Health and Safety Code, Chapter 6.5, Sections 25100–25257.1, or in the Resource Conservation and Recovery Act, 42 U.S.C. 6901 et seq.

Liquidated Damages: The amount stated in the Specifications, as provided for in Government Code Section 53069.85, to be paid to the District or to be deducted from any payments due or to become due the Contractor for each Day of Inexcusable Delay in completing the whole or any specified portion of the Work beyond the specified Contract Time(s) or any other amount specifically stated as a Liquidated Damage in the Contract.

Material: Material incorporated or to be incorporated into the Project or managed by the Contractor.

Milestone: A specified portion of the Work identified in the Contract as a Milestone that is to be completed under the Contract.

Milestone Completion: The date determined by the District when the Milestone is to be complete. Milestone Completion does not constitute Acceptance but does establish the completion date of the Milestone for the purpose of assessing Liquidated Damages, if any, associated with the Milestone.

Notice to Proceed: Refer to Article 5.02. Notice to Proceed.

Personnel Protection: Equipment and procedures that minimize human exposure to Regulated Material, Hazardous Material, Hazardous Waste, or unsafe situations.

Plans, Construction Plans: See Drawings.

Project: The erection, construction, alteration, repair, or improvement to be accomplished under the Contract. Refer to Work.

Project Completion: The stage at which the whole Work is complete per the Contract Documents, and the Engineer has performed the final inspection and issued a Project Completion letter.

Proposal: The Proposal states the price for which the Bidder proposes and agrees to perform the Work. See Proposal and Bid Items, Bid Form No. 1.

Qualified Biologist: A biologist who has the experience, education and training necessary to perform specific tasks related to the biological subject discipline, and in an unbiased fashion. The term 'qualified biologist' is used generically to mean a biologist who is trained to perform the given task; specifically, a fisheries biologist, wildlife biologist, or botanist. Training must be in the field to which the task is related. (Refer to the appendices for specific fields of study).

Reasonable Accuracy: Within the tolerances as shown on the Drawings or as indicated in the Specifications.

Regulated Material: Any substance or combination of substances for which Federal, State, or Local regulations require special management, storage, disposal, or handling practices. This includes, but is not limited to, material defined as Hazardous Material and Waste; designated waste (California Water Code Section 13173); and special waste (California Code of Regulations, Title 22, Div. 4.5 [Environmental Health Standards for the Management of Hazardous Waste]).

Remediation: Restoration of contaminated soil, groundwater, or other Materials to its pre-contaminated level or to a level acceptable to the District and Local, State, and Federal agencies.

Responsible Bidder: Responsible Bidder as defined in California Public Contract Code Section 1103.

Specifications: The directions, provisions, and requirements contained in the Standard Provisions, Special Provisions, and Technical Provisions.

Subcontractor: An entity or person contracting with the Contractor or with another Subcontractor to perform any portion of the Work. The term "Subcontractor" is referred to throughout the Contract Documents as singular in number and neuter in gender and means a Subcontractor, its employees or its authorized representative(s).

Supplier: An entity or person contracted with the District, the Contractor or its Subcontractors to provide Materials and/or equipment for any portion of the Work. The term "Supplier" is referred to throughout the Contract Documents as singular in number and neuter in gender and means a Supplier or its authorized representative.

Total Bid Price: The sum stated in the Bid for which the Bidder offers to perform the Work described in the Bid Documents. The Total Bid Price shall include the entire cost of all Work necessary for a complete and fully operational structure or facility in accordance with the requirements of the Contract Documents.

Work: Refer to Article 3.01. Work to be Done, paragraph A. References in the Contract Documents to "Work" may be to specific items of Work.

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SECTION 2. CONTRACT DOCUMENTS

2.01. Contract Documents and Precedence

A. The Contract Documents comprise the entire Agreement between the District and the Contractor concerning the Work. The Contractor shall properly perform all requirements of the Contract Documents.

B. The Contract Documents include the District's Contract form and any exhibits attached thereto, including the Notice to Bidders, Instructions to Bidders, Proposal, Standard Provisions, Special Provisions, Technical Provisions, Drawings, Specifications, Addenda, Appendices, approved Change Orders, and Directed Change Orders (DCO) as defined in Section 3, if any.

C. The Contract Documents are intended to be complementary and include all items necessary for the Contractor's proper execution and completion of the Work. Anything mentioned in the Specifications and not shown on the Drawings, or shown on the Drawings and not mentioned in the Specifications, shall be as if shown or mentioned in both. Any part of the Work not shown or mentioned in the Drawings or in the Specifications that is inferable or implied by either, or that is necessary or usual for proper performance of the Work, shall be provided by the Contractor at its own expense.

D. In case of conflicts, errors, and discrepancies in any of the Contract Documents, the order of precedence (from highest to lowest priority) is as follows. Within the same order of precedence, specific requirements shall take precedence over general requirements:

1. Change Orders (CO) or DCO
2. Agreement
3. Addenda
4. Special Provisions
5. Technical Provisions
6. Drawings/Plans
7. Standard Provisions
8. Instructions to Bidders
9. State Specifications and Plans
10. Appendices

E. With reference to the Drawings:

1. Figures or numerical dimensions govern over scaled dimensions.

2. Detail Drawings govern over general Drawings.

3. Addenda/CO or DCO Drawings govern over Contract Drawings.

4. Contract Drawings govern over standard Drawings.

5. Notes apply only to the Drawings where the notes appear, unless classified as “typical,” “general,” or “universally applicable,” in which case they apply to all Drawings where the conditions or circumstances noted occur.

6. Typical details apply to all Drawings, unless a specific, different detail is shown.

2.02. State Specifications and Plans

A. Unless otherwise stated, State Specifications and Plans referred to in these Specifications shall be the latest published edition of the State of California Department of Transportation Standard Specifications and Standard Plans and updates thereto and are by reference made a part of these Specifications the same as though set out in full, as to the provisions requiring compliance.

B. When specifically stated to follow the State Specifications and Plans for an item, the Work set forth in these Contract Documents shall be accomplished in accordance with the appropriate provisions and details of the State Standard Specifications and Standard Plans.

2.03. Clarification of Contract

A. The following interpretative rules apply throughout the Contract Documents:

1. The provisions of the Contract Documents are complementary and should be interpreted to view the Contract Documents as a whole.

2. A concept phrased in the singular should be interpreted in the plural as required.

3. Masculine includes feminine and feminine includes masculine.

4. The words “shall,” “will,” and “must” in any of their tenses indicate mandatory requirements. The word “may” indicates “may apply” or “may not apply.”

5. The use of examples (e.g., “such as” or “including”) does not limit or exclude examples not specifically mentioned.

6. The words “provide,” “furnish,” “perform,” “construct,” and “install” mean that the Contractor shall provide, perform, construct, and install and shall include all services necessary to provide, perform, construct, and install unless preceded by the word “only.”

B. The Contract Documents are not complete in every detail but show the purpose and intent only. The Contractor shall comply with their true intent and meaning, taken as a whole, and shall not avail itself of any manifest error, omission,

discrepancy, or ambiguity that appears in the Contract Documents, instructions, or work performed by others.

C. All corrections of readily apparent errors or omissions in the Contract may be made by the Engineer when such corrections are necessary for the proper fulfillment of their intention as construed by the Engineer. The misplacement, addition, or omission of any word, letter, figure, or punctuation mark that has no substantive legal effect will in no way change the due spirit, intent, or meaning of these Specifications.

D. Any part of the Work not shown on the Drawings or described in these Specifications, but that is reasonably or ordinarily implied by either, shall be furnished and installed by the Contractor as if fully described in these Specifications and shown upon the Drawings.

E. **Contract Document Clarifications (CDC)**: A document initiated by the District consisting of supplementary details, instructions, or information issued by the District that clarifies or supplements the Contract Documents. Contract Document Clarifications do not constitute a change in Contract Work, Contract Price(s), or an extension in Contract Time(s) unless requested by the Contractor and approved by the District in accordance with the Contract Documents.

F. Payment for items of Work that are called for in the Specifications or that are shown on the Drawings but that are not separately identified in the Proposal, shall be compensated as part of the Bid price of one or more of the items that are listed; no additional payment shall be made.

2.04. Requests for Information

A. **Request for Information (RFI)**: A document prepared by the Contractor requesting information from the District regarding the Project or Contract Documents.

B. Contractor shall be responsible for its costs and the costs of its Subcontractors to review Contract Documents and field conditions and to implement and administer an RFI system throughout the Contract Time(s) in accordance with the requirements of the Contract. The Contractor shall be responsible for costs incurred by the District for the Work of the District's consultants and District administrative efforts in answering Contractor RFIs where the answer could reasonably be found by reviewing the Contract Documents.

C. The Contractor shall carefully review the appropriate portions of the Contract Documents a minimum of 30 Fs in advance of the Work to be executed for the express purposes of checking for manifest errors, omissions, discrepancies, or ambiguities. The Contractor shall not be entitled to any compensation for Delays, disruptions, inefficiencies, or additional administrative effort caused by the Contractor's untimely review of the Contract Documents.

D. Should it appear that the Work to be done or any of the matters relative thereto are not sufficiently detailed or explained in the Specifications or on the Drawings, or if the Contractor discovers any discrepancies between the Contract Drawings and conditions in the field, or any errors or omissions in the Contract, or in the layout given by stakes, points, or instructions, the Contractor shall submit a written RFI to the Engineer. If the Contractor proceeds with any such Work without receiving such clarification or RFI reply, it shall be responsible for correcting all resulting damage and any nonconforming Work.

E. The Engineer will issue written clarification or interpretation of Contract Document requirements in response to the Contractor's requests and other sources of information. The Engineer's decision thereon shall be final; the Contractor shall conform to it as part of the Contract.

2.05. Examination of Drawings, Specifications, and Site of Work

A. As noted in the Notice to Bidders, the Contractor's submission of a Proposal is conclusive evidence that the Contractor investigated and is fully aware of the conditions and difficulties to be encountered of the character, quality, and quantities of Work to be performed, the Material to be furnished, and the requirements of the Proposal, Drawings, Specifications, and other Contract Documents.

B. Where investigation of subsurface conditions has been made by the District in respect to foundation, characterization of soils, groundwater, or other design, Bidders may inspect the records of the District as to such investigation, including examination of samples and drill cores, if any. When logs of test boring showing a record of the data obtained by the District's investigation of subsurface conditions are made available, these logs represent only the opinion of the District as to the character of Material encountered by it in its test borings and are made available only for the convenience of Bidders.

C. Note that the District's investigation of subsurface conditions is made for the purpose of design. The District assumes no responsibility whatsoever in respect to the sufficiency of test borings, or to accuracy of the log of test borings, or to other preliminary investigations, or of the interpretation thereof. There is no guarantee, expressed or implied, that the conditions indicated are representative of those existing throughout the Work, or to any part of it, or that unforeseen developments may not occur.

D. Making such information available to the Contractor is not to be construed in any way as a waiver of the provisions of this Article; Bidders must satisfy themselves through their own investigations, analyses, and interpretations as to conditions to be encountered.

E. No information derived from such inspection of records or from preliminary investigations made by the District, or from the Engineer, or from assistants, or from the maps, Specifications, profiles, or Drawings will in any way relieve the Contractor from any risk or from properly fulfilling all the terms of the Contract.

F. Site Investigation

1. The Contractor shall not be entitled to any adjustment in the Contract Price(s) or in Contract Time(s) if the existence of the condition that caused an impact alleged by the Contractor:

   a. Could have been reasonably discovered or revealed as a result of examination, investigation, exploration, test, or study of the site and of contiguous areas required by the Contract Documents to be conducted by or for the Contractor prior to commencing the Work; or

   b. Could have been inferred from the presence of other visible features, such as boulders, buildings, meters, and junction boxes on or adjacent to the site.

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SECTION 3. SCOPE OF WORK

3.01. Work to be Done

A. The performance by the Contractor of all of its responsibilities and obligations set forth in the Contract Documents. Work includes, but is not limited to, providing labor, Materials, Equipment, testing, services, and documentation required by the Contract Documents. References in the Contract Documents to "Work" may be to specific items of Work. All Work performed is to be in compliance with the Contract Documents.

B. During construction, the Contractor shall keep the worksite, areas adjacent to the worksite or otherwise impacted by the Contractor's operations and access roads in an orderly condition, free and clear of debris and discarded Materials.

3.02. Engineer

A. The Engineer of the District shall be the District's representative who assumes all duties and responsibility and has all rights and authority as assigned in the Contract Documents.

B. The Engineer of the District is the Deputy Operating Officer or Assistant Operating Officer of the Water Utility Capital or Watershed Capital or Water Utility Technical Support Division or Office of Watersheds as applicable. Administrative hearings, if required, will be conducted by an Operating Officer of a different Division or Office.

C. Authority of Engineer: The Engineer shall decide all questions that may arise as to the quality or acceptability of Material furnished, Work performed, and rate of progress of the Work; all questions that may arise as to the interpretation of the Drawings and Specifications; and all questions as to the acceptable fulfillment of the Contract on the part of the Contractor. The Engineer's decisions shall be final. The Engineer has the authority to enforce these decisions and provide direction to the Contractor, which the Contractor shall carry out promptly.

3.03. Contractor Staffing

A. A project manager and superintendent shall be provided as specified below:

1. The Contractor shall submit for approval in writing before starting the Work the name of the project manager and superintendent who shall have complete authority to represent and act for the Contractor. This submittal shall also include a list of reference projects with the following information: (i) the individual's name; (ii) the project name that serves as the basis of qualification; (iii) the project site location; (iv) a brief project description; and (v) the name and mailing address of the project owner.

2. The project manager shall have at a minimum seven (7) years' experience as a contractor's project manager on public works with not less than four (4) years' experience as a project manager on projects with

complexity and configuration similar to the Work described in the Contract Documents.

3. The superintendent shall have at a minimum seven (7) years' experience as a contractor's general superintendent on public works with not less than four (4) years' experience as a superintendent on projects with complexity and configuration similar to the Work described in the Contract Documents.

4. The superintendent of the Contractor shall normally be present at the site of the Work at all times while Work is actually in progress on the Contract. During any period when Work is suspended, arrangements acceptable to the Engineer shall be made for any emergency Work that may be required to be done by the Contractor.

5. Whenever the Contractor or an authorized representative is not present on any part of the Work where it may be desired to give direction, orders will be given by the Engineer, which shall be received and obeyed by the superintendent who may have charge of the particular Work in reference to which the orders are given. Any order given by the Engineer not otherwise required by the Specifications to be in writing will, on the request of the Contractor, be given or be confirmed by the Engineer in writing.

6. If the project manager or superintendent is not deemed qualified or if the project manager's or superintendent's performance on the Work is determined to be unsatisfactory by the Engineer, the project manager or superintendent shall be immediately removed from the Project. The Contractor shall submit for approval the same information described in this article for a proposed substitute project manager or superintendent.

7. The Contractor shall designate, in writing, the names and telephone numbers of at least three (3) representatives who can be contacted at any time in the event that an emergency occurs.

B. A Professional Scheduler shall be provided unless removed in the Special Provisions. The Professional Scheduler shall meet the requirements specified in Article 5.05. Professional Scheduler. If Professional Scheduler is not required, the Contractor is responsible for providing adequate resources required to develop and to maintain schedules.

C. A Site Safety and Health Supervisor shall be provided unless removed in the Special Provisions. The Site Safety and Health Supervisor shall meet the requirements specified in Article 8.11. Site Safety and Health Supervisor.

D. A Field Quality Control Manager shall be provided if required in the Special Provisions. The Field Quality Control Manager shall meet the requirements specified in the Special Provisions Article 20.04.02. Contractor's Quality Staffing Requirements.

3.04. Character of Workers

A. Any Subcontractor or person employed by the Contractor or Subcontractor who fails or refuses to carry out the directions of the Engineer, or who appears to the Engineer to be incompetent, or who acts in a disorderly or improper manner shall be removed from the Work immediately on the written request of the Engineer; such person shall not again be employed on the Work.

3.05. Layout of Work and Surveys

3.05.01. Responsibility of District

A. The District shall establish survey control points and reference points as shown on the Drawings for required field layout by the Contractor.

B. The District shall provide only the minimum survey crew services essential for orderly performance of the Work; District survey crews will not be available at all times for the Work under these Specifications.

C. The District shall provide to the Contractor the station(s) and offset distance(s) to all reference points and benchmarks that were provided by the District in paragraph A.

D. The District shall establish required stakes only once. Survey stakes destroyed or removed will be replaced by the District at the Contractor's expense.

3.05.02. Responsibility of Contractor

A. When the Contractor requires stakes or marks as provided for in paragraph A, it shall clear and grub the area to be staked and then notify the Engineer of such requirements in a reasonable length of time in advance of starting operations that require such stakes or marks. In no event shall a notice of less than seven (7) Days be considered a reasonable length of time.

B. Where construction operations require removal of the District's stakes or other survey marks, the Contractor shall reference such points in an approved manner. Survey stakes or marks established by the District shall be preserved by the Contractor until their removal is authorized. In case of their unauthorized destruction or removal by the Contractor's forces, they will be replaced at the Contractor's expense. Any cost to the District of replacing survey stakes or marks will be deducted from payments due the Contractor. Such cost will include a reasonable charge for use of District supplies, labor, and Equipment, plus overhead.

C. The Contractor is solely responsible for the measurements and layout of the Project from the given survey control points and reference points provided by the District. Any questions with regard to interpretation of Project layout shall be resolved by the Engineer.

D. The Contractor shall not remove or disturb survey monuments and permanent markers unless otherwise approved by the Engineer and not until the District has recorded and referenced the locations. The Contractor shall be charged at a reasonable rate for the restoration or replacement of survey monuments and permanent markers by the District.

E. No survey monuments, permanent markers for the District right of way, or District survey control points shall be removed or disturbed until the Engineer has recorded the locations thereof and a permit for such removal has been received from the agency having jurisdiction. When the construction Work has been completed, the Contractor shall replace said monuments accurately in the locations as referenced by the Engineer at no cost to the District.

F. If any marker or monument is destroyed by the Contractor without prior written approval of the Engineer, the Contractor shall be responsible for the accurate replacement of that marker or monument at no expense to the District by a Land Surveyor licensed by the State of California in accordance with the California Business and Professions Code Chapter 15, Land Surveyors, Section 8771.

3.06. Changes in the Work

A. **Change Order**: A written document that changes the Contract and has been fully executed bilaterally by the District and Contractor that authorizes an addition, deletion, or revision in the Work; an adjustment in the Contract Price(s); and/or the Contract Time(s), including Milestone Completion dates or durations.

B. **Directed Change Order (DCO)**: The District's written order that is a Change Order unilaterally executed by the District to order additions, deletions, or revisions in the Contract Work. If deemed necessary and/or appropriate by the Engineer, the DCO will include an adjustment in the Contract Price(s) and/or in the Contract Time(s) and/or in other terms and conditions that the District, at its sole discretion, deems reasonable for the change.

C. **Potential Change Order (PCO)**: The District's written request to the Contractor for a proposal to perform PCO Work prior to the District's issuance of a Change Order or DCO. A PCO may also be created by the District to track disputed Work.

3.06.01. Potential Change Orders and Change Orders

A. The District may at any time, or from time to time and without notice to the Contractor's surety, order additions, deletions, or revisions to the Work and/or to the Contract Time(s) and may request a proposal from the Contractor for a PCO for such additions, deletions, or revisions in the Work and/or in the Contract Time(s). Pursuant to Articles 3.07. Change in Contract Price(s) and 3.08. Change in Contract Time(s), the Contractor shall submit any requests for adjustments in the Contract Price(s) and/or in the Contract Time(s).

B. Notwithstanding the time limits stated in Article 3.06.01. Potential Change Orders and Change Orders, upon receipt of such request, the Contractor shall furnish a detailed estimate of increase or decrease in costs and/or in time, together with cost and schedule breakdowns and other supporting data within the time specified in the request, but no later than 30 Days after receipt of such a request unless the Engineer allows additional response time. The Engineer shall review and respond in writing to the Contractor's estimate prior to proceeding with the Work.

C. Changes in the Contract Price(s) shall be determined and paid in accordance with Article 3.07. Change in Contract Price(s). Changes in the Contract Time(s) shall be determined and adjusted in accordance with Article 3.08. Change in Contract Time(s).

D. The District and the Contractor shall execute appropriate Change Orders covering:

1. changes in the Work that are Ordered by the District pursuant to paragraph "A" above;

2. changes in the Contract Price(s) and/or Contract Time(s) that are agreed to by the parties; or

3. any other changes agreed to by the parties.

E. The Contractor shall not be entitled to an increase in the Contract Price(s) nor to an extension of the Contract Time(s) with respect to any Work performed that is not required by the Contract, except in the case of an emergency or in the case of uncovering Work as provided in Article 9.06.01. Inspection, paragraph H.

3.06.02. Change Order Request

A. Should the District's Contract Document Clarifications (CDC) or other written directive, in the opinion of Contractor, materially exceed or change the requirements of the Contract Documents, the Contractor shall submit to the District a written Change Order Request (COR) within seven (7) Days of receipt of the CDCs or of other written directive.

B. A COR shall reference the CDC or other written directive and the relevant Specifications and Drawings.

C. A COR shall also include a cost proposal and/or time adjustment proposal as a good faith estimate of any additional compensation or time associated with the affected Work.

D. Failure to submit a timely, documented COR shall constitute a waiver of any future claim for additional compensation or time relating to such Work.

3.06.03. Directed Change Orders

A. In situations where (i) the Contractor fails to submit a proposal for a PCO within the time specified; or (ii) when the District and the Contractor cannot agree on the terms and conditions of a PCO within a reasonable amount of time as determined by District; or (iii) if, in the judgment of the Engineer, it is impracticable because of the nature of the change or for any other reason for the parties to determine and agree on the costs and schedule impacts before the change must be performed, the District has the right to issue to the Contractor a DCO signed by the District only, with compensation based on the Engineer's estimate of cost, time, and other impacts associated with performance of changes in the Work.

B. A DCO may be issued by the District as a result of, but not limited to, any of the following conditions:

1. Responding to differing or unforeseen physical conditions under which the Work is to be performed as provided in Article 3.09. Differing Conditions.

2. Responding to any damage to improvements of property or to an emergency affecting the safety of life or property as provided in Article 4.10. Preservation of Property.

3. Utility relocation as provided in Article 4.25. Coordination With Utilities.

4. Emergency work as provided in Article 4.10. Preservation of Property and in the Special Provisions.

5. Protested Work under Article 3.11.01. Protest.

6. PCO work.

C. Upon receipt of a DCO, the Contractor shall immediately act upon the Work Ordered by the District, all in accordance with the applicable terms and conditions of the Contract Documents.

D. The District's issuance of a DCO is for the purpose of unilaterally modifying the Contract Work, and/or Contract Price(s), and/or Contract Time(s), as deemed necessary by the Engineer. The parties may subsequently negotiate mutually acceptable terms and conditions of a Change Order to replace the DCO, as provided in this Article.

E. The Contractor may, at any time after the District's issuance of a DCO, furnish a detailed estimate of increases or decreases in costs and/or time, cost and schedule breakdowns, and references to relevant Contract Specifications in support of its position with regard to the unilateral directive.

F. Should the Contractor disagree with the terms of the DCO, the Contractor may protest in accordance with Article 3.11.01. Protest. This action shall not delay the requirement to immediately act upon the Work as provided herein.

3.06.04. Allowable Quantity Variations

A. General: Increases or decreases in the quantity of a Contract item of Work shall be determined by comparing the actual pay quantity of an item of Work with the approximate quantity in the listing of the Bid items contained in the Proposal.

1. If the actual pay quantity of an item of Work varies from the approximate quantity by 25 percent or less, payment shall be made for the actual quantity of Work performed at the Contract unit price listed in the Proposal.

2. If the actual pay quantity of an item of Work varies from the approximate quantity by more than 25 percent, in the absence of an executed Contract Change Order or DCO specifying the compensation to be paid, the compensation payable to the Contractor shall be determined in accordance with this Article.

a. Increases of More Than 25 Percent: If the actual pay quantity of an item of Work exceeds the approximate quantity by more than 25 percent, the amount of Work in excess of 125 percent of the approximate quantity may be paid for by adjusting the Contract unit price, subject to the following conditions: (i) the Contractor can demonstrate to the satisfaction of the Engineer that an adjustment in the Contract unit price is warranted; and (ii) the adjusted unit prices are reasonable and approved by the Engineer. Such adjustment of the Contract unit price shall be the positive or negative difference between the Contract unit price and the actual unit cost of the total pay quantity of the item. At the sole option of the Engineer, the actual unit cost of the Work involved in such excess shall be determined in accordance with Article 3.07.01.G.2. (by mutual acceptance of a lump sum) or with Article 3.07.02. Cost of Extra Work (based on Time and Materials); such unit costs shall include an appropriate portion of the Contractor's allowable overhead and profit.

(1) If the cost of an item of Work includes Fixed Costs, the Fixed Costs shall be deemed to have been recovered by the Contractor by the payments made for 125 percent of the approximate quantity at the Contract unit price for the item; in computing the actual unit cost, the Fixed Costs shall be excluded.

(2) When the compensation payable for the quantity of Work performed in excess of 125 percent of the approximate quantity is less than $5,000 at the Contract unit price, no

adjustment in the Contract unit price shall be made unless requested in writing by the Contractor within 14 Days from the date the Contractor became aware, or should have reasonably become aware, of the increase in quantity.

b. Decreases of More Than 25 Percent: If the actual pay quantity of an item of Work is less than 75 percent of the approximate quantity, an adjustment in unit price shall not be made unless the Contractor makes a request in writing within 14 Days from the date the Contractor became aware, or should have reasonably become aware, of the decrease in quantity. If the Contractor makes a request, the actual pay quantity of this item of Work performed may be paid for by adjusting the Contract unit price, subject to the following conditions: (i) the Contractor can demonstrate to the satisfaction of the Engineer that an adjustment in Contract unit price is warranted; and (ii) the adjusted unit prices are reasonable and approved by the Engineer. Such adjustment of the Contract unit price shall be the positive or negative difference between the Contract unit price and the actual unit cost of the total pay quantity of the item, including Fixed Costs. At the sole option of the Engineer, payment for the actual quantity of Work shall be made by mutual acceptance of a lump sum amount or cost of Work based on Time and Materials; such unit costs shall include an appropriate portion of the Contractor's allowable overhead and profit.

(1) Payment for the actual pay quantity of such item of Work shall in no case exceed the payment that would have been made for the performance of 75 percent of the approximate quantity of such item at the Contract unit price.

B. Eliminated Items: If any Contract item of the Work is eliminated in its entirety, the Contract Sum shall be reduced by the amount bid for that Bid item, including overhead and profit. Payment shall be made to the Contractor for the actual cost incurred in connection with the eliminated Contract item if incurred prior to the date of notification in writing by the Engineer of such elimination.

1. If acceptable Material is ordered by the Contractor for an eliminated Contract item prior to the date of notification of the elimination by the Engineer, and if orders for the Material cannot be canceled, payment for the Material shall be made at the actual cost to the Contractor. In this case, the Material shall become the property of the District. If the Material can be returned to the vendor and if the Engineer so directs, the Material shall be returned, and the Contractor shall be paid for the actual cost for returning the Material.

2. The actual costs to be paid by the District to the Contractor in accordance with this Article will be computed in accordance with Article 3.07.02. Cost of Extra Work, which shall include an allowance for overhead and profit.

3. In the event the Contractor and the District are unable to agree on the credit amount due, the District shall unilaterally determine the amount.

C. Supplemental Contract Items: Items noted as “Supplemental” in the Proposal may be deleted entirely or in part at the sole discretion of the District. The provisions of Articles associated with Allowable Quantity Variations or Eliminated Items shall not apply to Supplemental Contract Items.

3.07. Change in Contract Price(s)

3.07.01. General

A. The Contract Price(s) constitutes the total compensation payable to the Contractor for performing the Work. All duties, responsibilities, and obligations assigned to or undertaken by the Contractor to perform the Work shall be at the Contractor’s expense without a change in the Contract Price(s).

B. The Contract Price(s) shall only be changed by a fully executed Change Order or by a DCO. Any requests by the Contractor for an increase or decrease in the Contract Price(s) shall be based on a written Change Order Request (COR) delivered promptly by the Contractor to the Engineer by no later than seven (7) Days after the date of the occurrence of the event giving rise to the request and stating the general nature of the request, unless the time is modified in the Special Provisions.

C. The COR by the Contractor shall be substantiated within 30 Days after submittal of the written notice with a cost proposal quantifying the costs and schedule impacts associated with the request with supporting data, unless the Engineer allows an additional period of time for the Contractor to ascertain more accurate data in support of the request, or unless the time is modified in the Special Provisions.

D. No request by the Contractor for an adjustment in the Contract Price(s) shall be valid if not submitted timely in accordance with this Article; failure to submit a timely and fully documented request shall constitute a waiver of any future requests or Claims for additional compensation or a time extension related to such Work.

E. Any request for an adjustment in the Contract Price(s) and/or in the Contract Time(s) shall include, but shall not be limited to:

1. a written description of the event or issue or combination of events/issues that gave rise to the request, including and without limitation, the start date of the event or events and the anticipated or actual finish date;

2. a written description of the legal basis of the request with specific references to the Contract provisions upon which the Contractor relies;

3. an identification of the Work (e.g., activities with the current updated Detailed Progress Schedule and similar information) affected by the event(s);

4. relevant correspondence and other information related to and supporting entitlement;

5. written documentation pursuant to Article 3.07.02. Cost of Extra Work through 3.07.05. Compensation for Time Extension related to pricing of the requested change;

6. a written description of the effect of the request on the progress of the Work;

7. a detailed schedule analysis based on the most current Detailed Progress Schedule that identifies the critical and/or controlling portions of the Work impacted by the change and the anticipated dates of the impact;

8. the specific number of Days of time extension requested for any impacted Contract Time(s);

9. a written proposal for any additional compensation being requested that would fully compensate the Contractor for all costs of acceleration of the related Work needed to overcome the associated Delay, if any; and

10. a written statement from the Contractor that the proposed adjustment is the entire adjustment of the Contract Price(s) and/or of the Contract Time(s).

F. The Engineer shall review the Contractor's COR within 14 Days after receipt of the cost proposal and supporting documents, and render its determination in writing, unless the time is modified in the Special Provisions, Work, and Contract Time. If the Engineer requires a longer period for its determination, it will provide written notice to the Contractor within the initial 14-Day period. If the Engineer does not issue a determination within the initial or extended period, the request shall be deemed rejected and the provisions of Article 3.11. Disputes shall apply.

G. The value of any Work covered by a PCO, Change Order, DCO, or any request for an increase or decrease in the Contract Price(s) shall be determined in one of the following ways:

1. Where the Work involved is covered by unit prices contained in the Contract Documents, by application of unit prices to the quantities of the items involved; or

2. By mutual acceptance of a lump sum, which shall follow the basic pricing rules set forth under Article 3.07.02. Cost of Extra Work and include an allowance for overhead and profit in accordance with Article 3.07.02.G. Contractor's Fee; unless otherwise approved by the Engineer; or

3. On the basis of the cost of Work (determined as provided in Articles 3.07.02. Cost of Extra Work and in 3.07.04. Special Services) plus a Contractor's fee for overhead and profit (determined as provided in Article 3.07.02. Cost of Extra Work). For this payment basis, the Engineer will direct the Contractor to proceed on a Time-and-Materials basis and may also establish a Not-to-Exceed (NTE) budget for the change.

3.07.02. Cost of Extra Work

A. The term "cost of extra Work" means the sum of all direct costs necessarily incurred and paid by the Contractor or estimated to be incurred and paid by the Contractor for labor, Materials, and Equipment in the proper performance of Work, plus a markup for overhead and profit as defined in this Article. Except as otherwise may be agreed to in writing by the District, such costs shall be in amounts no higher than those prevailing in the locality of the Project.

B. Labor: The direct cost of labor used in performing Work by the Contractor, a Subcontractor, or by other forces will be the sum of the following:

1. The actual or estimated wages paid plus any employer payments to or on behalf of workers for fringe benefits, including health and welfare, pension, vacation, and similar purposes.

2. There shall be added to the actual or estimated wages as defined above a percentage set forth in the latest "Labor Surcharge and Equipment Rental Rates" in use by the California State Department of Transportation, which is in effect on the date upon which the Work is accomplished. This percentage shall constitute full compensation for all payments imposed by State and Federal laws, including, but not limited to, workers' compensation insurance and Social Security payments.

3. The amount paid or estimated to be paid for subsistence and travel required by collective bargaining agreements.

4. For Equipment operators, payment for the actual or estimated cost of labor and subsistence or travel allowance shall be made at the rates paid, or estimated to be paid, by the Contractor to other workers operating similar Equipment already on the Work, or in the absence of such labor, established by collective bargaining agreements for the type of workers and location of the extra Work, whether or not the operator is actually covered by such an agreement. A labor surcharge shall be added to the cost of labor described herein in accordance with the provisions in this Article, which surcharge shall constitute full compensation for payments imposed by State and Federal laws, and all other payments made to on behalf of workers other than actual or estimated wages.

C. Materials: The direct cost of Materials used or to be used in performing Work shall be the actual or estimated cost to the purchaser, including sales tax,

whether the Contractor or a Subcontractor, from the Supplier thereof, except as the following are applicable:

1. Trade discounts available to the purchaser shall be credited to the District notwithstanding that such discounts may not have been taken by the Contractor.

2. For Materials secured other than by a direct purchase and direct billing to the purchaser, the cost shall be deemed to be the price paid, or estimated to be paid, to the actual Supplier as determined by the Engineer. Markup, except for actual or estimated costs incurred in the handling of such Materials, shall not be allowed.

3. Payment for Materials from sources owned wholly or in part by the purchaser shall not exceed the price paid, or estimated to be paid, by the purchaser for similar Materials from said sources on extra Work items or the current wholesale price for such Materials delivered to the worksite, whichever price is lower.

4. The Contractor is responsible for and shall not be compensated for any increases in Material costs beyond those included in its Contract Price(s), including, but not limited to, sudden market changes or unexpected Material price increases.

5. If, in the opinion of the Engineer, the estimated or actual cost of Materials is excessive or the Contractor does not furnish satisfactory evidence of the cost of such Material, then the cost shall be deemed to be the lowest current wholesale price for the quantity concerned delivered to the worksite, less any trade discount. The District reserves the right to furnish Material for the extra Work; no Claim shall be made by the Contractor for costs and profit on such Material.

D. Equipment: The Contractor shall be paid for the use of Equipment at the rental rate listed for such Equipment specified in the current edition of the Department of Transportation publication entitled, *Labor Surcharge and Equipment Rental Rates*, which is in effect on the date upon which the Work is accomplished. Such rental rates shall be used to compute payments for Equipment whether the Equipment is under the Contractor's control through direct ownership, leasing, renting, or under another method of acquisition. The rental rate to be applied for use of each item of Equipment shall be the rate resulting in the least total cost to the District for the total period of use. If it is deemed necessary by the Contractor to use Equipment not listed in the foregoing publication, an equitable rental rate for the Equipment will be established by the Engineer. The Contractor shall furnish cost data, which might assist the Engineer in establishing the rental rate.

1. The rental rates paid, or estimated to be paid, as above provided shall include the cost of fuel, oil, lubrication supplies, small tools, necessary attachments, repairs, and maintenance of all kinds; depreciation, storage, insurance, and all incidentals, unless the Equipment is idle due to a

Delay. Operators of Equipment will be separately paid for as provided in paragraph 4 of Article 3.07.02.B. Labor.

2. All Equipment shall be in good working condition and suitable for the purpose for which the Equipment is to be used.

3. Before construction Equipment is used on the extra Work, the Contractor shall plainly stencil or stamp an identifying number thereon at a conspicuous location and shall furnish to the Engineer, in duplicate, a description of the Equipment and its identifying number.

4. Unless otherwise specified, manufacturer ratings and manufacturer-approved modifications shall be used to classify Equipment to determine applicable rental rates. Equipment that has no direct power unit shall be powered by a unit of at least the minimum rating recommended by the manufacturer.

5. Individual pieces of Equipment or tools having a replacement value of $500 or less, whether or not consumed by use, shall be considered to be small tools; no payment shall be made.

6. Compensation for idle time of Equipment shall include the ownership costs only, not including operating costs, in accordance with the following:

   a. The Equipment rental rate shall be based on the delay factor in the edition of the Department of Transportation's publication entitled, *Labor Surcharge and Equipment Rental Rates*, in effect on the date the Work is accomplished.

   b. Daily number of payable hours equals the normal working hours during the delay, not to exceed eight (8) hours per Day or 40 hours per week.

   c. Delay Days exclude nonworking Days.

   d. Markups are not added.

E. Owner-Operated Equipment: When owner-operated Equipment is used, or anticipated to be used, to perform Work and is to be paid for as extra Work, the Contractor shall be paid for the Equipment and for the operator as follows:

1. Payment for the Equipment shall be made in accordance with the provisions in Contractor's Article 3.07.02.D. Equipment.

2. Payment for the cost of labor and subsistence or travel allowance shall be made at the rates paid, or estimated to be paid, by the Contractor to other workers operating similar Equipment already on the Project, or, in the absence of such other workers, at the rates for such labor established by collective bargaining agreement for the type of worker and location of the

Work, whether or not the owner-operator is actually covered by such an agreement. A labor surcharge shall be added to the cost of labor described herein in accordance with the provisions in paragraph 2 of Article 3.07.02.B. Labor.

3. Markup for Equipment rental and labor as provided in Article 3.07.02.G. Contractor's Fee shall be added to the direct cost of Equipment rental and labor, computed as provided herein.

F. Equipment Time: The rental time to be paid, or estimated to be paid, for Equipment on the Work shall be the time the Equipment is in productive operation on the Work being performed and shall include the time required to move the Equipment to the new location and return it to the original location or to another location, requiring no more time than that required to return it to its original location. Moving time shall not be paid if the Equipment is used on Work other than the extra Work. Loading and transporting costs shall be allowed, in lieu of moving time, when the Equipment is moved by means other than by its own power. No payment shall be made for loading and transporting costs when the Equipment is used at the site of the extra Work on other than the extra Work. The following shall be used in computing the rental time of Equipment on the Work:

1. When hourly rates are listed, any part of an hour less than 30 minutes of operation shall be considered to be a half hour of operation, and any part of an hour in excess of 30 minutes will be considered one (1) hour of operation.

2. When daily rates are listed, operation for any part of a Day less than four (4) hours shall be considered to be a half Day of operation.

3. Rental time will not be allowed while Equipment is inoperative due to breakdowns or due to Contractor-caused Delays.

G. Contractor's Fee

1. Work Ordered on the basis of Time and Materials or forward-priced lump sum will be paid for at the estimated or actual and necessary cost as determined by the Engineer, plus allowances for overhead and profit; said allowances shall constitute the Contractor's Fee. For extra Work involving a combination of increases and decreases in the Work, the estimated or actual and necessary cost will be the arithmetic sum of the additive and deductive costs.

2. To the total of the direct costs computed as provided above, there will be added a markup for overhead and profit as specified below. The markup shall constitute full compensation for all direct and indirect overhead costs and profit, which shall be deemed to include all items of expense not specifically listed above as direct costs. No separate allowance or itemization for overhead costs shall be allowed. The following list, though

not intended to be comprehensive, indicates the types of costs that are included in the markup for overhead and profit for all Change Orders, including Time-and-Material Work:

a. Field and home office personnel, including, but not limited to, principals, project managers, superintendents, supervisory foremen, estimators, project engineers, detailers, draftspersons, schedulers, consultants, watchpersons, payroll clerks, administrative assistants, and secretaries.

b. All field and home office expenses, including, but not limited to, field trailers, parking, storage sheds, office equipment and supplies, telephone service at the Site, long-distance telephone calls, fax machines, computers and software, Internet and e-mail services, temporary utilities, sanitary facilities and services, janitorial services, small tools and Equipment with a cost under $500 each, portable scaffolding, blocking, shores, appliances, job vehicles, security and fencing, conformance to all regulatory requirements, including compliance with safety regulations, safety programs and meetings, cartage, warranties, record documents, and all related maintenance costs.

c. Administrative functions, including, but not limited to, reviewing, coordinating, distributing, processing, posting, recording, estimating, negotiating, scheduling, schedule updating and revising, expediting, surveying, engineering, drawing, detailing, revising shop Drawings, preparing record Drawings, carting, cleaning, protecting the Work, and other incidental Work related to the Change Order.

d. All other costs and taxes required to be paid, but not included under direct costs as defined in this Article.

3. The allowance for overhead and profit shall be made in accordance with the following schedule:

Element of the Work	Overhead and Profit Allowance
Labor	33 percent
Materials	15 percent
Equipment	15 percent

4. Subcontractor Markup: Labor, Materials, and Equipment may be furnished by the Contractor or by a Subcontractor on behalf of the Contractor. When all or any part of the extra Work is performed by a Subcontractor, the allowance specified in the above subparagraph “c” shall only be applied to the labor, Material, and Equipment costs of the Subcontractors to which the Contractor may add no more than five (5) percent of the Subcontractor’s total cost for the extra Work. In no case shall the sum of the individual markups applied to a Change Order

exceed ten (10) percent regardless of the number of Subcontractor tiers involved in performing the Work.

5. Bond and Insurance: Only the actual cost of bond and insurance premiums required because of the Change Order, with no markup for overhead and profit, will be allowed.

3.07.03. Time-and-Materials Work

A. If an NTE budget is established by the Engineer for Time-and-Material Work, the Contractor shall notify the Engineer when the cumulative costs incurred by the Contractor for Time-and-Material Work equal 80 percent of the pre-established budget. The Contractor may not be compensated for such Work that exceeds the NTE budget if the Contractor fails to provide the required notice before exceeding 80 percent of the established budget.

B. If Work being performed on a Time-and-Material basis is expected to take more than one (1) month, the Engineer may, in its sole discretion, issue an allowance Change Order to allow timely payment to the Contractor for undisputed Work performed. The dollar value of the Change Order shall be an allowance amount equal to or greater than the NTE. Any amount remaining after all Time-and-Materials sheets are priced shall revert to the District.

C. Cost of Work Documentation: For Time-and-Material Work, the Contractor shall furnish the Engineer extra work reports on a daily basis covering the direct costs of labor and Materials and charges for Equipment whether furnished by the Contractor, Subcontractor, or by other forces. The District shall provide the extra daily work report forms to the Contractor. The Contractor or an authorized agent shall sign each daily extra work report. The daily extra work report shall provide names and classifications of workers and hours worked; size, type, and identification number of Equipment; and the hours operated. Copies of certified payrolls and statements of fringe benefits shall substantiate labor charges. Valid copies of vendor invoices shall substantiate Material charges.

D. The Engineer shall make any necessary adjustments. When these reports are agreed upon and signed by both parties, they shall become the basis of payment for the undisputed Work performed but shall not preclude subsequent adjustment based on a later audit.

E. The Contractor shall inform the Engineer when extra Work will begin so that the District inspector can concur with the daily extra work reports. Failure to conform to these requirements may impact the Contractor’s ability to receive proper compensation.

F. The Contractor shall price and submit to the Engineer in both electronic format and in hard copy a native Microsoft Excel-based cost summary of the daily extra work reports on no less than a weekly basis. This summary report shall total all costs incurred to date and compare them to the NTE amount with a percent-spent-to-date amount prominently displayed. The Contractor shall be

fully responsible for tracking the costs and for notifying the Engineer when the costs exceed 80 percent of the NTE value. The summary report shall not be considered a substitute for the notice required in this Section.

3.07.04. Special Services

A. Special services are defined as that Work characterized by extraordinary complexity, sophistication, or innovations, or a combination of the foregoing attributes that are unique to the construction industry. The following may be considered by the Engineer in reviewing or approving estimates for payment for special services:

1. When the Engineer and the Contractor, by Agreement, determine that a special service is required that cannot be performed by the forces of the Contractor or by those of any of its Subcontractors, the special service shall be performed by an entity especially skilled in the Work to be performed. After validation of invoices and determination of market values by the Engineer, invoices for special services based upon the current fair market value thereof may be accepted without complete itemization of labor, Materials, and Equipment rental costs if backup provided is acceptable to the Engineer.

2. When the Contractor is required to perform Work necessitating special fabrication or machining process in a fabrication or a machine shop facility away from the job site, charges for that portion of the Work performed at the off-site facility may, by Agreement, be accepted as a special service, and accordingly, invoices for the Work may be accepted without detailed itemization at the Engineer's discretion.

B. All invoices for special services shall be adjusted by deducting all trade discounts offered or available, whether the discounts were taken or not. In lieu of the allowances for overhead and profit on labor, Materials, and Equipment specified herein, a single allowance of ten (10) percent will be added to invoices for special services.

3.07.05. Compensation for Time Extensions

A. Adjustments in compensation for adjustments in Contract Time(s) shall be allowed only for causes in Article 3.08.01. Change in Contract Time(s), General, paragraphs "E.1." through "E.5." computed in accordance with Article 3.07.02. Cost of Extra Work. No adjustments in compensation shall be allowed when District-caused Delays to a Controlling Item of Work and Contractor-caused Delays to a Controlling Item of Work occur concurrently or for causes stated in Article 3.08. Change in Contract Time(s).

3.08. Change in Contract Time(s)

3.08.01. General

A. The Contract Time(s) for the Contract is specified in the Special Provisions. The Contract Time(s) shall only be changed or adjusted by a fully executed Change Order or by a DCO.

B. Notice and Substantiation: Any request for a change in the Contract Time(s) shall comply with the notice and substantiation requirements shown in Article 3.07. Change in Contract Price(s). No request for an adjustment in the Contract Time(s) will be valid if not submitted in accordance with the requirements of this Article.

C. The Contract Time(s) shall only be extended when a Delay occurs that impacts a Controlling Item of Work as shown in the most recently accepted Detailed Progress Schedule. Time extensions shall be allowed only if the cause is beyond the control and without the fault or negligence of the Contractor. Time extensions may also be allowed when District-caused delays to a Controlling Item of Work and Contractor-caused Delays to a Controlling Item of Work occur concurrently. The Contractor shall be notified if the Engineer determines that a time extension is not justified.

D. Types of Delays are defined below:

1. Compensable Delay: An Excusable Delay for which the Contractor is entitled to receive additional compensation for delay-related costs if (a) the delay was caused by the District or within its control or responsibility; (b) the Delay results in additional costs incurred by the Contractor; and (c) the Contractor has not assumed the risk of the Delay.

2. Concurrent Delay: Two or more independent causes of Delay to the Contractor's performance of Work that meet all of the following criteria: (a) the Delays occur at the same time during all or a portion of the delay period being considered; (b) the Delays directly prevent the Contractor from performing a Controlling Item of Work; (c) each Delay would have delayed the Contractor's performance of a Controlling Item of Work even in the absence of any of the other Delays.

3. Excusable Delay: A Delay to the completion of a specified Contract Time(s) that is due to causes that are unforeseeable and beyond the control and responsibility of the Contractor for which a time extension may be granted.

4. Inexcusable Delay: A Delay to the completion of a specified Contract Time(s) that was reasonably foreseeable or within the control and responsibility of the Contractor for which no compensation or time extension will be granted.

5. Non-compensable Delay: An Excusable Delay for which the Contractor may be entitled to an extension of time without additional compensation for delay-related costs.

E. The Contract Time(s) shall be extended in an amount equal to time lost due to Excusable Delays if a request is made thereof as provided in this Article. An extension in Contract Time(s) shall only be granted for Days on which the Contractor is prevented from proceeding with at least 75 percent of the normal labor and Equipment force actually engaged on the Work by occurrences or conditions resulting immediately therefrom that impact a Controlling Item of Work as determined by the Engineer. Causes of such Delays shall include:

1. changes;

2. failure of the District to furnish access, right of way, completed facilities of related projects, Drawings, Material, Equipment, or services for which the District is responsible;

3. survey error by the District;

4. suspension of Work pursuant to Article 5.07. Temporary Suspension of Work, paragraph C;

5. differing site conditions;

6. occurrences of a severe and unusual nature, including, but not limited to, acts of God, wars, riots, insurrections, fires, and excusable inclement weather. An “act of God” is defined as an earthquake, flood, cloudburst, cyclone, or other cataclysmic phenomena of nature beyond the power of the Contractor to foresee or to make preparation for in defense against, but does not include ordinary inclement weather; and

7. act of the public enemy, act of another governmental entity, act of a public utility or other third party outside the control of the District, epidemic, quarantine restriction, freight embargo, strike, or labor dispute. A delay to a Subcontractor or Supplier due to the above circumstances will be taken into consideration for extensions to the time of completion.

3.08.02. Inclement Weather

A. Inclement weather is any weather condition, the duration of which varies in excess of the average conditions expected, that is unusual for the particular time and place where the Work is to be performed or that could not have been reasonably anticipated by the Contractor as provided for in the Special Provisions.

B. The Contract Time(s) shall only be extended for Days in excess of the number of Days of inclement weather where the Contractor is prevented by inclement weather, or by conditions resulting immediately therefrom, from proceeding with

at least 75 percent of the normal labor and Equipment force engaged on Controlling Items of Work as shown on the current, updated, and accepted Detailed Progress Schedule.

C. Should the Contractor prepare to begin Work at the regular starting time at the beginning of any regular work shift on any Day on which inclement weather, or the conditions resulting from the weather, prevents Work from beginning at the usual starting time and the crew is dismissed as a result thereof, the Contractor shall be entitled to a one (1)-Day extension, whether or not conditions change thereafter during that Day and the major portion of the Day could be considered suitable for such construction operations.

D. The Contractor shall include a calendar in all of its Progress Schedules that includes nonworking Days for the number of inclement weather Days specified in the Special Provisions. This calendar shall be used for all weather-sensitive Work.

E. No extension in the Contract Time(s) due to inclement weather shall be considered until after the number of Days of inclement weather Days specified in the Special Provisions has been reached. No reduction in Contract Time(s) shall be made if the number of Days of inclement weather is not reached.

F. The Contractor shall not be entitled to additional compensation for Delays caused by inclement weather.

3.09. Differing Conditions

A. If any Work involves digging trenches or other excavations below the surface, the Contractor shall promptly, and before the following conditions are disturbed, notify the District in writing of any:

1. material that the Contractor believes may be a Regulated Material that is required to be removed to a Class I, Class II, or Class III disposal site in accordance with provisions of existing law;

2. subsurface or latent physical conditions at the site differing from those indicated in this Contract (Type I Differing Site Condition); and

3. unknown physical conditions at the site of any unusual nature, different materially from those ordinarily encountered, and generally recognized as inherent in Work of the character provided for in the Contract (Type II Differing Site Condition).

B. The Contractor’s written notice shall inform the District as to how such conditions affect its Work and shall recommend methods to overcome such conditions.

C. Differing Conditions shall not include:

1. all that is indicated or reasonably interpreted from the Contract Documents or reference documents;

2. all that could be seen on or could have reasonably been discovered or revealed as a result of examination, investigation, exploration, test, or study of the Project site. Reference is made to Article 2.05. Examination of Drawings, Specifications, and Site of Work;

3. conditions that are materially similar to or characteristically the same as those indicated or described in the Contract Documents or reference documents; and

4. conditions where the location of a building component is in the proximity where indicated in or reasonably interpreted from the Contract Documents or reference documents.

D. The District will promptly investigate the condition. If it finds that the conditions do materially so differ or do involve Regulated Material and cause a decrease or increase in the Contractor's cost of, or the time required for, performance of any part of the Work, the District may issue a Change Order or a DCO under the procedures described in this Contract. For Regulated Material, the District reserves the right to use other forces for exploratory work to identify and determine the extent of such Material and for removing Regulated Material from such areas.

E. In the event that a dispute arises between the District and the Contractor on whether the conditions materially differ or on the Contractor's cost of, or time required for, performance of any part of the Work, the Contractor shall not be excused from any scheduled completion date provided for by this Contract but shall proceed with all Work to be performed under the Contract. The Contractor shall retain any and all rights provided either by this Contract or by law that pertain to the resolution of disputes and protests between the contracting parties.

F. The Contractor shall be responsible for the safety and protection of the affected area of the Work for the duration of the District's investigation of potential differing conditions.

3.10. Cost Reduction Incentive

A. The Contractor may submit to the Engineer, in writing, proposals for modifying the Drawings, Specifications, or other requirements of the Contract for the sole purpose of reducing the total cost of construction (known as value engineering change proposals) as provided for in State Specifications Section 4-1.07B wherein the words "State" and "Department" shall mean the District.

3.11. Disputes

A. Claim: A written demand by the Contractor for an adjustment in the Contract Price(s) or in the Contract Time(s), or both, that is submitted in accordance with the requirements of the Contract Documents. Within the context of this Contract, a Claim is associated with a dispute as described in Articles 3.11. Disputes through 3.13. Dispute Review Board.

B. It is the intention of this Article that disputes between parties arising under and by virtue of the Contract be brought to the attention of the Engineer at the earliest possible time in order that matters may be resolved, if possible, or other appropriate action promptly taken. Disputes are divided into four categories: (i) protest, (ii) notice, (iii) potential Claim, and (iv) Claim. During the course of the Project and up to receiving the proposed final estimate, the Contractor must submit a Contract dispute in the form of a written notice, protest, potential Claim, or Claim to the Engineer.

C. Any disputes from Subcontractors or Suppliers that the Contractor passes through to the District for review and consideration shall be certified in the same manner the Contractor would certify its own disputes.

3.11.01. Protest

A. If the Contractor considers any Work demanded to be outside of the requirements of the Contract, or considers any records or ruling or act or omission of the Engineer to be unfair, the Contractor shall immediately, upon such Work being demanded or such record or ruling being made, ask in writing for written instructions or decisions, whereupon the Contractor shall proceed without delay to perform the Work or to conform to the record or ruling and, within seven (7) Days after date of receipt of the written instructions or decisions, shall file a written protest with the Engineer stating clearly in detail the basis of the protest. Except for such protests as are made of record in the manner herein specified and within the time limit stated, the records, rulings, instructions, decisions, and acts or omissions of the Engineer shall be final and conclusive. Instructions and decisions of the Engineer contained in letters transmitting Drawings to the Contractor shall be considered as written instructions and decisions subject to protest as herein provided.

3.11.02. Notice of Potential Claims

A. The Contractor is not entitled to additional compensation for any cause unless the Contractor submits to the District a written Notice of Potential Claim as hereinafter specified.

B. The written Notice of Potential Claim must set forth the reasons for which the Contractor believes additional compensation and/or adjustments in the specified Contract Time(s) will or may be due, the nature of the costs and/or time involved, and, insofar as possible, the amount of the potential Claim. This notice as above required must have been submitted to the District before the Contractor performs

the Work giving rise to the potential Claim for additional compensation and/or time, if based on an act or failure to act by the District, or in all other cases, within seven (7) Days after the happening of the event, thing, or occurrence giving rise to the potential Claim.

C. The Notice of Potential Claim shall be certified as required in Article 3.12. Claims.

D. Compliance with the foregoing shall not be a prerequisite to any Claim that is based on differences in measurement or errors of computations as to Contract quantities.

3.12. Claims

A. Claims by the Contractor must be submitted to the Engineer before the date of final payment. The Claim shall relate directly to the circumstances addressed in the Notice of Potential Claim and may not raise new issues or circumstances that were not identified in the Notice of Potential Claim. Claims shall be in writing, shall specify the basis for each Claim, shall refer to the applicable provision or provisions of the Contract, and shall show the method of computation and the actual amount claimed. The Claim shall include documents necessary to substantiate the Claim and to establish liability, causation, and damages. All other factual data, including documentation of actual costs pertaining to that Claim, shall be submitted. Each issue contained in a Claim must include documentation, including background, chronology, Contractor's position, supporting documentation of merit, supporting documentation of damages, schedules (if appropriate), and productivity exhibits (if appropriate). The Claim shall clearly state that it is a Claim being submitted under this Article. Failure to submit a written Claim within the 30-Day period waives any right to recover compensation or to an extension in the Contract Time(s) due to the issues referenced in the Notice of Potential Claim. In addition to the foregoing, to substantiate any Claim, the Contractor shall provide the information required by Article 3.07. Change in Contract Price(s).

B. Pricing of Claims shall be consistent and compliant with the requirements herein for adjustments in the Contract Price(s) and adjustments in the Contract Time(s).

C. Claims must be certified using the following language:

I,_____, BEING THE _____ (MUST BE AN OFFICER) OF_____ (CONTRACTOR), DECLARE UNDER PENALTY OF PERJURY UNDER THE LAWS OF THE STATE OF CALIFORNIA, AND DO PERSONALLY CERTIFY AND ATTEST THAT: I HAVE THOROUGHLY REVIEWED THE ATTACHED CLAIM FOR ADDITIONAL COMPENSATION AND/OR EXTENSION OF TIME FOR WORK PERFORMED BY THE CONTRACTOR AND/OR ANY SUBCONTRACTOR CLAIMS THAT ARE BEING PASSED THROUGH TO THE DISTRICT, AND KNOW ITS CONTENTS, AND SAID CLAIM IS TRUTHFUL AND ACCURATE; THAT THE AMOUNT REQUESTED ACCURATELY REFLECTS THE CONTRACT ADJUSTMENT FOR WHICH THE DISTRICT IS LIABLE; AND, FURTHER,

THAT I HAVE REVIEWED AND AM FAMILIAR WITH BOTH CALIFORNIA PENAL CODE SECTION 72 AND CALIFORNIA GOVERNMENT CODE SECTION 12650, ET SEQ., PERTAINING TO FALSE CLAIMS, AND FURTHER KNOW AND UNDERSTAND THAT SUBMISSION OR CERTIFICATION OF A FALSE CLAIM MAY LEAD TO FINES, IMPRISONMENT, AND/OR OTHER SEVERE LEGAL CONSEQUENCES.

D. The District, or its authorized representatives, shall have access, upon reasonable notice during normal business hours, to Contractor and Subcontractor books, documents, and accounting records, including, but not limited to, Bid worksheets, Bids, Subcontractor Bids and proposals, estimates, cost accounting data, accounting records, payroll records, time sheets, canceled checks, profit and loss statements, balance sheets, Project correspondence, including, but not limited to, all correspondence between the Contractor and its sureties and Subcontractors/vendors, Project files, scheduling information, and other records of the Contractor and all Subcontractors directly or indirectly pertinent to the Work of the Project; original as well as changed and claimed extra Work to verify and evaluate the accuracy of cost and pricing data submitted with any Claim for which additional compensation has been requested or Notice of Potential Claim has been tendered. Such access shall include the right to examine and audit such records and make excerpts, transcriptions, and photocopies at the District's cost.

E. The parties agree that in the event the Contractor or any Subcontractor fails to comply with this Article, the Claim will not be considered by the District. The Contractor agrees to impose upon its Subcontractors by appropriate subcontract provisions the obligations of this Article of the Standard Provisions.

F. No Claim shall be considered where there has been a failure to comply with the requirements relative to protest and Notice of Potential Claim as written elsewhere in these Specifications.

G. The presentation of a Claim shall be an express condition precedent to the Contractor's recourse to (i) informal conference; (ii) nonbinding mediation; and (iii) judicial arbitration to resolve disputes on construction Claims of three hundred seventy-five thousand dollars ($375,000) or less or court action upon the Contract for Claims in excess of three hundred seventy-five thousand dollars ($375,000) in compliance with Public Contract Code Section 20104 et seq.

3.12.01. Claims Less Than Fifty Thousand Dollars

A. For Claims less than fifty thousand dollars ($50,000), the Engineer shall respond in writing to any written Claim within 45 Days of receipt of the Claim or may request in writing within 30 Days of receipt of the Claim any additional documentation supporting the Claim or relating to defenses or Claims the District may have against the Contractor.

B. If additional information is thereafter required, it shall be requested and provided pursuant to this Article upon mutual agreement of the Engineer and of the Contractor.

C. The Engineer's written response to the Claim, as further documented, shall be submitted to the Contractor within 15 Days after receipt of further documentation or within a period of time no greater than that taken by the Contractor in producing the additional information, whichever is greater.

3.12.02. Claims From Fifty Thousand Dollars to Three Hundred and Seventy-Five Thousand Dollars

A. For Claims greater than or equal to fifty thousand dollars ($50,000) and less than or equal to three hundred seventy-five thousand dollars ($375,000), the Engineer shall respond in writing to any written Claims within 60 Days of receipt of the Claim or may request in writing within 30 Days of receipt of the Claim any additional documentation supporting the Claim or relating to defenses or Claims the District may have against the Contractor.

B. If additional information is thereafter required, it shall be requested and provided pursuant to this Article upon mutual agreement of the Engineer and of the Contractor.

C. The Engineer's written response to the Claims, as further documented, shall be submitted to the Contractor within 30 Days after receipt of further documentation or within a period of time no greater than that taken by the Contractor in producing the additional information or requested documentation, whichever is greater.

3.12.03. Informal Conferences

A. If the Contractor disputes the Engineer's written response or if the Engineer fails to respond within the time prescribed, the Contractor may so notify the Engineer in writing either within 15 Days of receipt of the Engineer's response, or within 15 Days of the Engineer's failure to respond within the time prescribed respectively, and demand an informal conference to meet and confer for settlement of the issues in dispute. Upon such demand, the Engineer shall schedule a meet-and-confer conference within 30 Days for settlement of the dispute.

B. If, following the meet-and-confer conference, the Claim or any portion remains in dispute, the Contractor may file a Claim pursuant to California Government Code, Title 1, Division 3.6, Part 3, Chapter 1 commencing with Section 900 and Chapter 2 commencing with Section 910. For purposes of those provisions, the running of the period of time within which a Claim must be filed shall be tolled from the time the Contractor submits its written Claim until the time the Claim is denied, including any period of time utilized by the meet-and-confer process conference.

3.12.04. Civil Actions

A. The following procedures are established for all civil actions filed to resolve Claims:

1. Within 60 Days, but no earlier than 30 Days, following the filing or responsive pleadings, the court shall submit the matter to nonbinding mediation unless waived by mutual stipulation of both parties. The mediation process shall provide for the selection within 15 Days by both parties of a disinterested third person as mediator, shall be commenced within 30 Days of the submittal, and shall be concluded within 15 Days from the commencement of the mediation unless a time requirement is extended upon a good-cause showing to the court.

2. If the matter remains in dispute, the parties agree to resolve their dispute by binding judicial arbitration pursuant to the Local Civil Rules of the County of Santa Clara Superior Court; notwithstanding, anything in such Local Civil Rules, the parties agree that the Civil Discovery Act of 1986 (Code of Civil Procedure, Title 3, Part 4, Chapter 3, Article 3 commencing with Section 2016 of Chapter 3 of Title 3 of Part 4 of Code of Civil Procedure) shall apply to any proceeding brought under this subdivision.

B. In addition to the Code of Civil Procedure, Part 3, Title 3, Chapter 2.5 commencing with Section 1141.10, (i) arbitrators shall, when possible, be experienced in construction law; and (ii) any party appealing an arbitration award who does not obtain a more favorable judgment shall, in addition to payment of costs and fees under that chapter, also pay the attorney's fees on appeal of the other party.

3.13. Dispute Review Board

A. When specified in the Special Provisions that a Dispute Review Board (DRB) process is required, the DRB process shall be in accordance with these Specification Provisions.

3.13.01. General

A. A DRB is to assist in and facilitate the avoidance and timely, impartial resolution of disputes.

B. All disputes referred to the DRB shall be subject to the dispute resolution process herein described as a condition precedent to initiating a subsequent dispute resolution process, such as arbitration or litigation, for that dispute.

C. Except as explicitly otherwise provided, all disputes that are actionable under the provisions of the prime Contract between the District and the Contractor may be referred to the DRB.

D. The DRB shall be utilized when dispute or potential Claim resolution at the Project level is unsuccessful. The DRB shall function until the Day of Acceptance of the Work by the District Board of Directors, at which time the work of the DRB will cease except for completion of unfinished dispute hearings and reports.

E. The Contractor shall include in all subcontracts that Subcontractors and Suppliers of any tier (i) agree to submit Subcontractor Claims to the Contractor in a proper form and in sufficient time to allow processing by the Contractor in conformance with the DRB resolution specifications; (ii) agree to be bound by the terms of the DRB provisions to the extent applicable to Subcontractor Claims; (iii) agree that, to the extent a Subcontractor Claim is involved, completion of all steps required under these DRB Special Provisions shall be a condition precedent to pursuit by the Subcontractor of other remedies permitted by law, including without limitation of a lawsuit against the Contractor; and (iv) agree that the existence of a dispute resolution process for disputes involving Subcontractor Claims shall not be deemed to create any Claim, right, or cause of action by any Subcontractor or Supplier against the District.

F. The DRB reports shall not be binding on the District or on the Contractor and shall be admissible in subsequent dispute resolution proceedings.

G. Immediately after award of the Contract, the District and the Contractor shall meet and discuss and establish the qualifications upon which nominees for the DRB are to be evaluated and jointly select prospective nominees.

H. The District, the Contractor, and the DRB shall execute an agreement similar to the Dispute Resolution Board Foundation's Three Party Agreement form included as an appendix to these Specifications. If there are any conflicts between the provisions of that agreement and these Specifications, the provisions of that agreement shall take precedence.

I. The District and the Contractor shall each bear their respective in-house costs and costs of providing those DRB-related services for which responsibility has been allocated herein. The cost of the DRB panelists shall be split evenly between the Contractor and the District in the manner as described in paragraph "J" in this Article.

J. The Contractor shall pay the full amount of any invoice or costs incurred from the DRB members in accordance with and as set forth in the DRB agreement and in these Specifications. The Contractor shall be reimbursed for 50 percent of these services utilizing the DRB Bid item, or Contract Change Order if no Bid item is specified.

3.13.02. DRB Qualifications

A. Board members shall be experienced in the interpretation of Contract Documents and the resolution of construction disputes and in the type of construction to be performed.

B. The following definitions apply for the purpose of setting forth experience and disclosure requirements:

1. Party directly involved: The District or the Contractor of this Project.

2. Contractor includes all joint-venture partners individually.

3. Party indirectly involved: The construction manager, designers, architects, engineers, or other professional service firms or consultants, joint-venture partners, Subcontractors of any tier, and Suppliers on this Project.

4. Financial ties: Any ownership interest, loans, receivables, or payables.

C. Eligibility

1. Direct Employment

a. Current employees of any of the parties directly or indirectly involved are prohibited from serving as Board members.

b. Prospective Board members who were past employees of one of the parties directly involved must obtain permission from the other party prior to appointment.

c. Previous, direct employment by one of the parties indirectly involved must be disclosed.

2. Consulting Assignments

a. Individuals who are employed in a consulting capacity by any of the parties directly involved are prohibited from serving as Board members.

b. Prospective Board members who are currently employed as a consultant by one of the parties indirectly involved must obtain permission from the other party prior to appointment.

c. Previous employment as a consultant by any party directly or indirectly involved must be disclosed.

3. Financial Ties

a. Individuals with financial ties to any of the parties directly involved are prohibited from serving as Board members.

b. Current financial ties to any of the parties indirectly involved must be disclosed.

c. Previous financial ties with any party directly or indirectly involved must be disclosed.

4. Close Personal or Professional Relationships

   a. Individuals with close personal or professional relationships with a key member of any party directly involved are prohibited from serving as Board members.

   b. Such current relationships with a member of any party indirectly involved in the Contract must be disclosed.

   c. All past personal or professional relationships with a key member of one of the parties directly or indirectly involved must be disclosed.

5. All past and current service as a Board member on projects where any of the parties directly or indirectly involved in this Contract were also involved must be disclosed.

6. No member shall have had substantial prior involvement in the Project in the judgment of the District and the Contractor.

7. Ongoing Responsibilities: While serving as a Board member on the DRB, no member shall participate in any discussion contemplating the creation of an agreement or making an agreement with any party directly or indirectly involved in the Contract regarding employment, or fee-based consulting services, or any other business arrangement after the Contract is completed.

3.13.03. Establishment of the DRB

A. The District and the Contractor shall jointly participate in the evaluation and selection of prospective nominees for the DRB.

B. The District and the Contractor shall provide to the DRB nominees a list of the construction manager, designers, architects, engineers, professional service firms, consultants, joint-venture partners, Subcontractors, and Suppliers involved or likely to be involved in the Project with a list of each party's key personnel.

C. DRB nominees shall provide the following, pursuant to the above requirements and in addition to the nominee's full name and contact information, to both parties:

   1. Résumé showing construction experience qualifying the person as a DRB member.

   2. Résumé showing past DRB participation, if any. List each DRB assignment separately, indicating the name and location of the Project, dates of DRB service, name of owner, name of contractor, Contract value, nominating party, if applicable, names of the other Board members, and the number of disputes heard.

3. Disclosure statement describing past, present, and anticipated relationships, including indirect relationships through the nominee's full-time employer, if any, to the Project, with all parties directly and indirectly involved in the Contract. Disclose close professional or personal relationships with key members of all of these parties.

4. Disclosure is a continuing obligation of all Board members throughout the life of the Contract.

D. The District and the Contractor shall then have three (3) weeks to solicit and receive information from prospective candidates, and another two (2) weeks to review and to jointly agree on the final selection of the three (3) members to serve on the DRB. In the event that all three (3) members were not selected from the initial pool of nominees, the process shall be repeated.

E. If the DRB Chair has not already been appointed as part of the selection process, as soon as is practicable, the Board members shall nominate the Chair and submit the nominee's résumé and request approval by the District and by the Contractor.

3.13.04. DRB Meetings

A. The DRB shall visit the Project site and meet with representatives of the parties at periodic intervals and at other times requested by the parties.

B. Each meeting shall consist of an informal discussion and a field observation of the Work in progress. The discussion and field observation shall be attended by personnel of the District and by the Contractor.

3.13.05. Dispute Resolution

A. Prior Good-Faith Negotiation

1. The District and the Contractor shall enter into good-faith negotiations to settle a dispute before referring the dispute to the DRB.

2. These good-faith negotiations shall be founded on the principle of full and timely disclosure of each party's position to the other party, including the exchange of pertinent supporting records, analyses, expert reports, and similar documentation, and shall proceed without delay following the inception of the dispute. Such good-faith negotiations may involve the solicitation and rendering of a DRB advisory opinion as described herein.

B. Dispute Referral

1. A dispute may be referred to the DRB by either the District or by the Contractor. The dispute referral shall be made in writing to the DRB Chair with a copy concurrently provided to the other Board members and to the other party.

2. If the Contract stipulates a precedent dispute resolution process prior to referral to the DRB and if one party fails to meet or adhere to the time requirements set forth under the Contract for this process, the other party may then refer the dispute to the DRB. In the event that the Contract does not specify a precedent process or specifies a precedent process without time requirements, either party may refer the dispute to the DRB after passage of a reasonable period of time without progress toward a negotiated settlement; the DRB will determine if the dispute should be heard.

3. The dispute referral shall concisely define the nature and specifics of the dispute that are to be considered by the DRB and the scope of the recommendation requested.

4. The DRB Chair shall confer with the parties to establish a due date for delivering pre-hearing submittals, and a date, time, and location for convening the DRB hearing. Hearings shall be convened at the next periodic meeting, unless the parties agree to a shorter or longer period.

C. Pre-hearing Submittal

1. The District and the Contractor shall each prepare a pre-hearing submittal and transmit it to all three (3) members of the DRB and to the other party. The pre-hearing submittal, comprised of a position paper with such backup data as is referenced in the position paper, shall be tabbed, indexed, and the pages consecutively numbered.

2. Both position papers shall, at a minimum, contain the following:

   a. A joint statement of the dispute and the scope of the desired report placed in a prominent location. The language of this joint statement shall summarize in a few sentences the nature of the dispute. If the parties are unable to agree on the wording of the joint statement of dispute, each party's position paper shall contain both statements and identify the party authoring each statement.

   b. The basis and justification for the party's position with reference to Contract language and other supporting documents for each element of the dispute. To minimize duplication and repetitiveness, the parties may identify a common set of documents that will be referred to by both parties and submit it in a separate package.

   c. When the scope of the hearing includes quantum, the referring party shall include a schedule impact analysis and full cost details, calculated in accordance with methods set forth in the Contract. This requirement does not apply if the report is to be made for entitlement alone or for entitlement with guidelines for quantum.

3. The number of copies, distribution requirements, and time for submittal will be established by the DRB and communicated to the parties by the Chair.

D. DRB Hearings

1. The District will arrange for or will provide hearing facilities at or near the site.

2. Attendance

a. The District and Contractor shall both limit attendance at the hearing to personnel directly involved in the dispute and participants in the good-faith negotiations that were conducted prior to submittal to the DRB except as noted below.

b. Prior to the date established for the hearing, each party shall provide a list of proposed attendees to the DRB and to the other party. In the event of any disagreement, the DRB shall make the final determination as to who attends the hearing.

c. Attorneys shall not participate in the hearing. Attorneys representing the parties are permitted to attend dispute hearings provided that prior permission is obtained from the other party.

d. At DRB hearings regarding Claims by a Subcontractor, including pass-through Claims by a lower tier Subcontractor or Supplier against the Contractor that are actionable by the Contractor against the District, the Contractor shall require and ensure that each Subcontractor involved in the dispute has presented an authorized representative with actual knowledge of the facts underlying the Subcontractor Claims.

3. The conduct of the hearing shall be established by the DRB according to its operating procedures and be generally consistent with the following guidelines:

a. The party who referred the dispute to the DRB shall present its position first, followed by the other party.

b. Both parties shall be allowed successive rebuttals, assuring a full and adequate opportunity to present their position, and to rebut the opposing party's position, until, in the DRB's opinion, all aspects of the dispute have been fully and fairly covered.

c. The DRB shall be fully prepared to, and may at any time, ask questions, request clarifications, or ask for additional data and/or for job records.

d. Either party may request that the DRB direct a question to or request a clarification from the other party. The DRB shall determine at what point in the proceedings such requests may be made and if they will be granted. In general, the DRB will not allow one party to be questioned directly by the other party.

e. In difficult or complex cases, additional hearings may be necessary to facilitate full consideration and understanding of the dispute.

f. The DRB, in its discretion, may allow introduction of arguments, exhibits, handouts, or documentary evidence that were not included in that party's pre-hearing position paper and that had not been previously submitted to the other party. In such cases, the other party will be granted time to review and prepare a rebuttal to the new material.

E. Failure to Prepare a Pre-hearing Submittal or Attend a DRB Hearing

1. In the event that either party fails to deliver a pre-hearing submittal by the date established by the DRB, the DRB shall, at its discretion, determine whether the hearing shall proceed as originally scheduled or whether additional time shall be provided and a new date established. On the final date and time established for the hearing, the DRB shall proceed with the hearing utilizing the information that has been submitted.

2. In the event that some or all of the representatives of either party fail to appear at the appointed time of a DRB hearing, the DRB shall proceed with the hearing. The hearing shall take place as if all party representatives were in attendance. The DRB shall consider all evidence brought before it and hear testimony from those party representatives who are present.

F. Use of Outside Experts

1. By the District or by the Contractor

a. A party intending to offer an outside expert's analysis at the hearing shall disclose such intention in writing to the other party and to the DRB no less than 30 Days prior to the due date for delivering the pre-hearing submittal. The expert's name and a general statement of the area of the dispute that will be covered by his/her testimony shall be included in the disclosure.

b. Upon receipt of the above disclosure, the other party shall have the opportunity to secure the services of an outside expert to address or respond to those issues that may be raised by the other party's outside expert. The disclosure requirements shall be

the same as that specified above, except the time requirement is ten (10) Days.

c. The cost for securing outside expert services shall be borne by the party securing such services.

2. By the DRB

a. Prior to arranging for outside experts, the DRB shall obtain prior approval from the District and from the Contractor by providing:

(1) A statement explaining why the expert assistance is needed.

(2) An estimate of the cost of the expert assistance.

(3) A disclosure statement in accordance with the requirements of Article 3.13.03. Establishment of the DRB herein using the criteria established in Article 3.13.02. DRB Qualifications.

(4) A confidentiality statement, consistent with the DRB's agreement, executed by the proposed expert.

(5) The Contractor and the District shall equally bear the cost of the services of the outside expert employed by the DRB.

G. DRB Report

1. The DRB's recommendations for resolution of a dispute will be formalized in a written report with a format as determined by the DRB and signed by all Board members. The report should consist of a concise description of the dispute, short statements of each party's position, findings as to the facts of the dispute, discussion and rationale for the recommendation(s), and the recommendation(s). The report shall be submitted concurrently to the parties as soon as possible after completion of the hearing as agreed by all parties.

2. If the DRB cannot arrive at a unanimous report, the Board shall prepare minority findings and recommendation(s), which, together with the majority findings and recommendation(s), shall comprise the DRB report. The report shall identify the issues of disagreement along with the reasons for disagreement.

3. Clarification

a. Either party may request clarification of a report within ten (10) Days following receipt of the report. Within a reasonable

period of time, the DRB shall provide written clarification to both parties.

b. Requests for clarification shall be submitted in writing simultaneously to the DRB and to the other party.

c. Only one request for clarification per dispute from each party shall be allowed.

4. Reconsideration

a. Either party may request reconsideration of a report within ten (10) Days following receipt of the report when new information is obtained or developed that was not known at the time of the hearing, or when, in the party's opinion, the DRB misunderstood or failed to consider pertinent facts of the dispute. Within a reasonable period of time, the DRB shall provide written reconsideration to both parties.

b. Requests for reconsideration shall be submitted in writing simultaneously to the DRB and to the other party.

c. The Board will not entertain requests for reconsideration that amount to a renewal of a prior argument or an additional argument based on facts available at the time of the hearing.

d. Only one request for reconsideration per dispute from each party shall be allowed.

5. Acceptance

a. The District and the Contractor shall submit their written acceptance or rejection of the report concurrently to the other party and to the DRB within 14 Days of receipt of the report or following receipt of responses to requests for clarification or reconsideration.

b. Failure by either party to accept or reject within the specified period shall be construed as acceptance of the report by that party.

c. Acceptance by the District of a report on entitlement only, or on entitlement with guidelines for quantum, does not obligate the District to any particular quantum amount.

H. Advisory Opinions

1. An advisory opinion serves as a method for potentially avoiding a DRB hearing. It is not intended to replace the dispute resolution process

specified herein but may be implemented as part of the good-faith negotiations conducted between the parties.

2. When mutually agreed to by the District and by the Contractor, the DRB may, at its discretion, provide an advisory opinion on any issue.

3.14. Escrow Bid Documents

A. When required by the Special Provisions, Escrow Bid Documents shall be prepared and submitted as specified herein.

3.14.01. Introduction

A. The Escrow Bid Documents shall include complete documentation of all backup information used in the preparation of the Contractor's Bid prices for this Project as described below. The Escrow Bid Documents of the successful Bidder will be held in escrow for the duration of the Contract or until all Claims are resolved, whichever is later.

B. The Escrow Bid Documents are, and shall always remain, the property of the Contractor, subject to joint review by the District and by the Contractor as provided herein.

C. The District stipulates and expressly acknowledges that the Escrow Bid Documents, as defined herein, constitute trade secrets.

1. This acknowledgement is based on the District's express understanding that the information contained in the Escrow Bid Documents is not known outside the Bidder's business, is known only to a limited extent and by a limited number of employees of the Bidder, is safeguarded while in the Bidder's possession, and is extremely valuable to the Bidder's competitors by virtue of its reflecting Bidder's construction strategies, assumptions, and intended means, methods, and techniques of construction.

2. The District acknowledges that the Bidder expended substantial sums of money in developing the information included in the Escrow Bid Documents and further acknowledges that it would be difficult for a competitor to replicate the information contained therein.

3. The District further acknowledges that the Escrow Bid Documents and the information contained therein are being provided to the District only because it is an express prerequisite to award of the Contract.

4. The District further acknowledges that the Escrow Bid Documents include a compilation of information used in the Bidder's business intended to give the Bidder an opportunity to obtain an advantage over competitors who do not know or do not use the contents of such information.

5. The District further agrees, to the fullest extent permitted by law, to safeguard the Escrow Bid Documents against disclosure and not provide as public records.

D. The successful Bidder agrees, as a condition of award of the Contract, that the Escrow Bid Documents constitute all of the information used in the preparation of its Bid for this Work and that no other Bid preparation information shall be considered in resolving disputes or Claims. The successful Bidder also agrees that nothing in the Escrow Bid Documents shall change or modify the terms or conditions of the Contract Documents.

3.14.02. Purpose

A. The Escrow Bid Documents will be used solely to assist in the settlement of disputes and Claims. They will not be used for pre-award evaluation of the Contractor's anticipated methods of construction nor to assess the Contractor's qualifications for performing the Work.

3.14.03. Format and Contents

A. The Bidders may submit the Escrow Bid Documents in their usual cost estimating format; a standard format is not required. However, sufficient detail shall be included to ensure that the Escrow Bid Documents enable complete understanding and proper interpretation of their content.

B. The Escrow Bid Documents shall clearly itemize and separate the estimated cost of performing each major activity for each Bid item contained in the Bid. Bid items should be separated into sub-items to present a detailed cost estimate. Crews, Equipment, estimated quantities, and the rate of production shall be detailed. Increments of cost shall include, but shall not be limited to, such items as direct labor, permanent Material, supplies, consumables, subcontracts, Equipment charges, and allocation of overhead and profit. Plant, Equipment, and indirect costs should be detailed. All costs included in the Bid prices must be specifically identified and the methods of application described.

C. The Escrow Bid Documents shall include all quantity takeoffs; calculations of rates of production and progress; copies of quotes from Subcontractors and Suppliers; and memoranda, narratives, and all other information used by the Bidder to arrive at the prices contained in its Bid.

3.14.04. Submittal

A. Escrow Bid Documents must be submitted by the Bidders submitting the three apparent low Bids. The Escrow Bid Documents must be submitted in a sealed container, separate from the Bidder's Bid Proposal, no later than 5 p.m. on the third business day following the Bid opening. Each container must be clearly marked on the outside with the Bidder's name, date of submittal, Project name, and the words "Escrow Bid Documents." Timely submission of these forms is considered material by the District.

B. The Escrow Bid Documents must be accompanied by a separate certification, "Bid Form 10 – Escrow Bid Documents Certification of Completeness," signed by an individual authorized by the Bidder to execute the Bid Proposal. The Bidder certifies that the material in the Escrow Bid Documents constitutes all of the documentary information used in preparation of this Bid, and that the Bidder's authorized individual has personally examined the contents of the Escrow Bid Documents container and has determined that the Documents in the container are complete.

C. The Escrow Bid Documents of the apparent successful Bidder will be opened and examined by an appointed member of the District in the presence of the Bidder before the Contract is awarded. The apparent successful Bidder must attend this examination.

D. This examination is to ensure that the Escrow Bid Documents are legible and complete. It will not include a review of, or constitute approval of, proposed construction methods, estimating assumptions, or interpretations of the Contract Documents. The examination will not alter any condition or term of the Contract. Should the examination indicate that any data is incomplete or missing, the Bidder shall supply the missing information within 24 hours or at such other time as is mutually agreeable.

E. The timely submittal of complete Escrow Bid Documents is an essential element of the Bid process and a prerequisite to Contract award. Failure to provide the necessary Escrow Bid Documents will be sufficient cause for the District to reject the Bid as nonresponsive.

F. If the Contract is not awarded to the apparent successful Bidder, the Escrow Bid Documents of the Bidder submitting the next lowest responsive Bid shall be processed as described above. The Escrow Bid Documents of unsuccessful Bidders will be held unopened until such time that they are returned after execution of the Contract by the successful Bidder.

G. If any Bidder's Proposal is based on subcontracting any part of the Work, each Subcontractor whose total subcontract price exceeds the percentage of the total Bid price specified in the Special Provisions, shall provide separate Escrow Bid Documents to be included with those of the Bidder. At the District's discretion, such Documents shall be opened and reviewed, in the presence of the Subcontractor only in the same manner and at the same time as the review described above for the apparent successful Bidder.

H. In accordance with state law, if the Contractor substitutes a Subcontractor after Contract award, the District retains the right to require the new Subcontractor to submit Escrow Bid Documents.

3.14.05. Storage

A. Upon completion of the examination, receipt of the apparent successful Bidder's Escrow Bid Documents will be acknowledged in writing by the District. The

documents will be placed in escrow for the life of the Contract at an escrow firm within the greater Santa Clara County area chosen by the District. The District will pay for storage and maintenance of the Escrow Bid Documents.

3.14.06. Examination

A. The Escrow Bid Documents may be examined at any time deemed necessary by either the District or by the Contractor to assist in settling disputes and Claims.

B. An examination of the Escrow Bid Documents is subject to the following conditions:

1. As trade secrets, Escrow Bid Documents are proprietary and confidential.

2. The District and the Contractor (and any Subcontractor to the extent Escrow Bid Documents are required by a Subcontractor) shall each designate in writing to the other party seven (7) Days prior to any examination representatives who are authorized to examine the Escrow Bid Documents. With the consent of both the District and the Contractor, members of the DRB may participate in the examination of the Escrow Bid Documents. No other person shall have access to the Escrow Bid Documents.

3. Access to the Escrow Bid Documents may take place only in the presence of a duly designated representative of both the District and the Contractor. If the Contractor fails to designate a representative or fails to appear for joint examination on seven (7) Days' notice, then the District representative may examine the Escrow Bid Documents upon an additional three (3) Days' notice.

3.14.07. Final Deposition

A. The Escrow Bid Documents will be returned to the Contractor after the Work has been completed and accepted and after all Claims and disputes involving this Work have been settled. The Contractor will thereupon be required to waive, in writing, any right to lodge further Claims involving this Work.

3.15. Partnering

3.15.01. Partnering Relationship

A. The District encourages a partnering relationship with the Contractor to effectively complete the Contract to the benefit of both parties. The purpose of this relationship will be to maintain cooperative communication and to mutually resolve conflicts at the lowest possible management level.

3.15.02. Professionally Facilitated Project Partnering

A. To further the partnering relationship, Professionally Facilitated Project Partnering can be implemented by one of two methods:

1. The District requires Professionally Facilitated Project Partnering. The Contractor shall comply with the Special Provisions regarding this requirement.

2. The Contractor submits a written request for Professionally Facilitated Project Partnering. However, this method can only be implemented if the Engineer approves the request in writing.

B. Implementation of Professionally Facilitated Project Partnering

1. Scheduling the Professionally Facilitated Project Partnering workshops, selecting the Professional Partnering Facilitator and workshop site, and other administrative details shall be as agreed to by both parties.

2. Partnering workshops will be held on a quarterly basis during construction, or as needed, and as determined by the Engineer and by the Contractor. Both parties will determine workshop attendees, agenda, and duration. Persons required to be in attendance will be the Engineer and/or the Engineer's authorized agents and key Project personnel; the Contractor's authorized representative, on-site Project manager, and key Project supervision personnel of both the prime and principal Subcontractors and Suppliers; and other personnel as deemed necessary by the District and by the Contractor.

3. The Contractor shall secure the Professional Partnering Facilitator and the off-site meeting room. The District will pay in full for the services of a Professional Partnering Facilitator and for the off-site meeting room based on invoices priced without markup. Payment for these services shall be made utilizing the Professionally Facilitated Project Partnering Bid item or Contract Change Order if no Bid item is specified. All other costs associated with the partnering workshops will be borne separately by the party incurring the costs (e.g., wages and travel expenses); no additional payment shall be made.

C. The establishment of Professionally Facilitated Project Partnering will not change or modify the terms and conditions of the Contract and will not relieve either party of its legal requirements of the Contract.

3.16. Claims and Disputes per Public Contract Code Section 9204

A. Public Contract Code Section 9204 (PCC 9204) applies to all contracts entered into on or after January 1, 2017. PCC 9204 shall remain in effect only until January 1, 2020, and as of that date is repealed, unless a later enacted statute,

that is enacted before January 1, 2020, deletes or extends that date. The provisions of PCC 9204 are set forth below.

B. The Legislature has found and declared that it is in the best interests of the state and its citizens to ensure that all construction business performed on a public works project in the state that is complete and not in dispute is paid in full and in a timely manner. PCC 9204 shall apply to any claim by a contractor in connection with a public works project.

C. Prior to submitting a claim per PCC 9204, the Contractor shall comply with Article 3.11.01. Protest, Article 3.11.02 Notice of Potential Claims, 3.12. Claims, A. through F.

D. For purposes of PCC 9204, the following definitions apply:

1. "Claim" means a separate demand by a contractor sent by registered mail or certified mail with return receipt requested, for one or more of the following:

   a. A time extension, including, without limitation, for relief from damages or penalties for delay assessed by a public entity under a contract for a public works project.

   b. Payment by the public entity of money or damages arising from work done by, or on behalf of, the contractor pursuant to the contract for a public works project and payment for which is not otherwise expressly provided or to which the claimant is not otherwise entitled.

   c. Payment of an amount that is disputed by the public entity.

2. "Contractor" means any type of contractor within the meaning of Chapter 9 (commencing with Section 7000) of Division 3 of the Business and Professions Code who has entered into a direct contract with a public entity for a public works project.

3. "Public entity" means, without limitation, except as provided in subparagraph (b), a state agency, department, office, division, bureau, board, or commission, the California State University, the University of California, a city, including a charter city, county, including a charter county, city and county, including a charter city and county, district, special district, public authority, political subdivision, public corporation, or nonprofit transit corporation wholly owned by a public agency and formed to carry out the purposes of the public agency.

4. "Public works project" means the erection, construction, alteration, repair, or improvement of any public structure, building, road, or other public improvement of any kind.

5. "Subcontractor" means any type of contractor within the meaning of Chapter 9 (commencing with Section 7000) of Division 3 of the Business and Professions Code who either is in direct contract with a contractor or is a lower tier subcontractor.

E. 1.a. Upon receipt of a claim pursuant to PCC 9204, the District shall conduct a reasonable review of the claim and, within a period not to exceed 45 days, shall provide the Contractor a written statement identifying what portion of the claim is disputed and what portion is undisputed. Upon receipt of a claim, the District and Contractor may, by mutual agreement, extend the time period provided in this Article.

1.b. The Contractor shall furnish reasonable documentation to support the claim.

1.c. If the District needs approval from the Board to provide the Contractor a written statement identifying the disputed portion and the undisputed portion of the claim, and the Board does not meet within the 45 days or within the mutually agreed to extension of time following receipt of a claim sent by registered mail or certified mail, return receipt requested, the District shall have up to three (3) days following the next Board meeting after the 45-Day period, or extension, expires to provide the Contactor a written statement identifying the disputed portion and the undisputed portion.

1.d. Any payment due on an undisputed portion of the claim shall be processed and made within 60 days after the District issues its written statement. If the District fails to issue a written statement, paragraph 3. below shall apply.

2.a. If the Contractor disputes the District's written response, or if the District fails to respond to a claim issued pursuant to this Article within the time prescribed, the Contractor may demand in writing an informal conference to meet and confer for settlement of the issues in dispute. Upon receipt of a demand in writing sent by registered mail or certified mail, return receipt requested, the District shall schedule a meet and confer conference within 30 days for settlement of the dispute.

2.b. Within 10 business Days following the conclusion of the meet and confer conference, if the claim or any portion of the claim remains in dispute, the District shall provide the Contractor a written statement identifying the portion of the claim that remains in dispute and the portion that is undisputed. Any payment due on an undisputed portion of the claim shall be processed and made within 60 days after the District issues its written statement. Any disputed portion of the claim, as identified by the Contractor in writing, shall be submitted to nonbinding mediation, with the District and the Contractor sharing the associated costs equally. The District and Contractor shall mutually agree to a mediator within ten (10) business days after the disputed portion of the claim has been

identified in writing. If the parties cannot agree upon a mediator, each party shall select a mediator and those mediators shall select a qualified neutral third party to mediate with regard to the disputed portion of the claim. Each party shall bear the fees and costs charged by its respective mediator in connection with the selection of the neutral mediator. If mediation is unsuccessful, the parts of the claim remaining in dispute shall be subject to applicable procedures outside this Article.

2.c. For purposes of this section, mediation includes any nonbinding process, including, but not limited to, neutral evaluation or a dispute review board, in which an independent third party assists the parties in dispute resolution through negotiation or by issuance of an evaluation. Any mediation utilized shall conform to the timeframes in this Article.

2.d. Unless otherwise agreed to by the District and the Contractor in writing, the mediation conducted pursuant to this Article shall excuse any further obligation under Public Contract Code Section 20104.4 (see Article 3.12.01. Claims Less Than Fifty Thousand Dollars through Article 3.12.04. Civil Actions) to mediate after litigation has been commenced.

2.e. This Article does not preclude the District from requiring arbitration of disputes under private arbitration or the Public Works Contract Arbitration Program, if mediation under this Article does not resolve the parties' dispute.

3. Failure by the District to respond to a claim from a Contractor within the time periods described in this Article shall result in the claim being deemed rejected in its entirety. A claim that is denied by reason of the District's failure to have responded to a claim, or its failure to otherwise meet the time requirements of this Article, shall not constitute an adverse finding with regard to the merits of the claim or the responsibility or qualifications of the Contractor.

4. Amounts not paid in a timely manner as required by this Article shall bear interest at 7 percent per annum.

5. If a Subcontractor or a lower tier Subcontractor lacks legal standing to assert a claim against the District because privity of contract does not exist, the Contractor may present to the District a claim on behalf of a Subcontractor or lower tier Subcontractor. A Subcontractor may request in writing, either on his or her own behalf or on behalf of a lower tier Subcontractor, that the Contractor present a claim for work which was performed by the Subcontractor or by a lower tier Subcontractor on behalf of the Subcontractor. The Subcontractor requesting that the claim be presented to the District shall furnish reasonable documentation to support the claim. Within 45 Days of receipt of this written request, the Contractor shall notify the Subcontractor in writing as to whether the Contractor presented the claim to the District and, if the original

Contractor did not present the claim, provide the Subcontractor with a statement of the reasons for not having done so.

F. A waiver of the rights granted by PCC 9204 is void and contrary to public policy, provided, however, that (1) upon receipt of a claim, the parties may mutually agree to waive, in writing, mediation and proceed directly to the commencement of a civil action or binding arbitration, as applicable; and (2) a public entity may prescribe reasonable change order, claim, and dispute resolution procedures and requirements in addition to the provisions of PCC 9204, so long as the contractual provisions do not conflict with or otherwise impair the timeframes and procedures set forth in PCC 9204.

G. Nothing in PCC 9204 shall impose liability upon a public entity that makes loans or grants available through a competitive application process, for the failure of an awardee to meet its contractual obligations.

SECTION 4. LEGAL REGULATIONS AND RESPONSIBILITY

4.01. Laws to be Observed

A. The Contractor shall remain informed of and in compliance with the latest version of applicable existing and future Federal, State, County, and Municipal laws, ordinances, rules, and regulations, including, but not limited to, those cited herein.

4.02. Equal Opportunity Requirements

A. The Santa Clara Valley Water District is an equal opportunity employer and requires its Contractors to have and adhere to a policy of equal opportunity and nondiscrimination. In the performance of the Agreement, the Contractor will comply with all applicable Federal, State, Local Laws and Regulations, and will not discriminate against any Subcontractor, employee, or applicant for employment in the recruitment, hiring, employment, utilization, promotion, classification or reclassification, transfer, recruitment advertising, evaluation, treatment, demotion, layoff, termination, rates of pay or other forms of compensation, and selection for professional development training (including apprenticeship); or against any other person on the basis of sex (which includes pregnancy, childbirth, breastfeeding, and medical conditions related to pregnancy, childbirth, or breastfeeding); race, religion, color, national origin (including language-use restrictions); ancestry, religious creed (including religious dress and grooming practices); political affiliation, disability (mental and physical, including HIV or AIDS); medical condition (cancer and genetic characteristics) and genetic information; marital status, parental status, gender, age (40 and over); pregnancy, military, and veteran status; sexual orientation, gender identity, and gender expression; the exercise of family and medical care leave; the exercise of pregnancy disability leave; or the request, exercise, or need for reasonable accommodation.

B. The Contractor's policy must conform with applicable State and Federal guidelines, including the Federal Equal Opportunity Clause, "Section 60-1.4 of Title 41, Part 60 of the Code of Federal Regulations;" Title VII of the Civil Rights Act of 1964 as amended; the American's with Disabilities Act of 1990; the Rehabilitation Act of 1973 (Sections 503 and 504); the Age Discrimination Act of 1975 (42 U.S.C. Section 6101 et. seq.); California Fair Employment and Housing Act (Government Code Section 12900 et. seq.); and California Labor Code Sections 1101 and 1102.

4.03. Employment of Labor

A. In the employment of labor in the performance of the Contract, the District desires that the Contractor and all Subcontractors give first consideration to residents of the District.

4.04. Prevailing Wages

A. The Work to be performed pursuant to this Contract is "public works" subject to the California Prevailing Wage Law, California Labor Code Section 1720, et seq. and the applicable implementing regulations (the Prevailing Wage Law) with which the Contractor must comply. The General Prevailing Wage Rates issued by the California Department of Industrial Relations may be adjusted by the State during the term of this Contract. Notwithstanding any other provisions of this Contract, the Contractor will not be entitled to any adjustment in compensation in the event there are adjustments to the General Prevailing Wage Rates.

1. In accordance with the Prevailing Wage Law, the Director of the Department of Industrial Relations has ascertained the general prevailing rate of wages and employer payments for health and welfare, pension, vacation, and similar purposes available to the particular craft, classification, or type of workers employed on the Work. These rates are set forth in the latest determination obtained from the Director, which is on file in the office of the Clerk of the Board of Directors and incorporated herein by reference the same as though set out in full. The rates are also available on the State of California Department of Industrial Relations website at http://www.dir.ca.gov.

2. The Contractor shall pay a penalty to the District of $200 for each Day, or portion thereof, for each worker paid less than the stipulated prevailing rate for any public Work done under the Contract by the Contractor or by any Subcontractor in violation of the provisions of the Prevailing Wage Law.

B. Each Contractor and Subcontractor shall keep an accurate payroll record, showing the name, address, Social Security number, work classification, straight time, and overtime hours worked each Day and week, and the actual per-diem wages paid to each journeyman, apprentice, worker, or other employee by him/her in connection with the public Work. The payroll records shall be certified and shall be available for inspection at all reasonable hours at the principal office of the Contractor in accordance with the Prevailing Wage Law.

1. The Contractor and each Subcontractor, pursuant to California Labor Code Section 1776, must submit certified weekly payroll(s) within ten (10) Days after the Owner's request for submission of certified weekly payroll records. The certified payroll(s) must include the date of actual payment of wages for each worker employed on the Project and a breakdown of each payment, including all fringe benefits included in such wage for each worker.

2. In the event that the Contractor fails to comply with the ten (10)-Day submission deadline of California Labor Code Section 1776, the Contractor shall pay a penalty to the District of $100 for each Calendar Day or portion thereof, for each worker, until the Contractor achieves compliance with Section 1776.

3. The Contractor shall inform the District of the location of the payroll records—including the street address, city, and county—and shall, within five (5) working Days, provide a notice of a change in location and address. The Contractor is responsible for compliance with payroll record requirements imposed by Section 1776 of the Labor Code.

C. The Contractor must submit certified weekly payroll(s) in support of the monthly request for payment as required herein. Certified weekly payroll(s) must be submitted within ten (10) Calendar Days from the progress payment end date. Payroll(s) shall contain the full name, address, and Social Security number of each employee; his/her correct classification and rate of pay; daily and weekly number of hours worked; itemized deductions made; and actual wages paid. Payroll shall also indicate apprentices and ratio of apprentices to journeymen. The employee's address and Social Security number need only appear on the first payroll on which his/her name appears. The payroll(s) shall be accompanied by a Statement of Compliance signed by the employer or agent indicating that the payroll(s) is correct and complete and that the wage rates contained therein are not less than those required by the Contract. The Statement of Compliance shall be on forms furnished by the District or on any form with identical wording. The Contractor shall be responsible for the submission of copies of the payroll(s) of all Subcontractors, including sub-Subcontractors.

1. This project is subject to compliance monitoring and enforcement by the State of California Department of Industrial Relations. The Contractor and Subcontractors must furnish the records specified in Section 1776 directly to the Labor Commissioner in the following manner: monthly, in a format prescribed by the Labor Commissioner.

2. The District will take all actions reasonably necessary to enforce the prevailing wage requirements of this Contract, including retaining progress payment funds not supported by certified payroll(s).

3. Retentions for failure to submit satisfactory payroll(s) are in addition to all other retentions provided for in the Contract.

D. The Contractor and each Subcontractor shall preserve their respective payroll records for a period of four (4) years from the date of filing a Notice of Completion and Acceptance under the Contract.

1. The work of installing, assembling, repairing, or reconditioning—or other work of any nature on machinery, Equipment, or tools used in or upon the Work—is considered a part of the Work to be performed under the Contract; any laborers, workers, or mechanics working on such machinery, Equipment, or tools are subject to all of the requirements relating to labor set forth in the Contract.

2. The construction, erection, and operation of Material production, proportioning, or mixing plants from which Material is used wholly on the Contract or on contracts under the supervision of the District shall be

considered a part of the Work to be performed under the Contract; any laborers, workers, or mechanics working on such plants shall be subject to all of the requirements relating to labor set forth in the Contract.

4.05. Hours of Labor

A. Eight (8) hours of labor constitutes a legal Day of work. The Contractor shall pay a penalty to the District of $25 for each worker employed in the execution of the Contract by the Contractor or by any Subcontractor for each Day during which such worker is required or permitted to labor more than eight (8) hours in violation of Labor Code Sections 1810 to 1815, inclusive.

4.06. Apprentices

A. The Contractor shall comply with Sections 1777.5, 1777.6, and 1777.7 of the Labor Code concerning the employment of apprentices by the Contractor or by any Subcontractor.

B. Section 1777.5 requires the Contractor or Subcontractor employing persons as defined in any apprenticeable occupation to apply for a certificate of approval to the joint apprenticeship committee that is nearest the site of the public works project and that administers the apprenticeship program in that trade. The certificate will also fix the ratio of apprentices to journeymen that will be used in the performance of the Contract. The ratio of work performed by apprentices to journeymen in such cases shall not be less than one (1) hour to five (5) hours, except when the committee finds that any one of the following conditions are met:

1. In the event unemployment for the previous three (3)-month period in the Project site area exceeds an average of 15 percent; or

2. In the event the number of apprentices in the area exceeds a ratio of one (1) to five (5); or

3. If there is a showing that the apprenticeable craft or trade is replacing at least one thirtieth of its journeymen annually through apprenticeship training either (i) on a statewide basis, or (ii) on a local basis; or

4. If assignment of an apprentice to any Work performed under a public works contract would create a condition that would jeopardize his/her life; or the life, safety, or property of fellow employees; or the public at large; or if the specific task to which the apprentice is to be assigned is of such a nature that training cannot be provided by a journeyman.

C. The Contractor is required to make contributions to funds established for the administration of apprenticeship programs if the Contractor employs registered apprentices or journeymen in any apprenticeable trade on such contracts and if other contractors on the public works site are making such contributions.

D. The Contractor and any Subcontractor shall comply with the requirements of Sections 1777.5 and 1777.6 in the employment of apprentices.

E. Information relative to apprenticeship standards, wage schedules, and other requirements may be obtained from the Director of Industrial Relations, ex officio the Administrator of Apprenticeship, San Francisco, CA, or from the Division of Apprenticeship Standards and its branch offices.

4.07. Permits and Licenses

A. The Contractor shall procure all permits and licenses, pay all charges and fees, and give all notices necessary and incident to the prosecution of the Work, except as provided in the Special Provisions.

4.08. Patents and Copyrights

A. The Contractor shall assume all costs, including any costs of defense arising from the use of any copyrighted composition, secret process, patented or unpatented invention, article, Equipment, device, or appliance manufactured, furnished, or used in the performance of the Contract, including their use by the District, unless otherwise specifically stipulated in the Specifications.

4.09. Interference With Fire Hydrants, Highways, and Fences

A. The Contractor shall conduct operations so as not to close or obstruct any portion of any highway, road, or street, or prevent in any way free access to fire hydrants until permits have been obtained thereof from the proper authorities. If any highway required to be kept open shall be rendered unsafe by the Contractor's operations, the Contractor shall make such repairs or provide such temporary guards as shall be acceptable to the authorities having jurisdiction and to the Engineer. Any highway or street maintenance or repair work required by local authorities in connection with necessary operations under the Contract shall be performed by the Contractor at the Contractor's own cost and expense. Fences subject to interference shall be maintained as effective barriers consistent with the original intent; upon approval of the Engineer, they may be moved or rearranged to facilitate prosecution of the Work until the Work is finished, after which they shall be restored to their original location in an equal or better condition than existed prior to rearrangement.

4.10. Preservation of Property

A. The Contractor shall exercise due care to avoid damage to existing improvements, utility facilities, and adjacent property, real and personal. The fact that any existing underground improvement or facility is not shown on the Drawings shall not relieve the Contractor of the responsibility to ascertain the existence of any underground improvement or facility that may be subject to damage by reason of the Contractor's operations.

B. Any damage to improvements or property—whether above or below ground, private or public, within or adjacent to the Project limits—arising from or in consequence of the performance of the Contract shall be promptly repaired by the Contractor.

C. If the Engineer requires such repair to be made prior to the execution or continued performance of any part of the Work included in this Contract, the Engineer will so notify the Contractor who shall delay or discontinue the performance of that part of the Work until the necessary repair has been made. Such delay shall be considered Inexcusable Delay; no extension of time for completion of the Contract will be allowed. The Contractor will be subject to Contract damages for any impact to the Contract Milestones resulting from its damage to property or from failure to make timely repairs.

D. When Ordered by the Engineer to make any such repair, the Contractor shall start work thereon within 4 hours and shall prosecute the same with diligence to completion. Upon failure of the Contractor to so comply with such order, or upon the Contractor's failure to make immediate emergency repairs reasonably determined by the Engineer to be necessary in the best interests of the public, the Engineer shall have authority to cause the repair to be made and to deduct the costs thereof from any money due, or which may become due, the Contractor.

E. In an emergency affecting the safety of life or property, including adjoining property, the Contractor shall act to prevent, to the extent possible, such threatened loss or injury whether instructed or not to do so by the Engineer.

4.11. Contractor's Responsibility for the Work

A. Until the Acceptance of the Work, the Contractor shall have the charge and care of the Work and of the Material to be used therein and shall bear the risk of injury, loss, or damage to any part thereof by the action of the elements or from any other cause, whether arising from the execution or from non-execution of the Work. The Material to be used in the Work include both those furnished by the District and those furnished by the Contractor, including Material for which the Contractor has received partial payment.

4.12. Indemnification

A. The Contractor shall defend, indemnify, and hold harmless the District and its Directors, officers, employees, and agents from liability, loss, suits, actions, or claims brought for or on account of violation of Laws, Ordinances, Rules, or Regulations, or injury, damage, or loss (including death) caused by acts or omissions of the Contractor, its employees, or its agents.

B. The Contractor shall defend, indemnify, and hold harmless the agencies/parties named in Article 14.16. Insurance, of the Special Provisions—including their officers, employees, and agents—from liability, loss, suits, actions, or claims brought for or on account of any violation of Laws, Ordinances, Rules, or

Regulations, or injury, damage, or loss (including death) caused by acts or omissions of the Contractor, its employees, or its agents.

4.13. Contractor's Insurance

4.13.01. General

A. The insurance procured by the Contractor for the benefit of Santa Clara Valley Water District shall not be deemed to release or limit any liability of the Contractor. Damages recoverable by Santa Clara Valley Water District for any liability of the Contractor shall, in any event, not be limited by the amount of the required insurance coverage. Failure by the Contractor to maintain all required insurance at all times during the performance of this Contract and until Acceptance by the District, shall, at the discretion of the District, result in temporary suspension of Work, or termination of control, or termination of the Contract as indicated herein, and shall not be a basis for a time extension. The Contractor's insurance shall be primary with respect to any other insurance that may be carried by Santa Clara Valley Water District.

B. The District has the right to require the Contractor to provide complete, certified copies of all required pertinent insurance policies, including endorsements affecting the coverage required by the Agreement.

C. The specific insurance requirements and coverages shall be in accordance with the Special Provisions.

4.13.02. Insurance on Work and Material

A. The Contractor shall secure and maintain such direct damage insurance against such perils as the Contractor may deem necessary to protect the Work called for in this Contract, including Work completed, Material in place or to be used in the performance of this Contract, and such other miscellaneous items as may be necessary to the performance of this Contract.

4.14. Payment of Taxes

A. Except as otherwise specifically provided in the Special Provisions, the Contract Price(s) shall include full compensation for all current and future taxes that the Contractor is required to pay, whether imposed by Federal, State, or local government; no tax exemption certificate or any other document designed to exempt the Contractor from payment of tax will be furnished to the Contractor by the District.

4.15. Cooperation With Others

A. The District reserves the right to access and do other work, maintenance or operations on or near the Project. The Contractor shall cooperate with others and coordinate its Work with planned or ongoing work of the District or of other District contractors within or adjacent to the limits of the Contract Work. The

Contractor shall conduct the Work so as to facilitate work by the District or by others and prevent delay, additional expense, or hindrance thereto, and allow for the satisfactory prosecution of the Work.

B. The Contractor shall request from, and exchange with others, Drawings, data, and information as necessary to ensure proper completion of the Project and of the work of others. The Contractor shall furnish to the Engineer copies of correspondence and Drawings exchanged with other contractors.

C. The Contractor shall complete the following activities as requested by the Engineer to assist in the coordination of Contract Work with work by others: attend planning meetings; review and comment on Project documents relative to coordination aspects; schedule Work to promote efficient installation of all improvements; move Material, Equipment, or vehicles to allow work by others to proceed; and other reasonable activities.

D. No additional payment shall be made or Claims considered for Delay due to the Contractor's failure to coordinate the Work or because of conflicts with other construction, including that of the District.

E. The Contractor agrees to reimburse the District for any payments made to other Contractors that were incurred as a result of the Contractor's Inexcusable Delays.

4.16. Property Rights in Material

A. Nothing in the Contract shall be construed as vesting in the Contractor any right of property in the Material used after they have been attached or affixed to the Work or after payment has been made for 90 percent of the value of Material delivered to the site of the Work, whether or not they have been so attached or affixed. All such Materials shall become the property of the District upon being so attached or affixed or upon payment of 90 percent of the value of Material delivered by the Contractor to the worksite and not used as provided herein.

4.17. Rights in Land and Improvements

A. Nothing in these Standards shall be construed as allowing the Contractor to make any arrangements with any person to permit occupancy or use of any land, structure, or building within the limits of the Contract for any purpose whatsoever, either with or without compensation, in conflict with any agreement between the District and any owner, former owner, or tenant of such land, structure, or building.

4.18. Title to Material Found on the Work

A. The title to all water and to the right to use all water; and all soil, stone, gravel, sand, minerals; and all other Material developed or obtained in the excavation or other operations by the Contractor, or by any Subcontractor, and the right to use or dispose of the same are hereby expressly reserved by the District; neither the

Contractor, nor any Subcontractor, shall have any right, title, or interest in, or to any part thereof; neither shall they, nor any of them, assert or make any claim thereto. The Contractor may be permitted to use in the Work, without charge, any such Material that meet the requirements of these Specifications.

4.19. Trespass

A. The Contractor shall be responsible for all damage or injury that may be caused on or to any property by trespass by the Contractor or any Subcontractor in the course of their employment, whether the said trespass was committed with or without the consent or knowledge of the Contractor.

4.20. Subcontracting

A. The Contractor shall comply with the Subletting and Subcontracting Fair Practices Act commencing with Public Contract Code Section 4100. Violations shall subject the Contractor to penalties described therein.

B. For the purposes of consenting to substitution of a designated Subcontractor in accordance with Public Contract Code Section 4107, 4109, and 4110, the Administrative Hearing Officer will be in accordance with Article 3.02. Engineer.

C. The Engineer reserves the right to order the Contractor to terminate any subcontract if, in the Engineer's opinion, the Subcontractor fails to comply with the applicable requirements of this Contract.

D. Nothing herein contained shall create any contractual relation between any Subcontractor and the District or shall relieve the Contractor of any liability or obligation hereunder.

E. All contracts with Subcontractors and lower-tier Subcontractors and purchase agreements with Suppliers and lower-tier Suppliers shall provide that they are freely assignable to the District or to the District's designee under the following conditions:

1. The District terminates the Contractor's control of the Work in accordance with Article 4.22. Termination of Control; and

2. The District directs such assignment.

4.21. Assignment of Antitrust Claims

A. Government Code Sections 4550 through 4554 pertaining to the assignment of antitrust claims are incorporated herein in full by this reference.

4.22. Termination of Control

A. The District may terminate the Contractor's control of the Work at any time upon a determination that the same is in the best interests of the District.

4.23. Termination of Contract

A. The District may terminate the Contract at any time upon a determination that the same is in the best interests of the District. Upon such termination, the rights, duties, and obligations of the parties shall be as stated in Section 8-1.14 of the 2010 State Specifications, wherein the words “Director” and “Engineer” shall mean the Engineer and the words “State” and “Department” shall mean District. Payment after termination of Contract shall be in accordance with the District’s Standard and Special Provisions.

4.24. Contractor’s Cost Data

A. The District or any of its duly authorized representatives shall, until the expiration of four (4) years after filing the Notice of Completion and Acceptance under this Contract or any subcontract under it, have access to and the right to examine any Contractor or Subcontractor payroll, records of personnel, invoices of Material, records of plant and Equipment costs, and any and all other directly pertinent books, documents, papers, and records of such Contractor or Subcontractors involving transactions related to the said Contract or subcontracts. In the event State or Federal funds are involved in financing the Project, the State or Federal Government shall have the same rights of inspection as the District.

4.25. Utilities

A. In general, the location of existing utility facilities as shown on the Drawings is approximate. This information has been obtained from utility maps furnished by the various agencies involved; the District does not guarantee either the correctness of the locations or the extent of such locations.

B. California Government Code Section 4215 does not require public agencies to indicate the presence of service laterals or appurtenances whenever the presence of such utilities can be inferred from the presence of other visible facilities (e.g., buildings, meter boxes, junction boxes) on or adjacent to the construction site. Service laterals (e.g., house sanitary, water, electrical, gas, cable TV, storm or telephone cables, appurtenances) may not all be shown on the Drawings. No changes in the Contract Price(s) or the Contract Time(s) shall be made due to the presence of unidentified or incorrectly located service laterals or appurtenances. It shall be the responsibility of the Contractor to ascertain the exact location of the utility facilities.

C. Unless otherwise indicated on the Drawings or specified in the Specifications, the Contractor shall maintain in service all utilities, including house services, power, lighting, and telephone conduits, and any other surface or subsurface structure or facility of any nature that may be affected by the Work; provided, however, that the Contractor, for convenience, may arrange with the owner to temporarily disconnect house service lines or other facilities along the line of the Work. The cost of disconnecting and restoring such utilities shall be borne by the Contractor.

D. In the event that a main or trunk-line utility facility is encountered that interferes with the Work and that is neither shown on the Drawings nor specified in the Specifications, the Contractor shall immediately notify the District in writing. The District may have the appropriate utility company or public agency relocate the facility, or the District may direct the Contractor to relocate the facility in accordance with Article 3.06. Changes in the Work.

E. In the event that a main or trunk-line utility facility is encountered that interferes with the Work and that the Contractor believes is not shown on the Drawings or indicated in the Specifications with Reasonable Accuracy, the Contractor shall immediately notify the District in writing.

1. If the Engineer determines that the main or trunk-line utility facility was shown on the Drawings or was indicated in the Specifications with Reasonable Accuracy, the Contractor shall be solely responsible for relocation or removal; no additional time shall be granted nor additional payment made, for any additional Work required.

2. If the Engineer determines that the main or trunk-line utility facility was not shown on the Drawings or was not indicated in the Specifications with Reasonable Accuracy, the District may have the appropriate utility company or public agency relocate the facility, or the District may direct the Contractor to relocate the facility in accordance with Article 3.06. Changes in the Work.

F. When a delay in the completion of the Project is caused by the failure of the District or by the owner of a utility facility to provide for removal or relocation of existing main or trunk-line utility facilities that are not shown on the Drawings or that are not indicated in the Specifications or that are not shown on the Drawings or indicated in the Specifications with Reasonable Accuracy, the Contract Time(s) shall be extended in accordance with Article 3.08. Change in Contract Time(s).

G. Various existing utilities, both above and below ground, may be encountered during construction. The Contractor shall perform all Work in such a manner so as to avoid damage to existing utilities. The Contractor is responsible for any damage due to failure to exercise due care.

H. The Contractor shall notify underground service alert (U.S.A.) a minimum of five (5) working days prior to the start of excavation or demolition in accordance with California Government Code requirements. The Contractor is responsible for coordinating the U.S.A. notification according to the Contractor’s schedule; any delay due to utility markings through the U.S.A. process is the responsibility of the Contractor.

I. The Contractor shall verify the exact location of all indicated or field marked utilities and shall make a sufficient number of exploratory excavations of all utilities that may interfere with the Work sufficiently in advance of the construction. The Contractor shall promptly notify the Engineer when such

exploratory excavations show the utility location as shown on the Drawings to be in error.

J. The Contractor shall not interrupt the service function or disturb the support of any utility without authority from the utility owner or an order from the Engineer. All valves, switches, vaults, and meters shall be maintained and readily accessible for emergency shutoff.

K. The District and the owners of utilities or their authorized agents reserve the right to enter upon the right of way at all times for the purpose of operations and maintenance of their facilities or for making necessary connections or repairs to their properties. The Contractor shall cooperate with the District and with the affected utilities engaged in such Work to avoid any unnecessary Delay or hindrance to such Work.

L. The Contractor is responsible for doing all Work and furnishing all Materials required for protecting in place or restoring all existing above- and below-ground utilities disturbed or damaged during construction to a condition equal to or better than that existing prior to construction.

M. The Contractor shall protect all utilities that may be impacted by the Work. All exposed utilities shall be supported firmly and uniformly conforming to the utility requirements. No utilities shall be left exposed for a period exceeding eight (8) hours unless approved by the utility and by the Engineer. Unless otherwise shown on the Drawings, all utilities shall be backfilled with at least 12 inches of select imported backfill around the utility.

N. All utility pole and guy anchors shall be protected, and, where the walls of a trench are within five (5) feet of a pole or anchor, lateral support to the pole shall be provided by the Contractor.

O. The Contractor shall immediately notify the utility owner and the Engineer if any existing utilities have sustained damage prior to excavation or if the Contractor disturbs or damages the existing utility during the excavation. The Contractor shall bear the cost of repair or replacement of any utility damaged as a result of construction operation.

4.26. Asbestos-Related Work

A. The Contractor shall comply with California Business and Professions Code Section 7058.5, which states that no Contractor shall engage in asbestos-related work, as defined, unless certified by the Contractor's State License Board to do so.

B. The Contractor shall comply with California Labor Code Section 6501.5 relative to asbestos related work, the applicable provisions of the Code of Regulations, Title 8 General Industry Safety Orders, and BAAQMD Regulation 11, Rule 2.

SECTION 5. PROSECUTION AND PROGRESS OF WORK

5.01. Assignment

A. The performance of the Contract may not be assigned except upon consent of the Board of Directors. Consent shall not be given to any proposed assignment that would relieve the original Contractor or surety of its responsibilities set forth in the Contract.

B. The Contractor may assign moneys due in accordance with the Contract; such assignment shall be recognized by the District if given proper notice thereof, to the extent permitted by law. Assignment of moneys shall be subject to all proper setoffs in favor of the District and to all deductions provided for in the Contract. All money withheld, whether assigned or not, shall be controlled by the District.

5.02. Notice to Proceed

A. The Notice to Proceed (NTP) shall be issued by the Engineer within ten (10) Days after receipt of the signed Agreement and after approval by the District of the contract bonds and insurance documents. The NTP authorizes the Contractor to proceed with the Work and establishes the First Chargeable Day of the Contract.

5.03. Commencement of Work

A. The First Chargeable Day as specified in the NTP will be at least ten (10) Days after the date of said Notice.

B. The Contractor shall provide written notice to the Engineer, at least 2 working days in advance, of the date the Contractor intends to start work on site.

5.04. Meeting Requirements

A. This Article includes requirements for scheduling, attending, and conducting Project meetings for the purpose of addressing issues related to the Work and for reviewing and coordinating progress of the Work. Project meetings include the preconstruction meeting, progress meetings, coordination meetings, and special meetings as specified herein.

B. Qualifications of meeting participants: Representatives of firms and organizations participating in each meeting shall be qualified and authorized to act on behalf of the firm or organization they represent.

5.04.01. Preconstruction Meeting

A. The purpose of the preconstruction meeting is to review the Project, designate responsible personnel, and inform the Contractor of the District's Contract administrative procedures, correspondence communication protocol, and other special requirements of the Contract. The Contractor shall come prepared to discuss its staffing, how it will successfully perform the Work, and discuss its plan

for temporary utilities, safe Work environment, environmental compliance, emergency response, and any tie-ins, outages, or shutdowns. The Contractor shall also be prepared to review and discuss the Contractor's markup breakdown, Change Order pricing structure, the Standards to be used on the Project, and what the Contractor must provide as backup for Change Orders or for extra Work pricing.

B. The Engineer will arrange the preconstruction meeting and will notify the Contractor regarding the meeting time, date, and place. The meeting shall be attended by the Contractor and its Superintendent and all representatives of Subcontractors or suppliers whom the Contractor may desire to invite or whom the District may request with the intent being a full understanding of the issues discussed by all parties. The Engineer shall prepare the agenda, preside at the meeting, and record meeting minutes.

5.04.02. Progress Meetings

A. The Engineer shall conduct progress meetings on a regular weekday and at a time mutually agreed to by the Contractor and by the Engineer. The purpose of the progress meetings is to review construction progress; submittal status; Potential Change Order, Change Order, and DCO status; construction safety issues and concerns; conflicts; environmental compliance; public/neighborhood issues; progress payments; and any other subject as deemed appropriate.

B. The Contractor shall allow for one (1) meeting a week.

C. Subject to the Engineer's approval, the frequency of the progress meetings may be reduced at the beginning and at the end of the construction period.

D. The Contractor's superintendent, suppliers, and Subcontractors shall attend the meetings as required. Third parties, such as agency representatives and utilities, may be invited by the Engineer to attend as deemed appropriate.

E. Typical agenda. Typical agenda items can include:

1. Review and approval of previous meeting minutes.

2. Review of progress since the previous meeting.

3. Contractor's Progress Schedules, including Look-Ahead Schedules.

    a. Review of off-site fabrication and delivery schedules.

    b. Problems that may affect the Contractor's schedule performance.

    c. Corrective measures to recover from forecasted Delays whether Excusable or Inexcusable.

    d. Updates and/or revisions to the Contractor's Detailed Progress Schedules.

4. Interface with operations.

5. Safety and security.

6. Review of submittals schedule.

7. Status of RFIs.

8. Field observations, problems, and conflicts.

9. Status of QC inspections and corrections.

10. Environmental issues.

11. Housekeeping.

12. Status of submittal review.

13. Status of PCOs.

14. Status of COs.

15. Other business.

16. A review of the monthly billing once per month.

5.05. Professional Scheduler

A. All Detailed Progress Schedules shall be prepared and updated throughout the Contract Time(s) by a Schedule Professional who has, at a minimum, five (5) years of recent, verifiable experience in preparing, updating, and maintaining computerized Critical Path Method (CPM) construction schedules using Oracle Primavera, Microsoft Project, or similar scheduling software on at least two (2) completed construction projects of a similar size and degree of complexity as this Project.

B. Prior to the Contractor's submission of the initial Detailed Progress Schedule, the Contractor shall submit the form in Appendix I and receive a favorable review of the résumé and professional references of the proposed Scheduler. The references shall be from at least two (2) project owners or construction managers familiar with the Scheduler's work on projects identified in the Scheduler's résumé. The District reserves the right to reject the proposed Scheduler based on lack of qualifications as defined in this Article.

5.06. Progress Schedules

A. The Contractor is responsible for scheduling the sequence of its Work in all Progress Schedule(s) as described below.

5.06.01. Preliminary Progress Schedule

A. Within ten (10) Days of the First Chargeable Day of the Contract as specified in the NTP, the Contractor shall submit to the Engineer a Preliminary Progress Schedule. This schedule shall include all activities that are planned to occur within the first 45 Days of the Contract.

5.06.02. Baseline Progress Schedule

A. Within 30 Days of the First Chargeable Day of the Contract as specified in the NTP, the Contractor shall submit its initial Detailed Progress Schedule, which, if accepted, shall become the Baseline Progress Schedule for the Project. The submittal shall be in hard copy and native electronic format and shall fully conform to the numbered items below:

1. The schedule shall be prepared using Oracle Primavera, Microsoft Project or similar Precedence Diagramming Method (PDM) scheduling software.

2. The Baseline Progress Schedule shall be a Critical Path Method (CPM) schedule that is comprehensive, credible, well-constructed, and controlled. The schedule shall include input from its major Subcontractors and Suppliers and represent the complete scope of work. It shall represent the planned order of significant activities to complete the Work within the time allowed under this Contract. Any Detailed Progress Schedules shall be presented in sufficient detail such that sequence and interdependence of activities of the Project can be identified. The schedule shall include proper logic and adequate activity durations and show a logical critical path and Controlling Items of Work.

3. The schedule shall account for on-site and off-site activities, including, but not limited to, permits, mobilization, and submittals (prepare and submit, review and approve, revise and resubmit); fabrication and delivery, installation, construction, system shutdowns, testing and start-up; training of District personnel; deficiency list; closeout; and demobilization. The schedule shall include key Milestones; reviews by the District, regulatory agencies, and other third parties of the Work; construction and sequencing constraints as specified in these Specifications; construction Work by the District forces or other third parties that interface with the Work; District-managed activities, such as the District furnishing Equipment; removal or relocation of interfering utilities by third parties; delivery of operation and maintenance manuals; and adequate time for Work completion and closeout activities.

4. Activity calendars shall reflect the planning basis and any Contract restrictions. All non-work Days and work hours shall be explained for each calendar.

5. The schedule shall reflect any limitations on work hours required by the Contract and any permit restrictions and conditions that are required.

6. Each schedule activity shall include a unique ID number and description, pertinent predecessors and successors, start/finish dates, an assigned workday calendar, a duration, percent complete, calculated float and activity codes to group the Work into Work Breakdown Structure (WBS) categories, location, responsibility, trade, and other rational groupings to facilitate sorting and filtering of the schedule activities.

7. Activities making up the critical path for the entire Contract and the critical path for each specific designated portion of the Work shall be identified. The network diagram shall be organized to indicate a continuous flow of progress of activities from left to right.

8. Except for concrete curing, submittal review, Equipment fabrication and deliveries, schedule activities shall be no longer than 20 working days. Activities longer than 20 working days shall be subdivided into sub-elements of work.

9. The Contractor shall submit a tabular listing of the schedule along with the network diagram.

10. The use of float suppression techniques, such as preferential sequencing (arranging critical path through activities more susceptible to District-caused delay); special lead/lag logic restraints; zero-total or free-float constraints; extended activity times; or imposing constraint dates other than required by this Contract shall be cause for rejection of the schedule using such techniques. The use of Resource Leveling (or similar software features) for the purpose of artificially adjusting activity durations to consume float and influence the critical path shall also be cause for rejection.

11. The Engineer's favorable review of the schedule shall not relieve the Contractor of errors and omissions in tasks, durations, or logic. No time extensions shall be granted because of errors or omissions on the schedule. It is the Contractor's responsibility to incorporate all necessary activities to cover the entire Work scope.

12. A favorably reviewed Baseline Progress Schedule is a condition precedent to payment.

B. Cost Loading

1. Work activities other than third-party and District-managed activities shall be cost loaded. No activity shall have a value greater than $50,000 except for activities representing major Equipment purchases or installation. Progress Schedules exhibiting front-loaded costs are unacceptable. The Contractor shall revise the Schedule of Values (SOV)

pursuant to Article 6.01. Schedule of Values until accepted by the Engineer.

2. The Contractor shall create two (2) hierarchical schedule activity codes in the scheduling software: (i) Bid Item and (ii) SOV. Each code shall have line item name corresponding to the accepted Bid items and SOV titles. Costs shall progressively roll up from the activity level to the SOV level; SOV codes shall roll up to the Bid Item level.

3. Each cost-loaded schedule activity shall be assigned one of the SOV codes. An activity shall not contain work assigned to more than one SOV code. The SOV code will be used to summarize cost-loaded activity values to produce the required SOV submittal. Table 6-1, referenced in Article 6.01.02. Submittal, is an acceptable form for this submittal. The SOV submittal shall be produced from the Progress Schedule software.

4. The sum of the monetary values of the activities assigned to each SOV code shall be equal to the accepted amount of that SOV line item. The sum of all the cost-loaded activities in the latest accepted schedule update shall total the latest approved Contract amount.

C. Early Completion Schedule

1. The District is not required to accept an earlier (advanced) schedule (i.e., one that shows early completion date[s] but within the specified Contract Time[s]). Time(s) for completion of Work shall adhere to the Contract Time(s) specified in these Specifications unless earlier time(s) of completion is requested by the Contractor and agreed to by the District. Any such agreement shall be formalized by a Change Order or by a DCO.

2. If the Contractor submits any Baseline Progress Schedule or Detailed Progress Schedules showing any Contract Time(s) earlier than a corresponding, specified Contract Time(s) and that early completion date is not agreed to by both parties through a Change Order or through a DCO, the duration from such early completion date and from the specified Contract Time(s) is considered “float” and shall belong to the Project.

3. Accordingly, the Contractor in this situation is to show in the Baseline Progress Schedule or in the Detailed Progress Schedules a specific activity identified as Project Completion Float, which may be adjusted as that float is used or increased. The Contractor shall not be entitled to a time extension due to any cause or reason that consumes Project Completion Float.

5.06.03. Revised Baseline Schedules

A. If the Contractor desires to make a change to the Baseline Progress Schedule after commencing construction, a revised Baseline Progress Schedule and

associated narrative shall be submitted to the District at least 15 Days prior to any such change.

B. The narrative shall state the reasons for the change; any change to the Baseline Progress Schedule shall be discussed in the submittal to the District.

C. A revised Baseline Progress Schedule shall not become effective until accepted by the District.

5.06.04. Updates to the Detailed Progress Schedules

A. Any and all updates or revisions to the initial Detailed Progress Schedule shall conform to the same requirements as the Baseline Schedule in Article 5.06. Progress Schedules.

B. The Contractor shall submit an update of the prior month's Detailed Progress Schedule to the Engineer before the 25th Day of each month.

C. Each schedule update shall incorporate all current information, including progress. Actual start and finish dates shall be updated and shall match daily reports. Work completed shall be shown with actual start and finish dates for each activity. Work in progress shall be shown with the actual start date and the percentage of Work completed as of the last date of the previous month.

D. The Contractor shall also submit a narrative report that shall include a description of problem areas, state the reasons for any changes made to the schedule activities, current and anticipated delaying factors and their impact, and an explanation of corrective actions taken or proposed.

E. Progress status shall be evaluated on the basis of float on the critical path at the time of updating, with negative float indicating the Project is behind schedule and positive float indicating ahead-of-schedule status.

F. Acceptance of the Detailed Progress Schedule updates is a condition precedent to payment.

G. Recovery Schedules

1. At any time that construction progress lags behind any Baseline Progress Schedule or any updated/revised Detailed Progress Schedule accepted by the Engineer by either ten (10) working Days or by five (5) percent of the remaining time to complete the Contract, whichever is less, the Contractor shall prepare and submit a Recovery Schedule to the Engineer. This Recovery Schedule shall demonstrate how construction will be expedited and executed to achieve the contractual completion dates (either Milestone Completion or Project Completion dates).

2. Activity ID numbers shall be the same as in the most current and accepted and updated Detailed Progress Schedule. ID numbers of

deleted activities shall not be reused on the Recovery Schedule. New ID numbers (not used in the most current and accepted Detailed Progress Schedule) shall be used for new activities.

3. A revised narrative describing the remaining Work as reflected in the Recovery Schedule shall be included and shall include a separate listing of all activities deleted, changed, or added with an explanation for each change.

4. Once favorably reviewed by the Engineer, the Recovery Schedule shall become the current, revised Detailed Progress Schedule against which future progress is to be measured.

5.06.05. Time Impact Analysis

A. If the Contractor foresees that an Excusable Delay, as defined, will impact a Controlling Item of Work, a written request for adjustment of the impacted Contract Time(s) and supporting data shall be promptly submitted to the Engineer in accordance with Article 3.08. Change in Contract Time(s). To substantiate the Contractor's request, the supporting data shall include a Time Impact Analysis (TIA) based on the updated and accepted Detailed Progress Schedule for the month preceding the Excusable Delay.

B. The TIA shall represent Excusable Delays as separate activities or as groups of activities. These activities shall be entered into the relevant part of the schedule update that was accepted just prior to the time the Excusable Delay occurred. In case of a deductive change reducing the quantity of Work, activities representing the deleted scope shall be dissolved or its estimated duration adjusted to reflect the reduction.

C. The Contractor shall submit a written report with the TIA describing the Excusable Delay by the occurrence and the impact of the event time computation on all affected activities.

D. Only changes or delays that affect or create Controlling Items of Work as defined by the schedule shall result in time adjustments. The Engineer shall determine if a request for time extension is warranted.

E. Total float or slack is defined as the amount of time between the early start date and the late start date, or the early finish date and the late finish date of any activity in the schedule. Total float or slack is not for the exclusive use or benefit of either the District or the Contractor. It is an expiring resource available to either party on a first-come, first-served basis.

5.06.06. "Three-Week-Look-Ahead" Schedules

A. The Contractor shall provide Three-Week-Look-Ahead Schedules on a weekly basis and present them at the weekly progress meetings.

B. The Three-Week-Look-Ahead Schedules shall be prepared in the form of a bar chart breaking down activities into detailed subtasks on the Contractor's Detailed Progress Schedules. Subtasks shall identify related activities on the Detailed Progress Schedules and responsibility for completion of the sub task.

C. The Contractor shall notify the Engineer in writing of any deviation from the current Three-Week-Look-Ahead Schedule within 24 hours of identification of said deviation.

D. The Three-Week-Look-Ahead Schedules shall indicate inspections by the Engineer or by regulatory agencies and construction Work by the District forces or by other third parties that interface with the Work.

5.06.07. Payment

A. Contractor shall submit a Baseline Progress Schedule, detailed monthly Progress Schedule updates, and Recovery Schedules to the District. The schedules shall be favorably reviewed by the District before a pending payment request is approved.

B. Full compensation for furnishing, updating, revising, and submitting Detailed Progress Schedules and associated reports shall be considered as included in various Contract items of work; no additional payment shall be made.

C. Submittal and favorable review of Detailed Progress Schedules and their components that meet the requirements of Article 5.05. Progress Schedules in this Section is a condition precedent to making a payment request.

5.07. Temporary Suspension of Work

A. By written order to the Contractor, the Engineer may suspend the Work, wholly or in part, for an indefinite period or for such period as the Engineer may deem necessary, for any of the following reasons:

1. Weather conditions or other conditions that are unfavorable for the proper prosecution of the Work;

2. Failure of the Contractor to carry out orders given or to perform any provisions of the Contract; and

3. For the convenience and benefit of the District.

B. Such suspension shall be effective upon receipt by the Contractor of the written order suspending the Work and shall be terminated upon receipt by the Contractor of the written order terminating the suspension.

C. If the Engineer orders a suspension of all or of a portion of the Work that is on a critical path, pursuant to A.1 or A.3 in this Article, this shall be cause for a time extension if it impacts Milestone completion.

5.08. Liquidated Damages

A. If the Work is not finished or completed by the Milestone dates in the Contract, it is agreed that damage shall be sustained by the District and that it is and shall be impracticable and extremely difficult to ascertain and determine actual damage that the District will sustain. It is agreed that the Contractor shall pay to the District the sum(s) set forth in the Special Provisions. Liquidated Damages shall be assessed separately and independently.

B. The Contractor agrees to pay Liquidated Damages herein provided for, and further agrees that the District may deduct the amount thereof from any moneys due, or that may become due, to the Contractor under the Contract. Imposition of Liquidated Damages shall not preclude the District from taking other action as deemed appropriate to ensure performance of the Contract and shall not relieve the Contractor of its responsibility to comply with these Specifications.

SECTION 6. MEASUREMENT AND PAYMENT

6.01. Schedule of Values

6.01.01. Preparation

A. The Contractor shall develop the Schedule of Values (SOV) in the Baseline Progress Schedule.

B. Progress payments shall not be made until the SOV has received a favorable review by the Engineer.

C. Each schedule activity representing a component of lump-sum Bid items shall include a directly proportional amount of the Contractor's overhead and profit. The Contractor's overhead and profit shall be completely distributed among all schedule activities. The Contractor shall provide additional cost documentation to the Engineer when requested so that values can be verified.

D. The Contractor shall list and maintain separately on the SOV and on any Detailed Progress Schedule all values for items of Equipment that will be submitted for on-site Material payment. These Material items shall not be "progressed" as a part of the physical progress assessment.

E. The Contractor shall prepare a Cash Flow Summary and a corresponding Cash Flow "S" Curve indicating the total dollar amount of Work planned for each month of the Project and shall equate the sum of monthly amounts to the Total Bid Price.

6.01.02. Submittal

A. The Contractor shall submit to the Engineer the detailed SOV that conforms to Table 6-1 as part of its Baseline Progress Schedule and Detailed Progress Schedule Update submittals.

B. The SOV submittals shall include a Cash Flow Summary and a Cash Flow "S" Curve.

6.01.03. Revision

A. All construction Change Order authorizations shall be added to updated and revised Detailed Progress Schedules as cost-loaded activities and shall be coded to appropriate SOV line items. Additional cost documentation shall be provided to the Engineer when requested.

B. The Contractor shall not change the final approved SOV without the approval of the Engineer. The SOV has a one-to-one direct relationship to the list of activities on the Contractor's Progress Schedule. Additions or deletions of activities on the Contractor's Detailed Progress Schedules shall require line item additions or deletions in the SOV. Any revision to the SOV shall be submitted with the monthly Detailed Progress Schedule updates.

6.02. Application for Payment

A. Applications for payment shall be based upon actual progress as measured on the accepted Detailed Progress Schedules and as in the SOV.

6.02.01. Preparation

A. Measurement of Quantities and Percent Complete

1. All Work, except Work based on Time and Materials, shall be paid for at the Contract Price(s) per unit of measurement and shall be measured by the Engineer in accordance with the English system of measurement. Unless otherwise specifically provided, the Engineer shall compute quantities by a method that, in the Engineer's opinion, is best suited to obtain an accurate determination. The weights of metalwork, pipe, and other metal parts to be paid for on the basis of weight shall be determined by the Engineer. The District will not provide scales for weighing Material. The Engineer shall determine the weight of each part or item in the most practicable manner and shall use for that purpose manufacturer weights, or in their absence, catalog weights or estimated weights, in that order; weights of nonmetallic coatings shall be excluded.

2. Unless otherwise agreed to by the Engineer, progress payments shall be based on percent complete for each applicable cost-loaded schedule activity as determined by visual observation of the Project by the Contractor and by the Engineer on a monthly basis. The schedule activity shall be updated to reflect percent complete. The schedule shall roll up activities to an activity code for each SOV and for each Bid Item.

B. Inclusion of Material On-Site

1. Partial payments may be made by the District to the Contractor for Material and Equipment furnished and delivered to the Project site but not yet incorporated into the Work, at the District's sole discretion, and only if the Material and/or Equipment meet all of the following requirements:

a. Material and/or Equipment are fabricated and/or are manufactured goods or Equipment relatively unique to the Project.

b. The Contractor can transfer clear title to the District.

c. If the Contractor does not have Builder's Risk coverage, the Contractor shall, at no additional cost to the District, (i) insure the Material against theft, fire, loss, vandalism, and malicious mischief; (ii) name the District as additional insured; (iii) deliver this policy or certificate of this insurance to the District; and (iv) receive the District's acceptance of the policy or certificate of insurance. Insurance shall be specific to material and be separate from other insurance required by the Contract. Insurance shall not

be cancelable for at least 30 days; cancellation shall not be effective until certificate thereof is given to the District.

d. Submittals for the Material and/or Equipment have been favorably reviewed by the District.

e. The Material and/or Equipment have been delivered, identified as property of the District, and physically separated from other Material; protected, properly stored, and maintained at the site in accordance with manufacturer requirements.

2. Only the Contractor's actual cost for Material may be paid prior to inclusion in the Work. The Contractor's actual cost for the Material must be supported by Supplier invoices, proof of payment by the Contractor, and other supporting documentation warranting that the Contractor has received and owns the Material or Equipment free and clear of all liens, charges, security interests, and encumbrances.

3. Material delivered to the site fewer than 30 days prior to their scheduled incorporation shall not qualify for partial payment consideration.

4. Temporary construction material (e.g., shoring) do not qualify for partial payment.

5. Final payment shall be made only for Material or Equipment incorporated into the Work. Upon Acceptance of the Work, all Material remaining for which advance payments had been made shall revert to the Contractor, unless otherwise agreed; partial payments made for these items shall be deducted from the final payment for the Work.

6. Payment for Material on-site does not relieve the Contractor of its obligations pursuant to the Contract.

6.02.02. Submittal of Application for Payment

A. On the 25th of each month, the Contractor shall prepare and submit the application for payment to the District. Each progress pay request is to include payment for Work completed up to and including the 25th of the month. The basis for partial payments of lump sum or other unit Contract items shall be determined by agreement between the Engineer and the Contractor.

B. Each application for payment shall be transmitted under the signature of the responsible authorized representative of the Contractor.

C. The Contractor's properly submitted application for payment request and request for final payment shall include the following substantiating data:

1. Cover letter identifying:

   a. the Project name and Project number;
   b. application number and date; and
   c. a detailed list of enclosures.

2. Contractor monthly Progress Pay Estimate summary sheet:

   a. The pay request submitted by the Contractor shall contain a source document that provides backup information on how the estimate was prepared;

   b. A source document is defined as the basic document used to record or calculate quantities; and

   c. The source document must contain the appropriate Contract Bid Item, the location of the installation, the necessary measurement and/or calculations, and the name of the person preparing the document.

3. Request for payment that meets the criteria listed in 6.02.01.B. Inclusion of Materials On Site:

   a. This form requires a description of each specific Material, quantity, value, and submittal review status substantiating evidence of purchase and cost and a completed affidavit.

4. Certified weekly payroll(s) for the pay estimate period in accordance with the Contract Prevailing Wage requirements.

5. Small/Micro Business Enterprise Utilization Report, if required.

6. Favorably reviewed Detailed Progress Schedule update with Cash Flow Summary and Cash Flow "S" Curve.

7. Daily Extra Work Report Form signed by both the District inspector and by the Contractor's representative, if applicable.

8. Satisfactory evidence that the Engineer has approved the action taken to correct any Noncompliance Notices and a numbered copy of the noncompliance log.

9. Written acknowledgement by the Engineer that the as-built Drawings have been updated that month.

6.02.03. Review of Application for Payment

A. Upon receipt of a payment request, the District shall review the payment request for the purpose of determining that the payment request is a proper payment request. Any payment request determined not to be a proper payment request suitable for payment shall be returned to the Contractor no later than seven (7) days after receipt. A payment request returned pursuant to this paragraph shall be accompanied by a letter citing reasons why the payment request is not proper. The following are examples of an improper payment request:

1. The item of Work requested to be paid was not performed.

2. The Work being requested to be paid has already been paid in previous Progress Pay Estimates.

3. The Work performed and requested to be paid was not done in accordance with the Contract (noncompliance).

4. The quality of the finished product is unacceptable.

5. The source documentation is inaccurate.

6. The Daily Extra Work Reports are not properly filled out.

7. There is a failure to submit an approved SBE Utilization Report, if required.

8. There is a failure to submit any of the Substantiating Documentation in Article 6.02.02. Submittal of Application for Payment.

6.02.04. Payment

A. Payment for all items of Work at the unit or lump-sum price shall be considered as full compensation for furnishing all labor, Material, tools, Equipment, and incidentals necessary to complete the item of Work; no additional payment shall be made. Payment for items of Work called for in the Specifications or shown on the Drawings but that are not separately identified in the Proposal shall be compensated as part of the Bid price of one or more of the items that are listed; no additional payment shall be made.

B. Non-Waiver: No progress payment made to the Contractor or the Contractor's sureties shall constitute a waiver of the right to assess Liquidated Damages pursuant to the Contract Documents.

C. The District shall pay within 30 Days valid, undisputed amounts, less any retention, withholds required by law or allowed by this Contract.

D. If the District fails to make any progress payment within 30 Days after receipt of an undisputed and properly submitted payment request from the Contractor, the District shall pay interest to the Contractor equivalent to the legal rate set forth in the Code of Civil Procedure, Section 685.010, subdivision (a).

E. The number of Days available to the District to make a payment without incurring interest pursuant to this Section shall be reduced by the number of Days by which the District exceeds the seven (7)-Day return requirement set forth in Article 6.02.03. Review of application for payment, paragraph A.

F. Unless otherwise indicated in the Special Provisions, the District shall retain five (5) percent of the estimated value of Work done and five (5) percent of the value of the Material so estimated to have been furnished and delivered and unused as aforesaid and shall pay to the Contractor, while carrying on the Work, the balance not retained as aforesaid after deducting there from all previous payments and all sums to be kept or retained under the provisions of the Contract. No estimate or payment shall be required to be made when, in the judgment of the Engineer, the Work is not proceeding in accordance with the provisions of the Contract, or when, in the Engineer's judgment, the total value of the Work done since the last estimate amounts to less than $1,000. No estimate or payment shall be considered to be Acceptance of the Work. All progress estimates and payments shall be subject to correction in the final estimate.

G. Escrow in Lieu of Retention

1. At the request of the Contractor, the District shall permit the substitution of securities or certificates of deposit equivalent to the amount of any monies withheld by the District as above provided. The deposit shall, in that event, be with the District or with a State- or Federal-chartered bank in California as the escrow agent.

2. Alternatively, upon written request of the Contractor, the District shall make payments of the retention as it is earned directly to the escrow agent.

3. The Contractor shall bear the expense of the District and of the escrow agent in connection with the escrow deposit made.

4. Securities or certificates of deposit to be placed in escrow shall include those listed in Government Code Section 16430, bank or savings and loan certificates of deposit, interest-bearing demand deposit accounts, standby letters of credit, or any other security mutually agreed to by the Contractor and by the District. Unless otherwise permitted by the escrow agreement, securities or certificates of deposit to be placed in escrow shall be of a value at least equivalent to the amounts of retention to be paid to the Contractor pursuant to this Section.

5. When the District makes payment of retentions directly to the escrow agent, the Contractor may direct, subject to approval of the District, the investment of the payments into securities.

6. The Contractor shall enter into an escrow agreement satisfactory to the District; this Agreement shall be substantially similar to that specified in Public Contract Code Section 22300.

7. The Contractor shall obtain the written consent of the surety to the agreement.

6.02.05. Withholding From Payments

A. The District may, at its option and at any time, withhold progress payment(s) or retain from any amounts due the Contractor sums sufficient to cover for one (1) or more of the following reasons:

1. Stop-Payment Notice Claims filed pursuant to the Civil and Labor Code.

2. Contractor has failed to comply with State law prompt payment requirements with regard to payments to Subcontractors.

3. Third-party claims have been filed or there is reasonable evidence indicating probable filing of these claims.

4. Liquidated Damages due or expected.

5. The Contract sum has been reduced by Change Orders.

6. Damage has occurred to the District or to another Contractor.

7. The Engineer determines that:

a. the Work cannot be completed for the unpaid balance of the Contract sum;

b. if any Contractor's Detailed Progress Schedule forecasts inexcusable late completion, or if the District determines that the Work will not be completed within the Contract Time(s), and that the current unpaid balance and retention will not be adequate to cover actual or Liquidated Damages for the anticipated Delay;

c. the Contractor persistently fails to perform the Work in accordance with the Contract Documents;

d. the Contractor fails to submit timely Change Order cost proposal breakdowns and documentation in accordance with the Contract Documents;

e. the Contractor fails to timely submit the Preliminary Progress Schedules, or Detailed Progress Schedules, or any updates or revisions to those submittals, and reports in accordance with the Contract Documents;

f. the Contractor fails to maintain detailed, timely, updated as-built documents or closeout items;

g. the Contractor fails to submit certified payroll records in accordance with the Contract Documents and prevailing wage requirements;

h. the Contractor has not submitted an approved SBE utilization report;

i. the Contractor fails to submit a proper payment request in accordance with the Contract Documents;

j. the Contractor fails to comply with the submittal requirements requiring rereview of the submittal;

k. the Contractor fails to submit a fully compliant Quality Control Plan;

l. there has been material noncompliance with the insurance requirements; or

m. the Contractor fails to comply with any other requirements of the Contract Documents.

6.03. Final Payment

A. As soon as practicable after completion of the Work, the Engineer shall prepare in writing and furnish to the Contractor the final estimate of the quantities of Work done and all payments due as part of the Contract; this estimate will show deductions for prior payments and any other amounts to be retained or withheld as part of the Contract. The amount determined due, less the amount retained and/or withheld, shall be paid.

B. The retained amount will not be due or payable until 35 days after the filing of the Notice of Completion of Contract and Acceptance of Work, subject to any withholds required by law or by the Contract.

C. Prior to release of the retained amount, the Contractor shall furnish the District with a release of all Claims by the Contractor against the District arising by virtue of this Contract. The release of Claims may include disputed Contract Claims in stated amounts as the Contractor may specifically exclude from the operation of the release pursuant to acceptance of Final Payment.

Tesla Update 1 received 6/23/09 | Schedule of Values Detail - Chris Saldon | 07-Jul-09 13:19

Cost Account IDs	Activity ID	Activity Name	Original Duration	Start	Finish	Total Float	Budgeted Total Cost	Actual Total Cost	Cost % Complete
Total			809.5d	21-Oct-08 A	16-Dec-11	139.5d	$81,420,562.00	$15,995,442.65	19.61%
1.A.1.1			17.0d	10-Nov-08 A	10-Dec-08 A		$1,120,000.00	$1,120,000.00	100%
1.A.1.1	P101040130	30% DESIGN	15.0d	10-Nov-08 A	10-Dec-08 A		$1,120,000.00	$1,120,000.00	100%
1.A.1.2			30.0d	11-Dec-08 A	23-Feb-09 A		$2,140,000.00	$2,140,000.00	100%
1.A.1.2	P101040150	60% DESIGN	30.0d	11-Dec-08 A	23-Feb-09 A		$2,140,000.00	$2,140,000.00	100%
1.A.1.3			87.1d	11-Dec-08 A	28-May-09 A		$1,240,000.00	$878,500.00	70.85%
1.A.1.3	P101040160	SITE CIVIL DESIGN 90%	30.0d	11-Dec-08 A	23-Feb-09 A		$0.00	$0.00	0%
1.A.1.3	P101040190	ARCHITECTURAL 90%	30.0d	11-Dec-08 A	23-Feb-09 A		$0.00	$0.00	0%
1.A.1.3	P101040250	90% DESIGN	48.0d	24-Feb-09 A	28-May-09 A		$1,240,000.00	$878,500.00	70.85%
1.A.1.4			30.0d	10-Nov-08 A	19-Dec-08 A		$100,000.00	$82,190.23	82.19%
1.A.1.4	P101040100	ONSITE GEOTECHNICAL INVESTIG...	28.0d	10-Nov-08 A	19-Dec-08 A		$100,000.00	$82,190.23	82.19%
1.A.1.5			17.0d	10-Nov-08 A	28-Nov-08 A		$25,000.00	$25,000.00	100%
1.A.1.5	P101040110	POTHOLE RESULTS & SITE SURVE...	15.0d	10-Nov-08 A	28-Nov-08 A		$25,000.00	$25,000.00	100%
1.A.2.1			63.0d	01-Jun-09	26-Aug-09	253.0d	$2,824,000.00	$0.00	0%
1.A.2.1	2A01040100	100% DESIGN	35.0d	01-Jun-09	20-Jul-09	48.0d	$2,500,000.00	$0.00	0%
1.A.2.1	2A01040120	ADDRESS REVIEW COMMENTS & ...	5.0d	20-Aug-09	26-Aug-09	244.0d	$324,000.00	$0.00	0%
1.B.1.1			326.0d	21-Oct-08 A	30-Nov-09	9.0d	$2,217,000.00	$2,155,000.00	49.3%
1.B.1.1	SU02574100	SUBMIT STEEL PIPE & FABRICATE...	0.0d	21-Oct-08 A			$1,000.00	$1,000.00	0.05%
1.B.1.1	SU02574110	SUBMIT STEEL PIPE FABRICATION...	5.0d	03-Dec-08 A	17-Dec-08 A		$1,000.00	$972.00	97.2%
1.B.1.1	PR02574100	PROCURE 144" & 84" HEADERS (S....	115.0d	08-Nov-08 A	18-Jun-09	10.0d	$959,481.00	$932,598.09	97.2%
1.B.1.1	PR02574110	PROCURE 120" & 144" PIPE (S.D. - ...	149.0d	08-Nov-08 A	29-Sep-09	4.0d	$491,674.00	$477,907.13	97.2%
1.B.1.1	PR02574120	PROCURE INLET & OUTLET TIE-IN...	231.0d	08-Nov-08 A	30-Nov-09	9.0d	$296,578.00	$288,245.78	97.19%
1.B.1.1	PR02574130	PROCURE 48" BRANCH PIPING (S....	110.0d	08-Nov-08 A	18-Jun-09	38.0d	$467,287.00	$454,279.00	97.22%
1.B.1.10			0.0d	10-Nov-08 A	10-Nov-08 A		$2,594,444.00	$1,026,157.00	39.55%
1.B.1.10	P101040120	BONDS & INSURANCE	0.0d		10-Nov-08 A		$2,594,444.00	$1,026,157.00	39.55%
1.B.1.2			253.0d	03-Nov-08 A	30-Sep-09	8.5d	$757,077.00	$757,077.00	100%
1.B.1.2	SU15100100	SUBMIT 84" & 144" VALVES (S.D. - ...	5.0d	03-Nov-08 A	12-Nov-08 A		$1,000.00	$1,000.00	100%
1.B.1.2	PR15100100	PROCURE 84" VALVES (S.D. - REQ...	149.0d	08-Jan-09 A	29-Sep-09	4.0d	$251,773.00	$251,773.00	100%
1.B.1.2	PR15100110	PROCURE 144" VALVES (S.D. - RE...	185.0d	25-Nov-08 A	30-Sep-09	8.5d	$504,304.00	$504,304.00	100%
1.B.1.3			202.0d	10-Dec-08 A	15-Jan-10	0.6d	$1,102,273.00	$1,051,281.00	95.37%
1.B.1.3	SU15100110	SUBMIT DeZURIK VALVES (S.D. - R...	5.0d	10-Dec-08 A	15-Dec-08 A		$1,000.00	$1,000.00	100%
1.B.1.3	PR15100120	PROCURE 48" DeZURIK VALVES (S....	150.0d	02-Mar-09 A	15-Jan-10	-25.4d	$550,636.00	$525,306.74	95.4%
1.B.1.3	PR15100130	PROCURE 90",78", 66" & 60" DeZUR...	158.0d	02-Mar-09 A	21-Aug-09	100.5d	$550,637.00	$524,974.26	95.34%
1.B.1.4			265.0d	13-Mar-09 A	05-Apr-10	67.0d	$307,500.00	$0.00	0%
1.B.1.4	SU11286100	SUBMIT CO2 SYSTEM	10.0d	13-Mar-09 A	08-Oct-09	65.0d	$1,000.00	$0.00	0%
1.B.1.4	PR11286100	PROCURE CO2 SYSTEM	110.0d	26-Oct-09	05-Apr-10	65.0d	$306,500.00	$0.00	0%
1.B.1.5			102.0d	29-Sep-09	18-Feb-10	44.5d	$109,680.00	$0.00	0%
1.B.1.5	SU11241100	SUBMIT CHEMICAL TANKS	5.0d	29-Sep-09	06-Oct-09	44.5d	$1,000.00	$0.00	0%
1.B.1.5	PR11241100	PROCURE CHEMICAL TANKS	80.0d	21-Oct-09	18-Feb-10	44.5d	$108,680.00	$0.00	0%
1.B.1.6			244.0d	01-Jun-09	06-May-10	49.0d	$1,289,099.00	$184,500.00	14.31%
1.B.1.6	SU16260100	SUBMIT EMERGENCY GENERATO...	5.0d	01-Jun-09	05-Jun-09	47.0d	$1,000.00	$1,000.00	100%
1.B.1.6	PR16260100	PROCURE EMERGENCY GENERAT...	220.0d	23-Jun-09	06-May-10	47.0d	$1,288,099.00	$183,500.00	14.25%
1.B.1.7			269.0d	23-Dec-08 A	15-Jan-10	-27.4d	$75,805.00	$75,805.00	100%
1.B.1.7	SU13420100	SUBMIT 48-IN MAG METERS (S.D. - ...	5.0d	23-Dec-08 A	26-Dec-08 A		$1,000.00	$1,000.00	100%
1.B.1.7	PR13420100	PROCURE 48-IN MAG METERS (S.D...	200.0d	19-Jan-09 A	15-Jan-10	-25.4d	$74,805.00	$74,805.00	100%
1.B.1.8			117.0d	11-Sep-09	23-Feb-10	53.5d	$128,925.00	$0.00	0%
1.B.1.8	SU11240100	SUBMIT CHEMICAL METERING PU...	5.0d	11-Sep-09	18-Sep-09	53.5d	$1,000.00	$0.00	0%
1.B.1.8	PR11240100	PROCURE CHEMICAL METERING P...	95.0d	05-Oct-09	23-Feb-10	53.5d	$127,925.00	$0.00	0%
1.B.1.9			143.0d	06-Aug-09	23-Feb-10	53.5d	$15,750.00	$0.00	0%
1.B.1.9	SU11247100	SUBMIT CHEMICAL TRANSFER PU...	5.0d	06-Aug-09	13-Aug-09	53.5d	$1,000.00	$0.00	0%
1.B.1.9	PR11247100	PROCURE CHEMICAL TRANSFER P...	120.0d	28-Aug-09	23-Feb-10	53.5d	$14,750.00	$0.00	0%
1.B.2.1.1			357.5d	21-Apr-09 A	03-Nov-10	38.5d	$1,289,346.00	$99,175.00	7.81%
1.B.2.1.1	SW02900100	PLANT TREES & TEMP IRR. SYSTEM	15.0d	08-Oct-10	27-Oct-10	34.5d	$90,000.00	$0.00	0%
1.B.2.1.1	SW02900110	HYDROSEED	4.0d	27-Oct-10	03-Nov-10	34.5d	$16,000.00	$0.00	0%
1.B.2.1.1	SW02200110	PREP ROAD SUBGRADE	10.0d	20-Jul-10	03-Aug-10	34.5d	$155,000.00	$0.00	0%
1.B.2.1.1	SW02520100	CONSTRUCT ROADS TO TOP OF S...	15.0d	17-Aug-10	08-Sep-10	54.5d	$167,500.00	$0.00	0%
1.B.2.1.1	SW02770100	CURBS & GUTTERS	15.0d	03-Aug-10	24-Aug-10	54.5d	$87,446.00	$0.00	0%
1.B.2.1.1	SW02510110	PAVE ROADS	10.0d	31-Aug-10	15-Sep-10	68.5d	$161,331.75	$0.00	0%
1.B.2.1.1	SW01500120	RELOCATE DSL LINE (S.D. - REQUI...	15.0d	21-Apr-09 A	11-May-09 A		$14,900.00	$14,900.00	100%

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TABLE 6-1. SCHEDULE OF VALUES SAMPLE

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SECTION 7. SUBMITTAL MANAGEMENT

7.01. Submittal Requirements

A. This Article includes requirements and procedures for preparing and submitting submittals and other information required by the Contract Documents.

B. Drawings listed in the Specifications shall be supplemented by the Contractor with the submittals required throughout the Contract Documents for the prosecution of the Work and for approval of Equipment. Submittals may include shop detail Drawings, fabrication Drawings, falsework and formwork Drawings, pipe layouts, and similar classes of Drawings, calculations, specifications, product data, samples, manuals, spare parts, photographs, survey data, schedules, or similar items required to be submitted to the Engineer by the Contract Documents.

C. These submittals shall be favorably reviewed by the Engineer before any Work involving these submittals is performed. No change shall be made by the Contractor to any submittal after it has been favorably reviewed by the Engineer.

D. Submittals shall contain all required, detailed information at a reasonable scale with enough views to clearly show the Work to be done or the item to be furnished and shall be properly checked.

7.02. Master Submittal List

A. Within 30 Days of the First Chargeable Day of the Contract as specified in the NTP and monthly thereafter, the Contractor shall submit an electronic copy of the Master Submittal List to the Engineer. This list shall be in Microsoft Excel spreadsheet format and shall identify all originally planned submittals. The purpose of this list is to assist in planning for submittal creation and review and to provide a monthly update of submittal review status. Items on this list shall be sorted by Specifications Number and shall include, at a minimum, the following information:

1. Item number.

2. Reference Specification Section number and paragraph.

3. Description of submittal.

4. Type of submittal (e.g., Shop Drawing, catalog, sample, certificate, test data, manual, other).

5. Original preparer of the submittal to include preparer's name, firm name, telephone number, and email address.

6. Estimated date for submission to the Engineer by the Contractor. Dates shall be coordinated with the Contractor's Progress Schedules to ensure sufficient time is allowed for processing submittals and for procurement of

Material prior to the start of a construction activity. The Contractor shall include submittals as activities in the Detailed Progress Schedules.

7. Actual date sent by the Contractor to the District.

8. Actual date returned by the District to the Contractor.

9. Submittal status.

B. The Contractor shall identify in the master submittal list the submittals that may require long-lead times for manufacturing and/or for delivery and that must be submitted early to the Engineer for review.

7.03. Timing of Submittals

A. The Contractor shall make submittals promptly in accordance with the accepted Detailed Progress Schedules and in such sequence as to cause no Delay in the Work. The time allowed by the Contractor for submittal review shall also provide sufficient time for disapproval and resubmission.

B. The sequence of submission of submittals shall be such that all information is available to the Engineer for review of each submittal as it is received. The Contractor is responsible for furnishing submittals in sufficient time for approval action, including resubmittal, without delaying construction.

7.04. Submittal Format

A. One (1) electronic copy and five (5) paper copies of each submittal shall be submitted.

B. All submittals shall be clearly identified by reference to the Project name, Specification Section, Article, paragraph, Drawing number, or detail as applicable. Submittals shall be well organized, clear, and legible, and of sufficient size for clear presentation of the data. Data submitted shall describe the Materials, Equipment, or other items to be furnished, and where applicable, the system in sufficient detail to indicate full compliance with the requirements of these Contract Documents. Data shall consist of complete Materials and Equipment lists accompanied by catalog data sheets, cuts, performance curves, diagrams, or similar descriptive materials. Materials and Equipment lists shall give, in each case, the name of the manufacturer, trade name, catalog reference, size, finish, and all other pertinent data.

C. All submittals shall be in the English language and per the customary Imperial System units of measure and weight (i.e., feet, inches, pounds, degrees in Fahrenheit, etc.). Metric units may be provided in addition to the customary Imperial System units of measure and weight.

D. All submittals and supporting data, catalogs, schedules, etc., shall be submitted as the instruments of the Contractor, who shall be responsible for their accuracy, completeness, coordination, and conformance with the Contract Documents. These submittals may be prepared by the Contractor, Subcontractors, or Suppliers; the Contractor shall review and ascertain that submittals meet all of the requirements of the Contract Documents while conforming to structural, space, and access conditions at the point of installation prior to submission to the Engineer. Designation of Work "by others" if shown in submittals shall mean that the Work shall be the responsibility of the Contractor rather than of the Subcontractor or of the Supplier who prepared these submittals. The Contractor shall ensure that there is no conflict with other submittals. The Contractor shall ensure coordination of submittals among the related crafts and Subcontractors.

E. If the submittals show any deviations from the Contract requirements, the Contractor shall include with the submittal a separate written description of such deviations and the reasons therefore. If any deviations from the Contract requirements are not clearly noted and prominently identified on the submittal, the review of the submittal shall not constitute acceptance of such deviations.

F. The Contractor shall review all submittals before submitting them to the Engineer and shall certify on each transmittal letter and on each submittal that the submittal has been checked, is in compliance with the Contract Documents except as specifically noted, and that each deviation from the Contract Documents is specifically noted.

G. Submittals shall include the following:

1. A separate transmittal form shall be used for each specific item, class of Material, Equipment, and items specified in separate, discrete Specification Section or Article, for which a submittal is required. Submittal documents common to more than one (1) piece of Equipment shall be identified with all appropriate Equipment numbers. Submittals for various items shall be made with a single form when the items taken together constitute a manufacturer's package or are so functionally related that expediency indicates checking or reviewing the group or package as a whole. The Specification Section or Article to which the submittal is related shall be indicated on the transmittal form.

2. A sequential number in chronological order shall be assigned for each submittal and shall be noted on the transmittal form. Submittal numbers shall have the following format: XXX.Y, where XXX is the sequential number (001 to 999) assigned by the Contractor; and Y is the re-submittal number (0 to 9). For each item submitted, the Contractor shall include the applicable Specification number on the submittal and on the transmittal form.

3. A separate written description of deviations from the Contract Documents, if any.

4. The date of submission and the dates of any previous submissions.

5. The District's name and the Project title and number.

6. Contractor identification.

7. The names of the following (as applicable):

   a. Subcontractor
   b. Supplier
   c. Manufacturer

8. Identification of the product with the Specification Section or Article number, page, and paragraph(s).

9. Field dimensions clearly identified as such.

10. Relation to adjacent or critical features of the Work or Material.

11. Applicable standards (e.g., ASTM).

12. Identification of revisions on resubmittals.

7.05. Submittals to be Furnished by the Contractor

A. Shop Drawings

1. Shop Drawings include, but are not necessarily limited to, custom prepared data (e.g., fabrication on erection/installation [working] Drawings, scheduled information, setting diagrams, actual shop work manufacturing instructions, custom templates, special wiring diagrams, coordination Drawings, individual system or Equipment inspection and test reports), including performance curves and certifications, as applicable to the Work.

2. Submittal of shop Drawings by simply annotating copies of the Contract Drawings is subject to rejection.

B. Product Data

1. Product data as specified in the individual Section or Article, includes, but is not necessarily limited to, standard, prepared data for manufactured products (sometimes referred to as catalog data or "cuts"), such as the manufacturer's product specification and installation instructions, availability of colors and patterns, manufacturer's printed statements of compliance and applicability, roughing in diagrams and templates, product photographs, standard wiring diagrams, printed performance curves and operational range diagrams, production or quality control inspection and test reports and certifications, mill reports, product

operating and maintenance instructions, recommended spare parts listing, and printed product warranties, as applicable to the Work.

C. Samples

1. Samples specified in individual Sections or Articles, include, but are not necessarily limited to, physical examples of the Work, such as sections of manufactured or fabricated work, small cuts or containers of Material, complete units of repetitively used products, color/texture/pattern swatches and range sets, specimens of coordination of visual effects, graphic symbols and units of work to be used by the Engineer or by others for independent inspection and testing, as applicable to the Work.

D. Concrete Reinforcement Submittals

1. Submittals for concrete reinforcement shall not simply be annotated copies of the Contract Drawings. New scale Drawings shall be prepared showing plans, all vertical structure elevations, sections, and details as required to clearly delineate the reinforcing to be furnished and installed. Submittals shall show and tabulate reinforcement dimensions, sizes, grades, shapes, splices, laps, splice locations, dowel lengths, and all similar information needed for construction, material takeoffs, and Engineer's review to determine compliance with the structural design. Submittals shall show reinforcement dimensioning and placement that reflect the Contractor's intended and approved concrete placement sequence.

E. Electrical and Instrumentation Equipment Submittals

1. Submittals as described herein shall be provided for all electrical and instrumentation Equipment and systems furnished as part of products and systems specified in these Specifications. These submittals shall include, but are not necessarily limited to, the following:

a. An Equipment list tabulating all components furnished, followed by the manufacturer's name, manufacturer's model number, and a cross-reference to its location on the submittals.

b. A complete conduit riser diagram and conduit schedule shall be prepared and submitted for the interconnection of all electrically powered Equipment. The riser diagram and conduit schedule shall detail conduit identification numbers as shown on the Drawings, as well as size, wires, and location. Where the riser diagram requires either more wires or larger conduits than detailed in the Drawings, the Contractor shall coordinate any required changes with the electrical Subcontractor, if any, before installation begins.

c. Interior and exterior panel elevation Drawings for all panels, consoles, and Equipment enclosures. The elevations shall be

drawn to scale and shall detail all Equipment in or on the panel. Nameplates, conduit access locations, mounting provisions, panel construction details, manufacturer's model number, and panel color (or color samples) shall be included.

d. Drawings and descriptive data and brochures of each item of Equipment. Electrical characteristics and requirements, enclosure types, manufacturer, and model number shall be included. Sheets or Drawings showing more than the particular item under consideration shall have crossed out all but the description of the item for which the review is requested.

e. Schematics and connection diagrams. A manufacturer's standard connection diagram or schematic showing more than one (1) scheme of connection shall not be accepted unless it is clearly marked to show the intended, work specific connections; terminal numbers shall be included. A written operation theory shall be included for all complex control schemes.

2. For each instrument furnished with mechanical systems, submittals shall include an Instrumentation, Systems, and Automation Society (ISA) S20 Data Sheet and technical bulletins or brochures. The summary data sheets and the technical bulletins shall include, but shall not necessarily be limited to, the following:

a. tag numbers per the Process and Instrumentation Drawings;

b. the manufacturer's model or other ordering designation;

c. product (item) names used on the Drawings;

d. physical location where installed;

e. input output characteristics;

f. range, size, and graduations as required;

g. physical size with dimensions and mounting details;

h. quantity and quality requirements for electric power, air, and/or water supply;

i. Materials in contact with or otherwise exposed to the process;

j. certified calibration and/or calibration curves where applicable; and

k. Detailed Instrumentation, Systems, and Automation Society (ISA) loop wiring diagrams showing requirements for each instrument that is furnished under this Section. The diagram shall identify all

device terminal points, as well as any intermediate terminal blocks. Power supplies, loop grounds, wire/cable number, etc., shall be detailed. Such loop wiring diagrams shall be prepared per ANSI/ISA S5.4. Optional items 1, 3, 4, 6, and 7 from paragraph 5.3 of S5.4 are also required. Note that the District loop numbering protocol used in these documents and required for submittals does not comply with ISA standards.

3. Submittal of motor data for acceptance shall include complete nameplate data in accordance with NEMA Standards and, in addition, the following information for motors typical of the units furnished:

   a. Ambient temperature setting
   b. Service factor
   c. Efficiency at ½, ¾, and full load
   d. Power factor at ½, ¾, and full load
   e. Motor outline, dimensions, and weight
   f. Descriptive bulletins, including full description of insulation system
   g. Bearing design data
   h. Special features (i.e., space heaters, temperature detectors, etc.)

7.06. Submittal Review Procedures

A. Review of submittals has as its primary objective the completion of the Work in full conformance with the Contract Documents, unmarred by field corrections and within the construction time provided. In addition to this primary objective, submittal review as a secondary objective shall assist the Contractor in its procurement of Equipment that shall meet all requirements of the Contract Documents; shall fit the structures detailed on the Drawings; shall be completed with respect to piping, electrical, and control connections; shall have the proper functional characteristics; and shall become an integral part of a complete operating facility.

B. For submittals that require the Engineer's review, one (1) copy shall be returned to the Contractor within 20 Days after receipt. The Contractor shall make any necessary corrections and revisions to the returned submittals and shall resubmit the submittals within 20 Days after receipt. The Contractor is responsible for furnishing submittals in sufficient time for approval action, including resubmittal without delaying construction.

C. The Contractor shall be solely responsible for agreement and conformity of submittals with the Contract Drawings and with the Specifications. The review of submittals shall be for general conformance with the design concept and with the Contract Documents. It is expressly understood that the Engineer's review of the Contractor's submittals shall not relieve the Contractor of any responsibility for:

   1. accuracy of dimensions and details;
   2. coordinating the Work with all other associated Work and trades;
   3. selecting fabrication processes;

4. techniques of assembly;
5. departing from details furnished by the Engineer;
6. its obligation to meet safety requirements;
7. its obligation to meet all other requirements of laws;
8. compliance with the Contract requirements; and
9. errors, including details, dimensions, and Material.

D. Favorable review of all submittals (returned “No Exceptions Noted” “In Receipt of” or “Make Corrections as Noted”) shall apply in general design only and shall in no way relieve the Contractor of responsibility for errors or omissions contained therein. Favorable review shall not relieve the Contractor of its obligations to meet safety requirements and all other requirements of laws nor shall it constitute a Change Order authorization. Favorable review shall not constitute acceptance by the District of any responsibility for the accuracy, coordination, and completeness of the submittals or for the items of Equipment represented on the submittals, nor shall it constitute a Change Order authorization.

E. If the Contractor submits an incomplete or disorganized submittal, the submittal shall be considered “Rejected” and shall be returned to the Contractor without review. The Engineer may, at its sole discretion, elect to provide a list of, or mark the submittal indicating some or all of, the areas that are incomplete. A complete submittal shall contain sufficient data to demonstrate that items comply with the Contract Documents; shall meet the minimum requirements for submissions cited in the Technical Specifications; and shall include any necessary revisions required for Equipment other than the first named manufacturer. The Engineer’s determination of whether a submittal is complete shall be final. The District reserves the right to return a submittal that requires coordination with another or other submittals not yet received by the District.

F. After review by the Engineer of each of the Contractor’s submissions, the submittal shall be returned to the Contractor with actions defined as follows:

1. No Exceptions Noted: The favorable review of a submittal is subject to its compatibility with future submissions and with additional partial submissions for portions of the Work not covered in this submission. It does not constitute approval or deletion of specified or required items not shown in the partial submission. The Contractor may proceed with the Work shown in the submittal.

2. Make Corrections As Noted: Same as 1 except that minor corrections as noted shall be made by the Contractor. The Contractor may proceed with the Work, providing corrections have been made; resubmission is not required.

3. Revise and Resubmit: Rejected because of inconsistencies or errors that shall be resolved or corrected by the Contractor prior to subsequent resubmission. The Contractor may not proceed with the Work shown in the submittal.

4. Rejected: Submitted material does not conform to Drawings and Specifications in major respects (i.e., wrong size, model, capacity, or material). The Contractor may not proceed with the Work shown in the submittal.

5. In Receipt Of: Receipt of submittal is acknowledged by the Engineer.

G. Resubmittals shall be processed in the same manner as first submittals. On resubmittals, the Contractor shall direct specific attention, in writing on the letter of transmittal and on resubmitted shop Drawings by use of revision triangles or other similar methods, to revisions from previous submissions. Any such revisions that are not clearly identified shall be made at the risk of the Contractor. If any such revisions are installed, all portions thereof that do not fully conform to the Contract Documents shall be corrected by the Contractor at its expense and as required by the Engineer.

H. The favorable review of submittals (returned “No Exceptions Noted” or “Make Corrections as Noted”) shall be obtained from the Engineer prior to the fabrication, delivery, and construction of items requiring submittals.

I. All resubmittals shall be accompanied by a memorandum or letter from the Contractor that responds to each written review comment provided by the Engineer in the previous submittal. Each response shall describe the corrective action taken or reason for the Contractor’s actions.

J. The Contractor shall make a complete and acceptable submittal to the Engineer at least by the second submission. If a returned submittal is required to be resubmitted more than once due to the Contractor’s failure to comply with submittal requirements, the Contractor may be charged all costs associated with rereview of the submittal. The charges may be deducted from a progress payment due, or that will become due, to the Contractor and shall be based on actual review hours recorded by the Engineer, District staff, and by the Engineer’s consultants, multiplied by their actual, fully burdened labor rates.

7.07. Substitutions

A. Substitutions are considered changes to the Contract. If Materials, Equipment, item, means, method, technique, sequence, or procedure of construction is required by the Contract Documents, the Contractor may furnish or utilize a substitute item, means, method, sequence, technique, or procedure of construction acceptable to the Engineer, unless identified as a sole/single-source item. Substitutions shall be formally submitted as a Request for Substitution. The Contractor must submit sufficient information to allow the Engineer to determine whether the substitution proposed is equivalent to that indicated or as required by the Contract Documents.

B. The Engineer shall respond in writing to the Contractor within ten (10) Days indicating the time necessary to evaluate each proposed substitution.

C. The Engineer shall be the sole judge in this matter. In the event the Engineer rejects the proposed items, the Contractor shall submit the Specified Items.

D. No substation shall be ordered, installed, or utilized without the Engineer's prior written acceptance, which shall be evidenced by either a favorably reviewed Request for Substitution, Change Order, or by a DCO. The District may require the Contractor to furnish, at the Contractor's expense, a special performance guarantee with respect to any approved substitution.

E. The Engineer shall record time required by the Engineer, District staff, and by the Engineer's consultants to evaluate substitutions proposed by the Contractor and to make changes in the Contract Documents occasioned thereby. Regardless of whether or not the Engineer accepts a proposed substitution, the Contractor shall reimburse the District for the charges of the Engineer and for the Engineer's consultants for evaluating each proposed substitution.

F. Cost or time impacts to other items of Work that are caused by any Contractor-initiated Request for Substitution, whether anticipated or unforeseen, shall be the responsibility of the Contractor.

G. Request for Substitution: Submission of items that are proposed as equivalent to any other item, means, method, sequence, technique, or procedure of construction shall be evaluated in accordance with the provisions outlined below. Burden of proof as to the submitted items being equivalent to the items required by the Contract Documents is the responsibility of the Contractor.

1. All provisions and evaluation criteria under Article 7.08. "Or Equal" Items, paragraph E in this Article shall apply to the proposed substitutions.

2. No submission of proposed substitutions shall be accepted or considered by the Engineer prior to Contract award.

3. Other additional provisions and/or criteria as deemed necessary by the Engineer.

4. Substitution(s) of Specified Item(s) item, means, method, sequence, technique, or procedure of construction proposed by the Contractor may require modifications in the Project design, Project schedule, and/or in the construction sequencing. The Contractor shall identify all necessary Project modifications required for the substitution(s). Necessary Project modifications may include, but may not be limited to, electrical, instrumentation, structural, mechanical, architectural, testing, engineering costs, and other related modifications.

5. The Contractor shall be responsible for all costs associated with the substitution(s), including submittal reviews and any Project redesign and modification. Contractor refusal to accept any of these costs shall be just cause for disapproval of the substitution(s).

6. If the proposed items are accepted, 50 percent of all savings shall be credited to the District. Total cost savings shall be less any design costs required for substitution(s) implementation.

7.08. "Or Equal" Items

A. Specified Item: Materials, Equipment, product, thing, or service referenced in the Contract Documents that has been identified by one (1) or more specific brand, manufacturer, Supplier, company, catalog number, or trade name. Whenever such designations shall be deemed to be used for the purpose of facilitating the description of the Specified Item and shall be deemed to be followed by the words "Or Approved Equal," whether explicitly stated or not, unless specifically noted to the contrary, in these instances, the Contractor may presume the specific brands are the only product known to the District that meet the requirements of the Contract Documents; the Contractor may propose the provision of Materials or Equipment that are equal to the Specified Item.

B. Equal Item: Item as referenced in these Contract Documents are those that, to the Engineer's knowledge, meet the requirements of the Contract Documents and are considered equal to the Specified Items.

C. The Contractor shall submit sufficient data, Drawings, samples, literature, calculations, and all other information as requested by the District to demonstrate to the Engineer that the proposed items are equal to the Specified Items.

D. Failure of the Contractor to submit the proposed Equal Item for review in the manner and time described in this Article shall be sufficient cause for rejection by the Engineer of the proposed Equal Item.

E. The Engineer's evaluation of the submitted items proposed as being equivalent to the Specified Items is based on, but is not limited to, the following:

1. Performance.
2. Functionality and efficiency.
3. Durability.
4. Life cycle costs.
5. Ease and economy of maintenance and operation.
6. Construction and physical characteristics as compared to the Specified Items or as delineated in the Contract Documents.
7. Dimensional compatibility with the Material it combined to produce a unified design system.
8. Compatibility with products in use.

9. All aspects of finished appearance, including form, texture, and color, that may affect other design elements.

10. Impacts to Project design, construction schedule, or construction sequencing.

F. The Engineer shall be the sole judge in this matter. In the event the Engineer rejects the proposed items, the Contractor shall submit the Specified Items.

G. The Contractor shall submit to the Engineer, in accordance with Public Contract Code Section 3400, after Contract award, no later than 35 Days after the date of NTP, a proposal for replacing a specified item with an equal item. At the sole discretion of the Engineer, the District may give written consent to the submission of the proposed Equivalent Item after the expiration of a 35-Day time limit.

7.09. Sole/Single Source

A. No substitution of designated Sole/Single Source items listed in the Contract Documents shall be allowed.

B. Wherever the District has made a finding and specified in the Contract Documents that a Sole/Single Source is required for one (1) or more of the listed reasons stated in the Public Contract Code Section 3400(c), the Material or Equipment specification shall list only one (1) manufacturer, catalog number, or trade name, followed by the designation “No Equal,” “No Others Acceptable,” “No Alternatives Allowed,” “No Other Manufacturers Accepted,” and/or similar language.

SECTION 8. SAFETY AND SECURITY MANAGEMENT

8.01. Public Safety

A. The Contractor shall be solely and completely responsible for conditions of the job site, including safety of all persons and property during the performance of the Work, except from the District's sole negligence or intentional misconduct. The Contractor's compliance with this requirement is not limited to normal working hours.

B. At all times, the Contractor shall provide for public safety and convenience. The Contractor's operations shall be conducted so as to offer the least possible obstruction and inconvenience to the public along with the greatest safety to the public. At no time shall the Contractor have more Work underway than can be prosecuted with proper regard to these considerations to the public.

C. At all times, the Contractor shall provide sufficient measures, such as, but not limited to, fences, barriers, barricades, railings, lights, signs, and any other warning devices and shall provide flagging and guards as are necessary to give adequate warning of any dangerous condition to the public and to reasonably and prudently provide for the greatest public safety and convenience. The Contractor shall comply with all reasonable requirements of the Engineer or public agency having jurisdiction in interpreting this subparagraph.

8.02. Accident Prevention

A. The Contractor is hereby informed that Work on this Project could be hazardous. The Contractor shall instruct all personnel working in potentially hazardous work areas of the potential dangers and shall provide safety Equipment and instruction as is necessary to prevent injury to personnel and damage to property. Special care shall be exercised relative to Work around high-voltage wires, high-pressure gas mains, high-pressure water pipelines, and other utilities. Temporary supports, as required by the utility company, shall be provided by the Contractor to protect utility facilities.

B. The Contractor shall strictly comply with all applicable City, County, and State Rules, Ordinances, Regulations, and Codes, including, but not limited to, CAL OSHA Labor Code Section 6300 et seq. and California Code of Regulations Title 8, Chapter 4. Nothing in these Specifications shall be construed to permit Work not conforming to governing Codes. When Contract Documents differ from governing Codes, the Contractor shall furnish and install the higher standards called for without additional charge. The Contractor shall also take, or cause to be taken, additional measures as may be necessary for the prevention of accidents.

C. The Contractor shall maintain an accurate record of, and shall report to the Engineer in writing, exposure data and all accidents resulting in death, traumatic injury, occupational disease, or damage to property, Material, supplies, or Equipment incident to Work performed under the Contract.

D. If the Engineer notifies the Contractor of any noncompliance with the foregoing provisions, the Contractor shall, after receipt of this notice, immediately take corrective action. If the Contractor fails or refuses to comply immediately, the matter may be referred to the proper authority. No part of the time lost due to any stop order issued by a proper authority shall be made the subject of a Claim for extension of time or for extra costs or damages by the Contractor.

E. Compliance by Subcontractors with the provisions of this Article shall be the responsibility of the Contractor.

8.03. Explosives and Stream Pollution

A. When the use of explosives is necessary for the prosecution of the Work, the Contractor shall not endanger life or property.

B. The Contractor must obtain and comply with permit(s) from all regulatory agencies for the storage and use of explosives.

C. The Contractor must obtain a permit from the California Department of Fish and Wildlife, if required, in advance of the use of underwater explosives. The Contractor shall comply with all applicable requirements of the Fish and Game Code relating to stream pollution, particularly Section 5650.

8.04. Fires

A. The Contractor must obtain and comply with the permit(s) from all regulatory agencies, including from the Bay Area Air Quality Management District (BAAQMD) if required, for fire-related activities.

8.05. Excavation Safety Plans

A. In accordance with Labor Code Section 6705, Miscellaneous safety Provisions, excavations five (5) feet or more in depth shall not begin until the Contractor has submitted, and the Engineer has returned indicating “In Receipt Of,” the Contractor’s detailed plan for worker protection from the hazards of caving ground during these excavations. The plan may be reviewed by the Engineer for completeness in accordance with Federal, State, and local regulations. The Engineer shall not be responsible for reviewing the accuracy of assumptions, data and information used, and procedures contained in the plan, or for the adequacy thereof. The plan shall show the details of the design of shoring, bracing, sloping, or other provisions to be made for worker protection during the excavations. The plan shall not allow the use of shoring, sloping, or a protective system less effective than that required by the Construction safety Orders. If the plan varies from the shoring system standards established by the Construction safety Orders, the plan (including calculations) shall be prepared, signed, and stamped by a registered Civil or Structural Engineer and by a registered Geotechnical Engineer in the State of California.

B. These plans shall be accompanied by a copy of a Permit to Excavate that has been issued by the Division of Occupational safety and Health as required by Labor Code Section 6500 et seq.

C. This Article shall be applicable regardless of the Contract Price(s).

D. The Contractor's Engineer shall review the adequacy of the Contractor's work methods, Equipment, bracing, or scaffolding, or safety measures, in, on, or near the construction site.

8.06. Tunnel Construction Safety

A. The Contractor shall comply with all applicable requirements of Labor Code Section 7950 et seq. regarding tunnel safety.

B. The Contractor shall notify the California Division of Occupational Safety and Health and the Engineer before any initial construction may be started at any tunnels.

C. The Contractor shall schedule a pre-job safety conference with representatives of the Division, District, employer, and employees before Work begins as required by Labor Code Section 7955. This conference shall include the employer's review of the construction plan and any special Equipment, practices, and potential safety and health problems. The Engineer shall be notified of the time and place of the conference.

D. The District shall obtain the tunnel classification prepared by the Division of Occupational Safety and Health prior to the request for bids, whenever possible, and make it available to the Contractor. A notice of the classification and any special orders, rules, or regulations to be used in construction, remodeling, demolition, or operation of the tunnel or underground mine shall be prominently posted at the site by the Contractor.

8.07. Confined Space Program

A. The Contractor working in or supporting work in a confined space shall have a Confined Space Program.

B. The Contractor shall submit a copy of its confined space program document to the Engineer. The program document shall be in compliance with all requirements of California Code of Regulations Title 8, Sections 1950–1962, and other applicable confined space requirements. Entry into a confined space shall not occur until the Contractor has submitted, and the Engineer has returned, indicating "In Receipt of," the Contractor's Confined Space Program document.

C. The Contractor shall ensure that all of its employees and Subcontractors working in or supporting Work in a confined space have received all training mandated by Cal/OSHA and meet any other Cal/OSHA requirements related to the Work. All entries into confined spaces shall be coordinated with the Engineer.

D. The Contractor shall provide confined-space rescue services for all Work performed in a permit-required confined space and for all entrants to a permit-required confined space regardless of the entrant's employer.

E. All employees of the Contractor or Subcontractor performing rescue services shall have received previous training, as applicable, in (i) atmospheric monitoring and ventilation; (ii) communication; (iii) emergency, self-rescue, and non-entry rescue operations; (iv) permit systems; (v) signs, symptoms, and consequences of exposure to contaminants; (vi) first aid and CPR; (vii) lockout/tagout; (viii) fall protection; (ix) electrical safety; and (x) respiratory protection.

F. The required training as described in Paragraph E above, shall be per established industry standards (i.e., the latest version of ANSI Z117.1, Safety Requirements for Confined Spaces, American National Standards Institute); and per Cal/OSHA regulations (i.e., California Code of Regulations, Title 8, Sections 1960[b] and 5157[k].) All rescue personnel shall also have practiced making permit space rescues at least once every 12 months by means of simulated rescue operations in which they remove dummies, mannequins, or actual persons from actual permit spaces or from representative permit spaces. Representative permit spaces shall, with respect to opening size, configuration, and accessibility, simulate the types of permit spaces from which rescue is to be performed. This training shall have taken place no more than 12 months before the Work to be performed on this Project begins.

G. Prior to the start of Work, the Contractor or any Subcontractor performing Rescue Services, shall submit to the District for review, a Rescue Training Certification (District Form FC 1767) included at the end of this Section, if/when it becomes necessary for District staff to enter a permit required confined space.

H. Prior to entry, the Contractor shall post the most current copy of its Rescue Training Certification form (without its attachments) at the worksite where rescue services are to be provided.

I. The Contractor shall submit an updated Rescue Training Certification form to the Engineer prior to the performance of each rescue service event. In addition, the Contractor shall submit an updated form to include any personnel not previously identified.

8.08. Temporary Facilities

A. Use construction hoists, elevators, scaffolds, stages, shoring, and similar temporary facilities of ample size and capacity to adequately support and move loads to which they will be subjected. Provide railings, kick plates, enclosures, safety devices, and controls required by law or regulation or for adequate protection of life and property.

B. Staging and falsework: Temporary support (e.g., formwork, falsework, or shoring) shall be designed and constructed in accordance with Construction Safety Orders, California Code of Regulations, Title 8, Sections 1541.1 and 1717. The

falsework plan, shoring plan, and any required calculations shall be submitted, and the Engineer has returned indicating “In Receipt of,” prior to commencement of any associated work on site.

C. Warning devices and barricades: Identify and guard hazardous areas and conditions by visual warning devices, and, where necessary, by physical barriers per Cal/OSHA requirements; by the latest version of the California Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD); and by State agency permit conditions.

D. Barricades: Place barriers at ends of excavations and along excavations to warn pedestrian and vehicle traffic of excavations. Provide barriers with flashing lights after dark. Keep barriers in place until excavations are entirely backfilled and fully compacted. Barricade excavations to prevent persons from entering excavation areas in streets, roadways, parking lots, or other public or private areas associated with the Project.

E. Temporary enclosures: When sandblasting, spray painting, spraying of insulation, fireproofing, or other activities inconveniencing or dangerous to property or to the health of employees, District staff, or the public are in progress, the area of activity shall be enclosed adequately to contain the dust, over spray, or other hazard. In the event that there are no permanent enclosures of the area or that enclosures are incomplete or inadequate, the Contractor shall provide suitable, temporary enclosures. The Contractor shall submit to the Engineer a temporary enclosure plan for protection of open bodies of water from contamination. Temporary enclosures shall not hinder or adversely affect treatment plant operations.

F. Above-grade protection: On multilevel structures, the Contractor shall provide safety protection that, as a minimum, shall meet the requirements of California Code of Regulations, Title 8 Industrial Relations.

G. Fences: Enclose Work site with fencing adequate to protect the Work as necessary against acts of theft, violence, and vandalism. When entire site or part thereof is to be permanently fenced, permanent fencing may be built to serve as both permanent and temporary protection of the Work site, provided that any damaged or defaced fencing is replaced prior to final acceptance.

8.09. Injury and Illness Prevention Program

A. Work shall not commence until the Contractor has submitted, and the Engineer has returned indicating “In Receipt of,” the Contractor’s Injury and Illness Prevention Program (IIPP). The IIPP shall comply with Cal/OSHA requirements California Code of Regulations, Title 8, Section 1509 (Construction), Section 3203 (General Industry), and other regulations as applicable. A copy of the program shall be available at all times at the job site. The Contractor shall designate a Safety Officer who will monitor and enforce the IIPP.

8.10. Safety and Health Program for Hazardous Waste Operations

A. The Contractor shall comply with California Code of Regulations, Title 8, Section 5192 and shall develop and implement a written safety and health program and a site-specific safety and health plan for employees involved in Hazardous Waste operations. The program shall be designed to identify, evaluate, and control safety and health hazards and provide for emergency response for Hazardous Waste operations. In compliance with Title 8, Section 5192, the written safety and health program shall incorporate:

1. an organizational structure;

2. a comprehensive work plan;

3. a Site-Specific Safety and Health Plan;

4. a safety and health training program;

5. a medical surveillance program;

6. the Contractor's standard operating procedures for safety and health; and

7. any necessary interface between general program and site specific activities.

8.11. Site Safety and Health Supervisor

A. The Contractor shall provide a site safety and health supervisor who has the responsibility and authority to develop and implement the site-specific safety and health plan and to verify compliance in accordance with California Code of Regulations.

B. The site safety and health supervisor shall be a qualified and experienced safety and health professional whose sole duty is safety, health, environmental control, and monitoring and who shall be on site during normal working periods and available 24 hours a Day, seven (7) Days a week by telephone or by other approved means. Safety representatives from Subcontractors shall not be substituted for the Contractor's safety representative.

C. The site safety and health supervisor shall meet, at a minimum, the following qualifications: five (5) years of construction project safety management experience on similar projects with OSHA 30-hour certified construction training or certified safety professionals (CSP) with experience in construction-related projects. The safety officer or other competent person shall maintain current training certificates in first aid and in CPR.

8.12. Site-Specific Safety and Health Plan

A. The Contractor shall develop, implement, and verify compliance of a site-specific safety and health plan for Work on this Project.

B. The safety and health plan shall conform to the requirements of all local, state, and federal ordinances, rules, regulations, and guidelines concerning occupational health and safety issues. It shall also include protocol to be utilized in the event unexpected Materials or substances are encountered.

C. The safety and health plan shall consist of procedures for the protection of the Contractor's personnel, including Subcontractors, District personnel, consultants, inspectors, and Supplier personnel working with Hazardous Material and the general public from Site-specific hazards.

D. The safety and health plan shall be prepared and signed by a Certified Industrial Hygienist (CIH). The safety and health plan shall identify the site safety and health supervisor who is responsible for the implementation of the plan.

E. Should the types of activities and associated hazards change during the course of work, the Contractor's CIH shall amend the appropriate sections of the safety and health plan to reflect the changed site conditions. The revisions shall address the specific potential hazards to workers and to any others who will be involved in the construction that could result from exposure to the new hazard(s).

F. The Contractor shall keep a copy of the safety and health plan at the job site at all times and shall provide a copy to all personnel working on site. All Contractor personnel performing work on site shall be required to read the safety and health plan and shall be required to sign an acknowledgment that he/she has obtained and read a copy of the safety and health plan. No worker shall be allowed to perform Work on the site until a copy of his/her signed acknowledgment has been submitted to the Engineer by the Contractor. At a minimum, the safety and health plan shall consist of the following items:

1. Project Organization: To include project manager, project site safety officer, superintendent, forepersons, Subcontractors, any team leaders, and other workers and shall address their roles and responsibilities.

2. Work Plan: Address anticipated Project activities and objectives of the site operations; identify performance tasks for the Project, methods, and activities for accomplishing these tasks, task hazard analysis for each task activity listed in the safety and health plan, personnel requirements, personnel training requirements, and medical monitoring requirements for site personnel.

3. Site Safety Meetings: Include the frequency of the meetings, who will conduct the meetings, time of Day meetings will be held, general topics that will be covered at the meetings, and documentation protocol.

4. Employee Training Assignments: Discuss the training elements and the employees who received the training.

5. Review of the Site History for Overall Hazard Characteristics: Discuss physical and health hazards, site characterization, and known and potential exposures to Hazardous Material.

6. Site Control Program: At a minimum, specify the site work zones, site personnel training requirements for each class/type of worker, site protective clothing requirements, safe working practices, and site communication.

7. Personnel Medical Monitoring Requirements: Discuss requirements for each class/type of worker to be on site and special condition hazards.

8. Personnel Protective Equipment Program: At a minimum, specify selection, personnel training requirements, Equipment storage requirements, Equipment maintenance and repair requirements, Equipment decontamination requirements, and Equipment limitations.

9. Engineering Controls: Specify additional engineering controls to be used for workplace safety, if any.

10. Monitoring: As applicable, at a minimum, specify monitoring methodology, frequency of monitoring, personnel training requirements to monitor, Equipment to be used, Equipment calibration methodology, and documentation protocol.

11. Material Handling: As applicable, specify machinery and Equipment to be used, tools to be used, containers to be used, and personnel training requirements for operators.

12. Decontamination: As applicable, specify procedures for decontamination area construction, personnel decontamination, Equipment decontamination, reinstate control, protective clothing debris control, and decontamination station personnel requirements.

13. Emergency Response Program: At a minimum, specify directions to the nearest medical facility, decontamination procedures for injured workers, and emergency Equipment available on site.

14. Spill Contamination Contingency Program: Shall include provisions for gases, liquids, and solids.

15. Sanitation Facilities: Identify availability for workers and provisions for different sexes.

16. Illumination: If used during the Project, specify the condition requirements for use, type of illumination to be provided, and illumination locations on site.

17. Confined Space Entry: Discuss personnel protective Equipment, ventilation method and Equipment, illumination method and Equipment, atmosphere testing and Equipment, safety protocol, and documentation protocol.

18. Site Excavation: Discuss types of Equipment to be used, personnel training requirements, safety practices to be utilized, open excavation construction, and personnel entry safety.

19. Safety Inspections: Identify scope of inspections, frequency and time of inspections, personnel qualification of inspector, and communications protocol.

G. The Contractor shall comply with the safety and health plan. Noncompliance with the safety and health plan shall be grounds for temporary suspension of all Work. Suspension of Work for noncompliance shall not be grounds for additional time or compensation.

H. The safety and health plan may be revised and/or amended by the Contractor and the Contractor's CIH as necessary during Work progress and as specified in these Specifications. Revisions and/or amendments to the safety and health plan shall be considered incidental to this item of Work; no additional payment shall be made.

8.13. Safety and Health Plan Implementation

A. Providing for worker safety and personal protection is the Contractor's responsibility and shall be in accordance with the Contractor's safety and health plan. The Contractor is responsible for providing any and all training, monitoring, personal protective Equipment, protective clothing, devices, Equipment, and/or facilities necessary for ensuring worker safety as may be recommended and/or as specified in the Contractor's safety and health plan.

B. The Contractor is responsible for ensuring that its personnel understand and comply with all site health and safety requirements specified in the safety and health plan.

8.14. Submittals

A. This Article summarizes required safety-related submittals. This Article is not intended to be all inclusive. In addition, some submittal requirements specified below may not apply depending on the specific Work under this Contract. Contractor is solely responsible for identifying and submitting to the District and/or to appropriate authorities having jurisdiction all Submittals required by applicable laws, rules, and regulations. The Contractor shall submit at a minimum the following items:

1. Injury Illness Prevention Program (IIPP): Shall be submitted and favorably reviewed by the Engineer prior to commencement of any Work on site.

The District may review or comment on the IIPP. The District's review or comment on the IIPP does not in any way relieve the Contractor of (i) any responsibility or liability for the IIPP, and (ii) being solely, fully, and completely responsible for the safety of all persons and property at the job site.

2. Site-Specific Safety and Health Plan: Shall be submitted and favorably reviewed by the Engineer prior to commencement of any Work on site (if applicable). The District may review or comment on the safety and health plan. The District's review or comment on the plan does not in any way relieve the Contractor of (i) any responsibility or liability for the plan, and (ii) being solely, fully, and completely responsible for the safety of all persons and property at the job site.

3. Names and qualifications (résumés including education, training, experience, and certifications) for the designated site safety and health supervisor and other competent and qualified personnel to be used on the Project in support of job site safety requirements.

4. Completed Activity Hazard Analysis (AHA) or Job Hazard Analysis (JHA) submitted for all significant activities and tasks with a high-risk potential, describing the job steps, hazards associated with each job step, and the controls used to remove or minimize the associated hazards. No hazardous Work shall be allowed without an approved AHA or JHA.

5. Incident Investigation Reports: Submitted to the Engineer within 24 hours of the Project incident.

6. Project-Specific Hazardous Substances Communications Plan: Contractor shall prepare and submit plan and receive favorable review by the Engineer prior to commencement of sitework activities.

7. Safety Meeting Attendance Sheet ("Toolbox" meetings): Submitted to the Engineer within seven (7) working Days of the last working Day of the month.

8. Air Monitoring Results/Reports: Submitted to the Engineer on request (if applicable).

9. Monthly Field Project Report (including man-hours, incident/injury, and property damage reports): Submitted to the Engineer on a monthly basis within seven (7) Days of the last working Day of the month.

10. Heavy Equipment Inspection Forms: Submitted to the Engineer on request (if applicable).

11. Documentation for all Individuals Applicable to Regulatory Medical Surveillance Guidelines and HAZWOPER Training per Cal/OSHA

Requirements: Submitted to the Engineer for review prior to beginning any Work associated with these requirements (if applicable).

12. Critical Lift Plans: Submitted to the Engineer on request (if applicable).

13. Crane Inspection Certifications: Submitted to the Engineer on request (if applicable).

14. Crane Operators Certification: Submitted to the Engineer on request (if applicable).

15. Applicable employee training and required medical approval documentation in compliance with Cal/OSHA standards.

16. Copies of detailed and documented quarterly crane inspections conducted by qualified individuals (if applicable).

17. Written crane inspections submitted to the Engineer on a daily basis.

8.15. Security Requirements at Job Site

A. The Contractor shall make adequate provision for the protection of the Work area against fire, weather, theft, and vandalism and for the protection of the public against exposure to injury. All costs arising from theft, fire, or vandalism of the construction Material and Equipment shall be borne by the Contractor.

B. During night hours, weekends, holidays, and during other times when no Work is performed at the site, the Contractor shall provide temporary closures or enlist services of security guards to protect temporary openings.

C. The Contractor shall not allow its staff to stay at the Project site outside of specified hours of Work.

8.16. General

A. The Contractor shall comply with the security requirements specified herein during the entire construction duration. These requirements are not to be construed to relieve the Contractor of its responsibility for the Work as specified in Article 4.11. Contractor's Responsibility for the Work.

B. The Contractor's personnel includes the Contractor's own staff, including, but not limited to, all tiers of Subcontractor staff, manufacturer representatives, technicians, delivery drivers, etc.

8.17. Identification and Badging

A. All Contractor personnel who enter the Project site are required to possess and carry a valid photographic identification. A current driver's license, or identification card issued by the California Department of Motor Vehicles or by other States, or a current passport is considered valid photographic identification.

This identification shall be presented to District staff and security guards upon request. Contractor personnel without this identification shall be denied access to or shall be asked to leave the site.

B. The District shall provide Project-specific identification badges for use by Contractor personnel. The District shall issue a photographic identification badge to each person who works at the site for more than five (5) continuous Days and generic (nonphotographic), temporary badges for Contractor personnel who work on an occasional basis (less than five [5] continuous Days).

C. The Contractor shall submit to the Engineer for approval a list of all Contractor personnel intended to work at the site for more than five (5) continuous Days. The list shall include the name, employer, and work phone number of each person. Upon approval by the Engineer, the Contractor shall complete a District furnished identification badge application for each eligible employee and make arrangements with the Engineer to have Contractor employee photographs taken at the District for the purpose of obtaining District-furnished photographic identification badges. Approved applications and valid photographic identifications shall be required before issuance of District photographic identification badges.

D. Planned, occasional site access. The Contractor shall plan in advance all occasional (less than five [5] continuous Days) site accesses. The Contractor shall notify the Engineer of the name and employer of the Contractor's personnel requiring occasional site access at least one (1) Day in advance of each occasional site access. After sign in, the District's security guard will issue a generic, temporary badge to the occasional visitor. The occasional visitor shall return his/her badge to the security guard upon leaving the site.

E. Emergency or unplanned site access. For emergency or unplanned access, as determined by the Contractor and approved by the Engineer and upon notification by the District's security guard, the Contractor designee shall verify to the District's security guard the identity of the Contractor personnel requiring emergency or unplanned site access. After sign in, the District's security guard will issue a generic, temporary badge to the emergency or unplanned visitor. The emergency or unplanned visitor shall return his/her badge to the security guard upon leaving the site.

F. The Contractor shall ensure that all Contractor personnel display their District issued photographic identification badge or generic, temporary badge in plain view at all times while on site. Any Contractor personnel who does not display his/her photographic identification badge or generic, temporary badge while on site shall be required to leave the site.

G. Lost or missing photographic identification badges shall be reported immediately to the Engineer; a generic, temporary badge shall be issued by the District's security guard. The District shall deduct $100 for each lost or missing photographic identification badge from the Contract amount.

H. Lost or missing generic, temporary badges shall be reported immediately to the Engineer; a generic, temporary badge shall be issued by the District's security guard. The District shall deduct $100 for each lost generic, temporary badge from the Contract amount.

I. The Contractor shall maintain a list of Contractor personnel in possession of a photographic identification badge. The Contractor shall record, at a minimum, the following information: employee name, employer, work phone number, badge issuance date, date when employee ceases working at the site, and date when badge was missing, lost, or returned to the District. The Contractor shall submit updated badge lists to the Engineer on or before the fifth Day of each month. The District may deduct from the Contract amount $200 for each badge list not submitted on time. Approved lists shall be the basis for determination of the deductions for photographic badges not returned within the allowed time limit.

J. The Contractor shall collect and return to the District photographic identification badges from all Contractor personnel within 30 Days from the date of their employment termination or when their assignment onsite is complete. If the Contractor fails to return the badges within 30 Days of the employee's termination or assignment completion, the District shall deduct $100 from the Contract amount for each photographic badge not returned on time.

K. At the completion of the Project, the Contractor shall return all District-issued photographic identification badges to the District. The District shall deduct $100 from the Contract amount for each photographic badge unreturned or returned after Project Completion.

8.18. Background Checks

A. The District reserves the right to request and receive this information as allowed by law and as required to complete a background check on any Contractor personnel who must enter the site.

B. The District reserves the right to deny access to the site to any person, as allowed by law.

8.19. Site Access Control

A. The District may maintain a security checkpoint at the gate(s) and facility(ies). The security checkpoint(s) may be staffed by a District security guard during normal working hours, and at other hours, on an as-needed basis. District roving guard(s) may also patrol the property.

B. Unless otherwise specifically required in these Specifications, the entire site perimeter, including all fences and gates, are to remain intact and functional throughout the construction period. Fences and gates that are accidentally breached by the Contractor shall be restored by the Contractor at no additional cost to the District by the end of the workday at the latest. Perimeter breaches shall be secured by the Contractor until the breaches have been closed to the

satisfaction of the Engineer. For work requiring perimeter breaches, the Contractor shall work with the Engineer to arrange appropriate measures to secure the perimeter at the Contractor's cost. The Contractor shall promptly inform the District of any accidental perimeter breaches. No unauthorized entries shall be allowed in these breaches, including deliveries and Contractor personnel.

C. All vehicles entering the Project site are subject to search by District guards.

8.20. Mail and Postal Deliveries to the Project Site

A. Unless an exception is granted by the Engineer, the Contractor shall not have United States Postal Service, Federal Express, UPS, or similar mail and package deliveries addressed to any District facility. Under no circumstance shall mail/packages be delivered to the reception area of any District facility.

8.21. Productivity Lost for Noncompliance With Security Measures

A. Costs and delays incurred by the Contractor due to security measures (e.g., deliveries or personnel held at the gate without badges or identification, refusal of package deliveries, etc.) shall not be cause for additional Contract Time(s) or for additional compensation for the Contractor.

B. Failure to comply with these security measures may lead to delay or to stop of the Work with no additional Contract Time(s) or additional compensation granted to the Contractor.

8.22. Payment

A. Full compensation for doing all Work and furnishing all Material required to comply with site safety and security requirements as specified in these Specifications shall be considered incidental and shall be included in other items of Work; no additional payment shall be made.

Santa Clara Valley Water District

Enter Company Name Here

RESCUE TRAINING CERTIFICATION

FC 1767 (01-31-14)

Contractor shall ensure that all its employees working in or supporting work in a confined space have received all training mandated by Cal-OSHA and meet other Cal-OSHA requirements related to such work.

All employees of the Contractor or subcontractor performing rescue services must have received previous training in **(1)** Atmospheric monitoring and ventilation; **(2)** Communication; **(3)** Emergency, self-rescue, and non-entry rescue operations; **(4)** Permit system; **(5)** Signs; **(6)** First aid and CPR; **(7)** Lockout/tagout; **(8)** Fall protection; **(9)** Electrical safety; and **(10)** Respirator protection.

Rescue services training must have been performed consistent with established industry standards (ANSI Z117.1, Safety Requirements for Confined Spaces, American National Standards Institute and Cal/OSHA regulations). All trained employees must have practiced making permit required confined space rescues at least once every twelve months by means of simulated rescue operations in which they remove dummies, mannequins, or actual persons from actual permit spaces or from representative permit spaces. "Representative permit spaces" must, with respect to opening size, configuration and accessibility, simulate the types of permit spaces from which a rescue could be performed. Such training shall have taken place no more than twelve months before the work to be performed on this Project begins.

With regard to employees of Contractor or any subcontractor performing rescue services, prior to the start of work, Contractor shall submit for review and acceptance by the District all of the following information in the spaces designated below: a certification with the respective employee's name, the name(s) of the trainers, the dates of training, the dates of all rescue practice sessions, and brief descriptions of the rescue practice sessions. Copies of all written materials provided during the training courses or rescue practice sessions shall be attached to this form. **Prior to entry, the Contractor shall post copies of such certifications (without their attachments) at the worksite where rescue services are to be provided.**

PREPARED BY _____ PHONE NO. _____ E-MAIL ADDRESS _____

	EMPLOYEE'S NAME	DATE OF LAST INCLUSIVE TRAINING (1, 2, 3, 4, 5, 6, 7, 8, 9, 10)	DATE OF LAST PRACTICE RESCUE SESSION (ANNUAL)	TRAINER NAME/COMPANY		DESCRIPTION OF THE RESCUE PRACTICE SESSION (BRIEF)	COPIES OF ALL WRITTEN MATERIAL PROVIDED DURING THE TRAINING COURSES OR RESCUE PRACTICE SESSIONS
1							☐ Yes ☐ No
2							☐ Yes ☐ No
3							☐ Yes ☐ No
4							☐ Yes ☐ No
5							☐ Yes ☐ No
6							☐ Yes ☐ No
7							☐ Yes ☐ No
8							☐ Yes ☐ No
9							☐ Yes ☐ No
10							☐ Yes ☐ No

I Certify that the information provided is true and correct:

SIGNATURE _____ PRINT NAME _____ TITLE _____

DATE PREPARED _____ COMPANY ADDRESS _____

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SECTION 9. QUALITY MANAGEMENT

9.01. General Quality Requirements

A. This Section includes Quality Control (QC) requirements and procedures for Materials, products, Equipment, and workmanship; inspection procedures and limitations; sampling and testing of Materials; and Contractor's Quality Assurance/Quality Control (QA/QC) program.

B. The Contractor shall provide and use Construction Equipment and plants capable of producing the quality and quantity of Work required. Construction Equipment shall be identified by readily visible numbers. If Ordered, the Contractor shall remove unsatisfactory Construction Equipment and discontinue the operation of unsatisfactory plants.

9.02. District Quality and Environmental Policy Training

A. The following training requirements are minimum requirements. This training is required as part of the District's Quality and Environmental Management System (QEMS). Additional training may be required in accordance with the Special Provisions for environmentally sensitive Projects.

B. The following applies to all Contractor and Subcontractor Project personnel:

1. The Contractor is hereby informed that all supervisory-level personnel must attend QEMS training before Work begins on the Project site. All other Contractor personnel must attend QEMS training within seven (7) Days of beginning Work on the Project site.

2. QEMS training will be administered by the District and will include one (1) 30-minute training session for all staff. It may be necessary to conduct training at the District's headquarters building. All personnel shall sign an acknowledgement that they have attended the subject training.

3. Upon completion of training, personnel will be provided with a QEMS training sticker to be placed on their hard hats. The District may require training on an annual basis.

9.03. Contractor's Quality Control Program

A. The Contractor's Quality Control (QC) program is the successful and systematic execution of a realistic plan to certify that required standards of quality design and construction are met and to preclude problems resulting from poor quality or lack of quality. In performing its QC function, the Contractor develops procedures to manage and control its Material, Equipment, personnel, and work so that the completed Work complies with the Contract requirements. The Contractor, in building to the quality standards in the Contract Documents, controls the quality of the Work.

B. The Contractor shall establish and execute a QC program for services that are procured by the Contractor. The program shall provide the Contractor with adequate measures for verification of and conformance to defined Contract requirements by the Contractor's personnel and lower-tier Subcontractors (including fabricators, Suppliers, and Subcontractors).

C. When required, as stated in the Special Provisions the Contractor shall submit to the Engineer a Project-specific QC plan. The QC plan shall contain a comprehensive account of the Contractor's QC procedures as applicable to this Work. Detailed requirements for this QC plan are delineated in the following paragraphs. The Engineer's review of the Contractor's QC plan shall not relieve the Contractor from any of its obligations for performing the Work. No Work shall start until the Contractor's QC plan has been favorably reviewed by the Engineer. No payments shall be made to the Contractor until the QC plan is favorably reviewed by the Engineer.

D. The QC Plan shall demonstrate that it has qualified QC personnel who meet or exceed the requirements of Special Provisions Article 20.04.02. Contractor's Quality Staffing Requirements. The QC plan shall identify the independent testing firms to be used in accordance with Article 9.09. Testing.

E. The Contractor's QC program shall ensure the achievement of adequate quality throughout all applicable areas of the Contract. The QC plan shall describe the program and include procedures, work instructions, and records. In addition, the Plan shall describe methods relating to areas that require special testing and procedures as noted in the Specifications.

F. Identification and Control of Items and Material: Procedures to ensure that items or Material that have been accepted at the site are properly used and installed shall be described in the QC plan. The procedures shall provide for proper identification and storage and prevent the use of incorrect or defective Material.

G. Inspection and Tests: The Contractor shall have written procedures and checklists defining a program for control of inspections performed; these procedures and checklists shall be described in the QC plan. Procedures shall include specific instructions for observing all Work in process and for comparing this Work with the Contract requirements (organized by Specification section), precluding the covering of deficient or rejected Work, halting or rejecting Work, and resolving differences between the Field QC Representative(s) and the production representative(s).

H. A complete matrix listing all operational, performance, and QC tests and inspections required in the Contract Documents: Each entry in the matrix shall include the Specification Section and paragraph; test/inspection description;

procedure used; on/off site; test frequency and acceptance criteria; and testing firm conducting each test. Below is a sample showing one (1) particular test:

Test and Inspection Plan Table

Spec Section	Test/Inspection Description	Procedure Used	On/Off site	Frequency	Acceptance Criteria	Conducted by	Documentation /Report	Notes
15453. 3.04.B	Hydraulic Pressure Test	15453. 3.04.B	On	After leak test, 2 hours	30 ft	John Smith	Hydro-test Report	

I. The QC plan shall identify all contractual hold/inspection points, as well as any Contractor-imposed hold/inspections points.

J. The QC plan shall include procedures to provide verification and control of all testing provided by the Contractor.

K. Supplier Quality Control (SQC): The QC plan shall include procedures to ensure that procured products and services conform to the requirements of the Specifications. This plan shall include periodic visits to the place of manufacture by the Contractor to perform QA activities. The District shall be notified of all such SQC visits a minimum of two (2) weeks in advance in case it elects to attend the visit. Requirements of these procedures shall be applied as appropriate to lower-tier Suppliers and/or to Subcontractors.

L. Deficient and Nonconforming Work and Corrective Action: The QC plan shall include procedures for handling deficiencies and non-conformances. Deficiencies and non-conformances are defined as documentation, Drawings, Material, Equipment, or Work not conforming to the contractually specified requirements or procedures. The procedures shall prevent non-conformances by identification, documentation, evaluation, separation, disposition, and corrective action to prevent recurrence. Conditions having adverse effects on quality shall be promptly identified and reported to the Contractor's senior-level management and to the Engineer. The cause of conditions adverse to quality shall be determined and documented and measures implemented to prevent recurrence. In addition, at a minimum, this procedure shall address:

1. Personnel responsible for identifying deficient and non-complying items within the Work.

2. The manner/process and the name of personnel by which deficient and noncompliant items are documented "in the field."

3. The personnel and process utilized for logging deficient and noncompliant work into a deficiency log at the end of each Day.

4. Tracking processes and documentation for deficient and noncompliant items.

5. Personnel responsible for achieving resolution of outstanding deficiencies.

6. Once resolved, the manner/process by which the resolutions are documented and by whom.

M. Special Processes and Personnel Qualifications

1. The QC plan shall include detailed procedures for the performance and control of special processes (e.g., welding, soldering, heat treating, cleaning, plating, nondestructive examination, etc.).

2. Personnel performing special process tasks shall have experience, training, and certifications commensurate with the scope, complexity, or nature of the activity. The Contractor shall submit personnel qualifications information to the Engineer before the start of Work on the Project.

N. The Contractor's QC staffing is subject to the Engineer's continued review. The Engineer, at its sole option and without cause, may direct the Contractor to remove and replace the Field QC Representative.

O. Audits: The Contractor's QC program shall provide for documented audits on a quarterly basis to verify that QC procedures are being fully implemented by the Contractor as well as by its Subcontractors and Suppliers. Audit records shall be submitted to the Engineer within five (5) business days after an audit.

P. The Engineer may perform independent QA audits to verify that actions specified in the Contractor's QC plan have been implemented. No Engineer audit finding or report shall in any way relieve the Contractor from any requirements of this Contract.

9.04. Quality Coordination Meetings

A. The Contractor shall provide, at a minimum, five (5) working days' advance notice and shall participate in the following three (3) QC coordination meetings. Minutes for each meeting shall be prepared by the Contractor's Field QC Manager and submitted to the Engineer. The meetings shall be mentioned in the Contractors daily inspection report with the minutes attached:

1. Pre-submittal Conference

a. Prior to the Contractor's submittal of the QC plan, the Field QC Manager, its Superintendent, and other relevant personnel shall convene a QC coordination conference with the Engineer to review and discuss the QC plan. During the conference, mutual understanding of the QC plan requirements should be developed.

2. Preparatory Meeting

a. Thirty (30) Days prior to beginning Work on each Definable Feature of Work (e.g., ceramic tile, fencing and gates, masonry, rough-in electrical, etc.), the Contractor's Field QC Manager,

Superintendent, other Contractor QC personnel (as applicable), and the foreman responsible for the Definable Feature of Work shall meet with the District Engineer. The meeting shall cover the following agenda, with minutes documented by the Contractor's Field QC Manager.

(1) Review the Contract Plans and Specifications.

(2) Review reference Codes and Standards.

(3) Confirm that all required submittals have been approved.

(4) Review relevant RFIs, field memos, and changes to the design of the Definable Feature of Work.

(5) Review QC requirements for the Work, including inspection, testing, and acceptance and tolerance requirements.

(6) Review critical installation procedures and quality compliance.

(7) Examine Work area to assure that all required predecessor Work has been completed, that all required deficiencies have been corrected and approved, and that all documented, remaining deficiencies shall not impair the construction of the planned Definable Feature of Work.

(8) Check availability of required resource and Equipment to perform the Work.

(9) Review Activity Hazards to address safety precautions.

(10) Determine commencement of the initial meeting.

3. Initial Meeting

a. One (1) workday before the beginning of construction of a Definable Feature of Work, the Contractor's Field QC Manager, Superintendent, other CQC personnel (as applicable), and the foreman responsible for the Definable Feature of Work shall meet with the Engineer. The meeting shall cover the following agenda, with Minutes documented by the Contractor's Field QC Manager.

(1) Review minutes of the preparatory meeting.

(2) Verify specified Material and Equipment is on site.

(3) Establish level of workmanship and verify that it meets minimum acceptable workmanship standards.

(4) Compare with required samples and mockups as appropriate.

(5) Verify adequacy of QC for the Work, including availability of test Equipment.

(6) Resolve all differences.

(7) Indicate exact location of initial phase in the minutes for future reference and comparison with follow-up phases.

(8) Repeat the initial phase for each new crew to work on site or any time accepted or specified quality standards are not met.

9.05. Documented Quality Control Records

A. The Contractor shall establish control methods of Contract Documents that describe how Drawings and Specifications are received and distributed to assure the correct issue of the document is being used. The methods shall also describe how as-built data are documented and furnished to the Engineer.

B. The Contractor shall maintain evidence of activities affecting quality, including operating logs, records of inspections and tests, audit reports, Material analyses, personnel qualification and certification records, procedures, and document review records.

C. Quality records shall be maintained in a manner that provides for timely retrieval, and traceability. Quality records shall be protected from deterioration, damage, and destruction.

D. The Contractor shall provide a list of QC records as specified in the Contract Documents that will be furnished to the Engineer at the completion of activities.

9.06. Inspection and Daily Reports

9.06.01. Inspection

A. The Contractor shall utilize qualified individuals to perform and document inspections and tests. At a minimum, “qualified” shall mean having performed similar QC functions on similar-type projects. Records of personnel experience, training, and qualifications shall be maintained and made available for review by the Engineer upon request.

B. The Engineer shall at all times have access to the Work during its construction and shall be furnished with every reasonable facility for ascertaining that the Material and the quality of performance are in accordance with the requirements and intentions of the Drawings and Specifications. All Work done shall be subject to the Engineer’s inspection as well as by external parties.

C. The day-to-day inspection performed by the various inspectors employed by the District shall not constitute approval or ratification of Work improperly done by the Contractor. The Engineer is the only person authorized to recommend Acceptance of Work and Material.

D. The presence or absence of an inspector during performance of the work shall not relieve the Contractor of any obligation to fulfill the Contract. It shall be the duty of the Contractor to see that all provisions are complied with in detail, irrespective of the inspection given the Work during its progress by the Engineer or by representatives of the Engineer. The District and the Engineer shall assume no responsibility for any plan or method suggested to the Contractor by the Engineer or by an inspector that is not specified or required. Any such suggestion shall be used at the risk and responsibility of the Contractor.

E. Inspection does not waive or alter the requirements or provisions of the Contract Documents. Inspection of the work or receipt of payment shall not relieve the Contractor of its obligation to fulfill all conditions of the Contract; improper work shall be subject to rejection.

F. No portion of any work, installed material, products, or equipment shall be covered or concealed in any manner without first being inspected by the Engineer. Whenever the Contractor is ready to backfill, bury, cast in concrete, hide, or otherwise cover any Work under this Contract, the Contractor shall notify the Engineer not less than one (1) Work Day in advance to request inspection before beginning any such work of covering. Failure of the Contractor to notify the Engineer at least one (1) Work Day in advance of any such inspections shall be reasonable cause for the Engineer to order a sufficient delay in the Contractor's schedule to allow time for such inspection. If any Work, Material, products, or Equipment is covered prior to inspection or prior to the express approval of the Engineer, that Work, Material, products, or Equipment shall be uncovered at no additional cost to the District. All associated costs, including its impact on other portions of the Work, shall be borne by the Contractor.

G. The Contractor shall not conceal any part of the Work until record Drawing information has been taken and recorded by the Contractor.

H. Should it be considered necessary or advisable by the District at any time before acceptance of the entire Work to make an examination of Work already completed by removing or tearing out same, the Contractor shall, on request, promptly furnish all necessary facilities, labor, and Material. If such Work is found to be defective or nonconforming in any material respect due to the fault of the Contractor or of Subcontractors, the Contractor shall defray all of the expenses of this examination and of satisfactory reconstruction. If, however, the Work is found to meet the requirements of the Contract, an equitable adjustment shall be made in the Contract Price(s) to compensate the Contractor for the additional services involved in the examination and reconstruction, and if completion of the Work has been delayed thereby, the Contractor shall, in addition, be granted a suitable extension of time.

I. Work, Material, products, and Equipment not conforming to the Contract Documents shall be considered defective and shall be corrected or removed and replaced with conforming Work, Material, products, and Equipment at no additional cost to the District.

9.06.02. Daily Inspection Reports

A. The Contractor is required to submit a daily QC inspection report providing factual evidence that required QC activities and/or tests have been performed. These records shall include the Work of Subcontractors and Suppliers and shall be on a form acceptable by the Engineer. Reports shall be made available at the end of each Work Day or no later than prior to the beginning of the next Work Day. Such reports shall, at a minimum, include the following:

1. Item(s) inspected.

2. Quality characteristics in compliance.

3. Quality characteristics not in compliance.

4. Corrective/remedial actions taken.

5. Statement of certification.

6. Field QC Representative's signature.

7. Contractor/Subcontractor and its/their area of responsibility.

8. Test and/or control activities performed with results and references to Specification/Drawing requirements.

9. Test reports as attachments.

10. Contractor's completed QC checklists, where applicable.

11. Records of any SQC reports performed off site as an attachment.

12. Any Noncompliance Notices (NCN) issued.

    a. An NCN shall be issued to document defective Work.

    b. Corrective Action Reports (CAR) shall be completed to close out an NCN. An NCN may not be closed until the CAR is accepted by the Engineer.

    c. A log of the NCN and the corresponding CAR shall be published at the end of each month.

13. A Contractor's verification statement stating that each daily report is a complete, true, and accurate account of that Day's construction activity.

    a. These records in report form shall be prepared daily. The records shall be available in the field within 24 hours after the date covered by the report for review by the Engineer; all reports for that week shall be submitted weekly to the Engineer.

    b. Reports need not be submitted for Days on which no Work is performed. At a minimum, one (1) report shall be prepared and submitted for every seven (7) Days of no Work and on the last Day of a no-Work period. All Days shall be accounted for throughout the life of the Contract. The first report following a Day of no Work shall be for that Day only.

    c. Reports shall be signed and dated by the Contractor Field QC Manager. The report from the Contractor Field QC Manager shall include copies of reports prepared by all subordinate QC personnel.

9.07. Plant Inspection

A. Material and Equipment that become a part of the completed Work shall be subject to inspection at the place of production or manufacture, at the shipping point, or at the site of the Work. Material and Equipment requiring inspection at the place of production or manufacture shall be designated by the Engineer. Where plant inspection is so designated, the Engineer shall be given a 14-Day advance notice of the start of manufacture or of production. For international locations and sites outside of the continental United States, a minimum notification of 30 working Days shall be provided. The Contractor's purchase orders for Material and Equipment, for which plant inspection has been designated by the Engineer, shall bear a suitable notation advising Suppliers and Subcontractors of inspection requirements.

B. If the required notification is not given, the District shall schedule the inspection at its convenience, and the activity to be witnessed shall not proceed until the Engineer arrives or until the District notifies the Contractor that it is choosing to waive its witness inspection requirement.

C. The Engineer or an authorized representative shall have free entry at all times to such parts of the plant as concerns the manufacture or production of Material and Equipment for the District. Adequate facilities shall be furnished free of charge to make the necessary inspection.

D. The Engineer may attend scheduled inspections of the off-site plant for Material, Equipment, or software to be incorporated into the Work. The District assumes no obligation to inspect Material or Equipment at the place of manufacture or production or at the shipping point. Unless otherwise noted in the Special

Provisions, cost for District representatives to attend off-site inspections shall be borne by the District.

E. In the absence of the Engineer, the District may reject the processes completed to date and require the activity to be redone. Delays resulting from waiting on the witness inspection for the reasons given above shall be considered an Inexcusable Delay. Expenses incurred by Delays or repeat of the Work process shall be borne by the Contractor.

F. Should any inspection attended by the Engineer be delayed, the Contractor shall reimburse the District for the actual salary costs of District staff, consultants, and special inspection firms multiplied by their actual, fully burdened labor rates and shall reimburse the actual cost of other direct costs incurred due to the inspection Delay.

G. The Contractor shall provide safe passage and access for inspection of the Work in any area. Off-site storage areas and warehouse facilities are also subject to inspection.

H. Material, products, and Equipment that are specified to require testing and inspection at the point of origin shall receive and pass such testing and inspection prior to being shipped to the Project site.

9.08. Sampling of Material

A. The Contractor shall furnish samples of Material as specified and as requested by the Engineer at no additional cost to the District. Samples shall be obtained and tested whenever necessary to determine the quality of the Material and compliance with the Contract Documents.

B. The Contractor shall assist the Engineer, District staff, regulatory agency personnel, and third parties in collecting or providing samples.

C. The Contractor shall not use Material specified to be tested in the Work until such testing indicates satisfactory compliance with the Contract Documents.

9.09. Testing

A. Unless otherwise specified, the Contractor is responsible for completing all required testing at no additional cost to the District. All tests shall be performed by independent testing firms accredited by the appropriate authority.

B. The testing firm shall be staffed with experienced personnel, properly equipped, and fully qualified to perform the tests in accordance with the specified standards. The Contractor shall submit documentation demonstrating that the testing firm and its personnel are properly accredited by the appropriate authority.

C. The Engineer has the right to inspect Work performed by the independent testing firm. This may include inspection of the independent testing firm's internal QA records (e.g., QA manual, equipment calibrations, proficiency sample performance, etc.).

D. Testing shall be completed in accordance with the specified standards in effect on the date bids are due. Where no standard is specified, testing shall be completed in accordance with the applicable ASTM and/or the latest published edition of the *State of California Department of Transportation Standard Specifications and Standard Plans* and updates thereto.

E. The Contractor shall submit copies of all manufacturer test reports performed to satisfy the applicable Material standard specification or test standard (e.g., certified mill test reports). Reports shall identify the lot of Material represented by the test. The manufacturer test reports supplement the inspection, sampling, and testing provisions otherwise required by the Contract Documents.

F. Content of Test Reports: Inspection and test results shall be documented and evaluated to ensure that requirements have been satisfied. Individual test records shall contain the following information:

1. Date and time of test.
2. Item tested, item number, and item description.
3. Test designation.
4. Test work sheet, including location the sample was obtained.
5. Test results.
6. Acceptance or rejection.
7. Retest information, if applicable.
8. Control requirements.
9. Tester signature.

G. The Contractor shall immediately inform the Engineer of all test results.

H. Availability and Submittal of Test Reports: All test reports shall be made available to the District's representative for viewing within 24 hours and must be submitted to the Engineer within seven (7) Days after each test is completed, with the Contractor's weekly inspection reports. Each test report for each type of test shall be consecutively numbered. The Contractor shall maintain a copy of all test results on site.

I. Control of Measuring and Test Equipment: Measuring and/or testing instruments shall be adequately maintained, calibrated, and adjusted to maintain accuracy within prescribed limits. Calibration shall be performed at specified periods against valid standards traceable to nationally recognized standards and documented.

9.10. District Quality Assurance

A. Quality assurance (QA) involves the activities of the District that are separate from, but in coordination and cooperation with, the Contractor to monitor that the level of quality set by the Contract Documents is achieved. Through periodic review, inspections, and tests, the District monitors that the Contractor's QC is working effectively and that the end product complies with the level of quality established by the Contract.

9.10.01. Testing by the District

A. The District may arrange for independent tests at its own cost. In such cases, the Contractor shall cooperate with the District's independent testing firm. This testing by the District shall not relieve the Contractor of its obligation to do the QC testing required under the Contract.

B. If independent testing indicates noncompliance with the Contract Documents, any retesting shall be charged to the Contractor.

C. Upon request, the Engineer will furnish the Contractor with copies of test results.

9.10.02. Defective Work

A. All Work not conforming to the Contract shall be considered defective and subject to rejection by the Engineer regardless of when or where the deficiency is detected. Unless otherwise permitted by the Engineer, rejected Work shall be remedied, removed, or replaced by the Contractor in a manner acceptable to the Engineer and at no additional cost to the District.

B. Noncompliance Notice (NCN): The Engineer may issue a NCN to the Contractor for any detected defective Work or a portion thereof.

C. The Contractor shall provide a written response within five (5) working days after receipt of the NCN. The Contractor's response shall detail either (i) reasons it believes that the Work was performed in accordance with the Contract Documents; or (ii) the corrective action it intends to take to correct the defective Work.

D. If the Contractor disputes issuance of the NCN, the Engineer shall respond after receipt of the dispute by either (i) withdrawing the NCN; or by (ii) directing the Contractor to correct the Work. If the Engineer directs the Contractor to correct the Work, the Contractor shall make such correction within five (5) working days after receipt of such direction from the Engineer or at such other time as may be agreed to with the Engineer.

E. If the Contractor fails to promptly comply with any order of the Engineer to correct the defective Work, the Engineer may terminate the Contractor's right to proceed with the affected Work and cause the defective Work to be removed and replaced at the Contractor's expense.

1. The District shall deduct from the Contractor's progress payment any cost it incurs in correcting the defective Work, including, but not limited to, rectifying the nonconforming Work, removing and storing salvageable Material and Equipment, discarding other Materials and Equipment, administrative costs, and all costs of repair or replacement of the Work of others.

2. If the District self-performs the remediation of the Contractor's nonconforming Work, the Contractor shall also be charged for the District's overhead markup.

3. If the current Contract unpaid balance and retention are insufficient to cover this amount, the Contractor shall reimburse the District.

9.11. Plumbing and Piping Quality

A. The Contractor shall consult with industry and manufacturer representatives for all piping Material being used in the Work. The purpose of this consultation is to ensure that the Contractor's personnel are fully trained and knowledgeable, possess written instructions on proper assembly, and have all recommended tools for quality Work. Consultation shall also include discussions between industry and manufacturer representatives and Contractor management and construction staff on the causes of past plumbing and piping failures and of problems and methods of avoidance. The Contractor shall provide training for its forces as required to produce consistent, high-quality Work without failed tests and warranty problems.

9.12. Control of Materials and Equipment

A. This Article includes general product requirements and requirements for delivery, storage, packing, loading, unloading, transportation, protection, and selection of Material and Equipment. Additional specific requirements for delivery, handling, protection, loading, and unloading may be specified within the Technical Specifications for Materials and Equipment.

B. The Contractor shall furnish Materials and Equipment as specified. Only new Material and Equipment conforming to the requirements of the Contract shall be incorporated in the Work.

9.12.01. Source of Material and Equipment

A. The Contractor shall furnish a list of sources of Material and Equipment to the Engineer in sufficient time to permit proper inspection and testing of Material and Equipment in advance of their use. Inspection and tests shall be made and

reports rendered. It is understood that such inspections and tests shall not be considered a guarantee of acceptance of any Material or Equipment that may be delivered later for incorporation in the Work. Any Equipment or Materials that, after has in any way become non-compliant with the Contract, shall not be used in the Work.

B. At the option of the Engineer, the source of supply of each of the Material shall be approved before the delivery is started. All Material proposed for use may be inspected or tested at any time during their preparation and use. If it is determined that sources of supply that appeared satisfactory do not furnish a uniform product, or if the product from any source proves unacceptable at any time, the Contractor shall furnish approved Material from other sources.

9.12.02. Product Data and Samples

A. The Contractor shall furnish without charge such samples as may be required.

B. No Material or Equipment shall be delivered to the Work without prior approval of submittals by the Engineer.

C. The Contractor shall provide products by the same manufacturer when products are of similar nature, unless otherwise specified; provide identical products when products are required in quantity; and provide products with interchangeable parts whenever possible.

D. The Contractor shall require each Equipment manufacturer to have maintenance facilities meeting the following minimum requirements:

1. Minimum three (3) years' operational experience.
2. Located in the continental United States.
3. Equipment and tools capable of making repairs.
4. Staff qualified to make repairs.
5. Inventory of maintenance spare parts.

E. All Materials, products, and Equipment shall be new, of the specified quality, and free of defects. Where samples have been submitted, the Materials, products, and Equipment incorporated into the Work shall be equal to the samples that have been approved. Should Materials, products, and Equipment required by the Work not be specified or described on the Drawings, the Contractor shall provide Materials, products, and Equipment of high, generally accepted quality standards that are comparable to the Work and that meet the identifiable needs of the Work.

9.12.03. Transportation and Delivery

A. The Contractor shall:

1. Transport and handle items in accordance with manufacturer's instructions.

2. Schedule delivery to reduce long-term, on-site storage prior to installation and/or operation. Under no circumstances shall Equipment be delivered to the site more than one (1) month prior to installation without written authorization from the Engineer.

3. Coordinate delivery with installation to ensure minimum holding time for items that are hazardous, flammable, easily damaged, or sensitive to deterioration.

4. Deliver products to the site in the manufacturer's original sealed containers or other packing systems, complete with Safety Data Sheets (SDS) and instructions for handling, storing, unpacking, protecting, and installing.

B. The Contractor may store Material and Equipment only in those locations approved by the Engineer. The Contractor is responsible for maintaining and restoring any affected areas as required by the Engineer.

C. All items delivered to the site shall be unloaded and placed in a manner that shall not (i) impact the Contractor's normal construction operation or those of Subcontractors and other contractors; (ii) interfere with the flow of necessary traffic; and (iii) interfere with the District's normal operations and maintenance activities. In addition, the Contractor shall:

1. Provide necessary Equipment and personnel to receive, accept, and unload all items delivered to the site.

2. Promptly inspect the shipment to assure that products comply with requirements, quantities are correct, and items are undamaged. For items furnished by others (i.e., the District, other Contractors), perform inspection in the presence of the Engineer and shall notify the Engineer verbally and in writing of any problems.

9.12.04. Storage and Protection of Material

A. Store and protect products in accordance with the manufacturer's instructions with seals and labels intact and legible.

B. Material and Equipment shall be stored to ensure preservation of quality and fitness for the Work. They shall be placed under cover when necessary and shall be stored in a manner that will facilitate prompt inspection.

C. Loose granular Material shall be stored on solid, flat surfaces in a well-drained area. Mixing with foreign matter shall be prevented.

D. Cement, lime, and similar moisture-sensitive Material shall be stored under a roof and off the ground and shall be kept dry at all times. All structural, miscellaneous, and reinforcing steel shall be stored off the ground or to otherwise prevent accumulation of dirt or grease and in a position to prevent accumulation of

standing water and to minimize rusting. Beams shall be stored with the webs vertical. Precast concrete shall be handled and stored in a manner to prevent accumulation of dirt, standing water, staining, chipping, or cracking. Brick, block, and similar masonry products shall be handled and stored in a manner to reduce breakage, cracking, and spilling to a minimum.

E. Material and Equipment storage areas shall be suitably secured to protect Material and Equipment from damage or from theft.

F. Except as stated in the Contract Documents or as otherwise approved by the Engineer, locations and arrangements for storage sites for Material and Equipment shall be selected and maintained by the Contractor at the Contractor's expense. Full compensation for furnishing such storage sites as may be necessary or as required by the Contractor shall be considered as included in the Bid price; no additional payment shall be made.

G. The storage and handling of potential pollutants and Hazardous Material, including, but not necessarily limited to, gasoline, diesel, oils, paint, and solvents shall be in accordance with all Federal, State, and local laws and all other requirements. Temporary special storage enclosures, double-walled tanks, berms, or other protective facilities shall be provided as required by law. All Hazardous Material shall be stored and handled in strict accordance with the SDS for each product. A copy of each SDS shall be maintained at the Project site by the Contractor.

H. Any Equipment or Materials that, in the opinion of the Engineer, has become damaged as to be non-compliant with the Contract shall be promptly removed from the site of the Work. The Contractor shall receive no compensation for the Materials or Equipment removed or for removal costs.

9.12.05. Maintenance and Protection of Installed or Stored Equipment

A. All mechanical and electrical Equipment and instruments subject to moisture or corrosive damage by the atmosphere if stored outdoors (even though covered) shall be stored in a weather-tight building and provided with adequate ventilation, as required, to prevent damage. The Contractor shall maintain temperature and humidity within the range required by the Equipment or instrumentation manufacturer. The building may be a temporary structure on the site or elsewhere, must be painted in a neutral color, and must be no larger than required.

B. All Equipment shall be stored fully lubricated with oil, grease, and other lubricants unless otherwise instructed by the manufacturer.

C. Moving parts shall be rotated or otherwise maintained in accordance with the manufacturer's instructions. Upon installation, the Contractor shall periodically exercise the Equipment to ensure that it does not deteriorate from lack of use.

D. Lubricants shall be changed as frequently as required by the manufacturer between installation and acceptance. New lubricants shall be put into the Equipment at the time of acceptance.

E. The Contractor shall maintain a preventive maintenance record for all Material and Equipment installed but not yet accepted that requires preventive maintenance by the manufacturer. A monthly report of all maintenance performed shall be submitted to the Engineer to certify maintenance has been performed as recommended by the manufacturer.

F. The Contractor shall maintain and repair, as recommended by the manufacturer, any Equipment that has been installed but not yet accepted.

G. The Contractor shall clean exposed Material and Equipment just prior to turnover to the District.

H. Prior to the District's use or acceptance, the Contractor shall have the manufacturer inspect any Equipment valued at more than $2,500 and stored longer than three (3) months and certify that its condition has not been detrimentally affected. Such certification must affirm that the Equipment has not been adversely impacted and the Equipment shall be guaranteed as specified. If such a certification is not provided, the Equipment shall be determined to be defective and shall be replaced at the Contractor's expense. Certification does not relieve the Contractor from meeting all testing requirements.

9.13. District-Furnished Material

A. Material furnished by the District shall be available as designated in the Special Provisions. The Contractor shall load, unload, and haul such Materials to the site of the Work at the Contractor's expense. Once received by the Contractor, the Contractor is responsible for all Material furnished and shall pay any damages and storage charges.

9.14. Final Inspection of Work

A. The Engineer shall make the final inspection of the Work in accordance with Section 11. Contract Closeout. The Contractor is directed to Section 11. Contract Closeout regarding the requirements necessary to obtain final inspection by the Engineer.

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SECTION 10. ENVIRONMENTAL

10.01. Good Neighbor Requirements

A. The District is a public entity that takes seriously its responsibility to be a “Good Neighbor.” Accordingly, the District seeks to perform its activities, including construction of its facilities, in a manner that takes into consideration the needs of the neighborhood and that is minimally disruptive.

B. The Contractor hereby acknowledges the critical importance of meeting the Contract requirements as set forth in these Specifications regarding “good neighbor requirements,” which include, but are not limited to, public safety, working hours, noise pollution and vibration, light pollution, air pollution, spillage and dust, traffic control, truck haul routes and parking restrictions, and storm water pollution.

C. The Contractor shall adhere to the above “good neighbor requirements” which relate to the lessening of the impact causes by the Work being performed under this Contract. The Contractor acknowledges that its responsibility to observe the restrictions of this Contract relating to the above requirements is significant, critical, and a material provision of this Contract. Any non-compliance with these requirements may be cause for the District to suspend Work.

10.02. Storm Water Pollution Prevention Plan

A. The Contractor shall prepare and submit to the District an electronic and hard copy Storm Water Pollution Prevention Plan (SWPPP) as required under the National Pollutant Discharge Elimination System (NPDES) General Permit for Storm Water Discharge Associated with Construction and Land Disturbance Activities Order No. 2009-009-SWQ, (as amended).

B. The SWPPP shall incorporate all appropriate storm water Best Management Practices (BMPs) and all risk-based requirements to comply with the NPDES General Permit. The BMP descriptions and the template for the SWPPP shall be in accordance with the current California Stormwater Quality Association (CASQA) Construction BMP Handbook/Portal, which can be purchased at http://www.cabmphandbooks.com.

C. The SWPPP shall be written, amended, certified, and stamped by a Qualified SWPPP Developer (QSD). The implementation of BMPs and all pollution control measures shall be overseen by a Qualified SWPPP Practitioner (QSP). The QSD and QSP shall be provided by the Contractor and shall meet the certification requirements as defined under Section VII of the NPDES General Permit.

D. The District shall make available the following: base maps for the Contractor’s use in preparing the vicinity and site maps for the General Permit; a copy of preexisting site and site design information; and a copy of the completed Notice of Intent (NOI), if required.

E. Prior to the commencement of any Work at the site(s), the SWPPP shall be favorably reviewed by the Engineer. Review by the Engineer shall not relieve the Contractor of responsibility for the completeness of the SWPPP nor for the accuracy of assumptions, data, and information used and procedures contained in the Contractor's SWPPP or the adequacy thereof.

F. The SWPPP shall be revised and/or amended by the Contractor's QSD as necessary during the progress of Work to comply with Federal, State, and local regulations and the requirements of these Specifications. All revisions and amendments shall be submitted to the Engineer. Revisions and/or amendments to the SWPPP shall be considered incidental to this item of Work; no additional payment shall be made.

G. The Contractor's personnel supervising the earthwork, sitework, erosion control, and sedimentation control and inspecting erosion controls shall be required to read the SWPPP. A copy of the SWPPP shall be maintained at the construction site by the Contractor and shall be available at all times for review by all Contractors, by the District, or by regulatory agency personnel.

10.02.01. Storm Water BMPs

A. The SWPPP shall include appropriate BMPs, as required, to comply with the specified risk level for the Project.

B. The Contractor shall design, construct, operate, inspect, and maintain the BMPs in accordance with the NPDES General Permit and with the instructions provided in the current CASQA Construction BMP Handbook/Portal.

C. The BMPs shall include, but shall not be limited to, the following:

1. Erosion control;
2. Sediment control;
3. Run-on/runoff control;
4. Wind erosion control;
5. Tracking control;
6. Non-stormwater Management;
7. Waste Management and Materials Pollution Control; and
8. Project-specific Environmental BMPs as specified in the Contract.

10.02.02. Regulatory Fines

A. The Contractor is responsible for any penalties or fines imposed upon the District by the Regional Water Quality Control Board (RWQCB) or by other regulatory bodies due to the Contractor's noncompliance with the requirements of the NPDES General Permit. The actual cost of such penalties or fines shall be subtracted from the amount due, or that may become due, the Contractor.

10.03. Water Pollution Discharges and Remedies

A. The Contractor shall remedy immediately any public nuisance or deficiency arising from, or in consequence of, the Contractor's failure to perform the Work specified under Article 10.02. Storm Water Pollution Prevention Plan and Article 19.02. Other Discharge Permits.

B. Upon the Contractor's failure to make appropriate and timely remedies as Directed by the Engineer in the best interests of the public, the Engineer may employ private or public workforces and Equipment to perform the Work. The Contractor shall be charged all costs associated with such remedy including actual hours recorded by District staff, District consultants, and District services, multiplied by their actual, fully burdened labor rates. Such action(s) taken by the Engineer shall not preclude the Engineer from taking other appropriate actions and shall not relieve the Contractor of responsibility to comply with these Specifications.

10.04. Water Quality

A. The Contractor shall meet all applicable regulatory requirements to ensure that any discharges to surface waters will not cause violation to the State water quality standards or violation of regulatory permits issued by regulatory agencies.

B. The Contactor shall prevent water quality degradation of water bodies and/or of storm drains. Water quality is measured in terms of pollution substances, turbidity, dissolved oxygen, pH, and temperature.

C. Oily, greasy, or sediment-laden substances or other Materials that originate from the Contractor's operation shall not be allowed to enter, or be placed where they may later enter, any reservoir, river, creek, or stream.

D. The Contractor shall comply with the requirements of the following permits, where applicable, and as specified in the Special Provisions, Article 19.04. Water Pollution Discharges:

1. State Water Resources Control Board (SWRCB) and (NPDES), General Permit for Storm Water Discharges Associated with Construction and Land Disturbance Activities.

2. U.S. Army Corps of Engineers CWA Section 404 Permit, and Regional Water Quality Control Board/State Water Resources Control Board CWA Section 401 Water Quality Certification. And/or Waste Discharge Permit.

3. Other individual RWQCB NPDES Permits.

4. Department of Fish and Wildlife 1603 Stream Bed Alteration Agreement.

E. The Contractor shall implement any additional water quality best management practices and mitigation measures described in these Specifications.

10.05. Burial Sites

A. The Contractor shall comply with all applicable laws and regulations pertaining to burial sites, including, but not limited to, Ordinance Code Section B6-18 of the County of Santa Clara and requirements of Public Resources Code Section 5097.98 and Health and Safety Code Section 7050.5. Upon discovering or unearthing any burial site as evidenced by human skeletal remains, the person making the discovery shall immediately stop work and notify the County Coroner. The Contractor shall also notify the Engineer. The Contractor shall immediately secure the site and protect any human remains from further disturbance.

B. Upon determination by the County Coroner that the remains are Native American, the Coroner may contact the California Native American Heritage Commission and the County Coordinator of Indian Affairs. No further excavation or disturbance of the site or of any nearby area reasonably suspected to overlie adjacent remains may be made except as authorized by the California Native American Heritage Commission and/or by the County Coordinator of Indian Affairs, and by the Engineer.

C. The Contractor is advised that if burials are encountered, it may be necessary to suspend Work on the Project to comply with the above requirements. Payment for a Delay of more than one (1) workday for each occurrence shall be made in accordance with Article 3.07. Change in Contract Price(s) and with Article 3.08. Change in Contract Time(s).

10.06. Discovery of Archaeological and Cultural Resources

A. The Contractor is advised that if archaeological artifacts are encountered, the Contractor will immediately notify the Engineer.

B. Work at the location of the find will halt immediately within 100 feet of the find. If an archaeologist is not present at the time of the discovery, the Engineer will contact an archaeologist for identification and evaluation pursuant to Public Resources Code Section 21083.2, California Code of Regulations Section 15126.4 (California Environmental Quality Act [CEQA] Guidelines) and to the mitigation measures of the Project CEQA document. If the archaeologist determines that the artifact is not significant, the Engineer will authorize the Contractor to resume construction.

C. If the archaeologist determines that the artifact is significant, the archaeologist will determine if the artifact can be avoided and, if so, will detail avoidance procedures. The Contractor will comply with these avoidance procedures.

D. If the artifact cannot be avoided, the archaeologist will develop an action plan that will include provisions to minimize impacts and, if required, a data recovery plan for recovery of artifacts in accordance with Public Resources Code Section 21083.2 and CEQA Guidelines Section 15126.4.

E. The Contractor shall delay Work until the action plan and, if required, the data recovery plan, are favorably reviewed by the Engineer. Once the action plan and the data recovery plan are favorably reviewed, the Contractor shall comply with the requirements of these plans.

10.07. Noise Pollution and Vibration

A. The Contractor shall be responsible for ensuring that noise produced by construction activities does not exceed the applicable local noise ordinance standards and is in compliance with the performance standards set forth in Section 18. Permits and Regulations of the Special Provisions.

B. At a minimum, the Contractor shall exercise precautionary measures listed below. Implementation of these measures shall in no way relieve the Contractor of the responsibility of compliance with the noise criteria.

1. Air compressors and internal combustion engines shall be in good operating condition that meet or exceed original factory specifications and shall be equipped with high grade mufflers, air inlet silencers (where appropriate), and noise suppressers.

2. All mobile or fixed noise-producing machinery and Equipment, including “package” Equipment (e.g., fans, cranes, arc welders, air compressors, electrical operators, etc.), shall be suitably housed, enclosed, shielded, and equipped with noise-control features or muffled to meet the noise limits specified in the Special Provisions.

3. All mobile or fixed noise-producing Equipment used by the Contractor that is regulated for noise output by Federal, State, or local law shall comply with this regulation while in use. This shall include vehicles licensed for use on public highways.

4. Electrically powered Equipment instead of pneumatic- or internal-combustion-powered Equipment shall be used where feasible.

5. The use of noise producing signals, including horns, whistles, alarms, and bells, shall be for safety warning and emergency purposes only.

6. No music system, including personal or vehicle radio, tape, CD players, or the like, shall be audible at the Project right-of-way line.

7. Trucks or other mobile Equipment shall not use engine decompression (“Jake Brakes”) for deceleration on grades where feasible.

C. The Contractor shall take all necessary precautions during its operations to limit peak particle velocities from vibratory compaction or percussion Equipment so that they do not become a public nuisance or result in property damage.

D. Any Equipment causing noncompliance with the noise or vibration criteria shall be removed from the job site as Directed by the Engineer.

10.08. Air Pollution

A. The Contractor shall comply with all applicable requirements of the applicable air quality management or control district and California Air Resources Board regulations.

B. Idling of internal combustion engines shall be held to an absolute minimum. All vehicles with internal combustion engines shall be fitted with spark arrestors.

C. The Contractor shall not use any of the listed Materials banned by BAAQMD Regulation 8, Rule 15.

D. Serpentine Materials that have average asbestos content greater than five (5) percent as determined by an aggregate bulk sample analysis pursuant to Air Resources Board Test Method 435 or an alternate method approved by the Air Resources Board or BAAQMD (see also California Code of Regulations, Title 17, Section 93106) shall not be used for surfacing.

E. Except as provided by law, idling of heavy-duty diesel trucks with gross vehicular weight ratings of greater than 10,000 pounds shall be no more than five (5) minutes per California Code of Regulations, Title 13, Section 2485.

F. The Contractor shall implement any additional air quality best management practices and mitigation measures described in these Specifications.

10.09. Spillage and Dust Control

A. Care shall be taken to prevent spillage when hauling is done. Spillage resulting from hauling operations along or across any public-traveled way shall be removed immediately by the Contractor. The Contractor shall pay all expenses for removal of spillage.

B. The Contractor shall control dust nuisances originating from the Contractor's operations either inside or outside the right of way.

C. The Contractor shall provide all necessary precautionary measures to control dust and to prevent spillage on public-traveled ways. At a minimum, the Contractor shall provide the measures listed below and shall also implement additional dust control best management practices and mitigation measures described in these Specifications. Implementation of these measures shall in no way relieve the Contractor of the responsibility to comply with these Specifications.

1. Active maintenance areas, unpaved access roads, and staging areas shall be kept sufficiently moist and watered as necessary or shall be applied with nontoxic soil stabilizers to control dust generation.

2. Trucks hauling sediments and other loose Material shall be covered and shall maintain at least six (6) inches of freeboard.

3. Tailgates of trucks shall be sealed.

4. Trucks shall be brushed down before leaving the site.

5. Paved site access roads shall be swept using vacuum-powered street sweepers when visible soil Material is carried onto the roadway.

6. During high winds, the excavation and grading activity shall be watered or the activity suspended, if necessary, to control dust.

7. Inactive areas shall be sprayed with soil stabilizers or shall be seeded to avoid erosion or dust.

8. Exposed stockpiles shall be watered, enclosed, covered, or sprayed with soil stabilizers.

9. Traffic speeds within the Project right of way shall be limited to 15 mph. For off-site restriction, comply with local agency requirements.

10. Sandbags or other bank protections shall be installed to prevent silt runoff to roadways.

D. The Contractor shall immediately remedy any spillage and dust nuisance or deficiency arising from, or in consequence of, the Contractor's failure to perform the Work specified in these Specifications.

E. Upon the Contractor's failure to make timely remedies determined by the Engineer to be necessary and in the best interests of the public, the Engineer may employ private or public workforces and Equipment to perform the Work. The Contractor shall be charged all costs associated with such remedy including actual hours recorded by District staff, District consultants, and District services, multiplied by their actual, fully burdened labor rates. Such action(s) taken by the Engineer shall not preclude the District from taking other actions as deemed appropriate and shall not relieve the Contractor of responsibility to comply with these Specifications.

10.10. Traffic Control

A. Traffic control shall consist of all work and Materials necessary to maintain safe vehicular, pedestrian, and cyclist traffic during construction and to perform "best management practices" to mitigate high-peak and high-volume construction traffic, prevent idling and queuing, establish site access limitations and mitigation measures, identify haul routes, and provide overall control of all construction traffic entering, exiting, and operating within the Project site.

B. All traffic control Work shall be performed in accordance with the requirements of the local agency having jurisdiction and California Department of Transportation requirements, if applicable. If required, the Contractor shall prepare a traffic control plan and submit said plan to the Engineer and to the appropriate agency having jurisdiction for favorable reviews in advance of the Work at the site.

C. The Contractor shall cooperate with the local agency having jurisdiction relative to handling traffic around the construction area. The Contractor shall make its own arrangements relative to keeping the Work area clear of parked vehicles to maintain sight visibility and access to adjacent properties. Existing road signs shall not be blocked at any time.

D. Truck traffic and haul routes shall be in compliance with local permits and ordinances. The Contractor shall obtain, at the Contractor's expense, any required haul route permit from the local authority having jurisdiction for transporting to and from the Project site construction Material and the disposal of surplus Material.

E. The Contractor shall conduct its operations and schedule cleanups that cause the least possible obstruction and inconvenience to traffic, pedestrians, cyclists, and adjacent property owners.

F. Damage done by the Contractor during the course of its Work to adjacent city, town, county, or private property shall be repaired or replaced in kind and as Directed by the Engineer.

G. Personal vehicles of the Contractor's employees and the Contractor's Equipment and vehicles shall not, at any time, be parked on the traveled way, shoulders, medians, or lanes that have not been approved for closure. When entering or leaving roadways carrying public traffic, the Contractor's Equipment, whether empty or loaded, shall in all cases yield to public traffic and shall travel in the direction of the traffic. Flaggers and traffic signs may be required to control this activity. No driveways or private roads shall be blocked. Safe access must be maintained for pedestrian traffic throughout the Work areas at all times.

H. Those parts of public streets, right of ways, and sidewalks that are allowed to be occupied by the Contractor shall be immediately vacated by the Contractor and returned to public use when the Contractor's use thereof is no longer necessary for the construction Work.

I. The Contractor shall comply with and pay for all costs associated with Public Convenience Section 7-1.03; Public Safety Section 7-1.04; and Temporary Traffic Control Section 12 of the State Specifications; and Article 8.01. Public Safety, of these Standard Provisions Specifications. Nothing in these Specifications shall be construed as relieving the Contractor from its responsibility as provided in Public Safety Section 7–1.04 of the State Specifications.

J. The Contractor shall coordinate with the appropriate local agencies having jurisdiction to receive their approval in the event any temporary lane closures on public streets are needed for the Contractor's operation. Any traffic signing and flaggers as approved by the local agencies for said lane closures shall be in place prior to closing the lane to traffic.

10.11. Regulated Material Management

A. Regulated Material includes, but is not limited to, Hazardous Material and Hazardous Waste.

B. The Contractor is responsible for and shall obtain all required permits and pay all fees and taxes for satisfying the requirements of any regulatory agency for the storage, testing, monitoring, usage, transportation, disposal, safety, and reporting, or for any other requirements regarding the management of Regulated Material on and off the Project site(s).

C. The Contractor shall not allow Regulated Materials to spill on District property or on easements or on other public or private right of ways. Any spillage of Regulated Materials resulting from the Contractor's operation shall be removed immediately by the Contractor at the Contractor's expense.

D. The Contractor shall immediately notify the Engineer of any potentially Hazardous Materials or Hazardous Waste encountered at the worksite and shall take all necessary action to prevent exposure of personnel until all Material is identified and proper action can be taken.

E. Unless otherwise stated in the Contract Documents, Contractor shall be responsible for management, testing, transportation, and disposal of all regulated Material encountered on site in accordance with applicable local, state, and federal regulations.

F. Waste Manifests for pre-existing Regulated Material: The District will be the Generator for all Regulated materials pre-existing on the worksite and will sign the associated waste manifests. The District shall be responsible for paying the State Superfund fees, the generator's fees, and other costs of testing and disposal of pre-existing regulated material wastes unless specifically stated otherwise in these Specifications.

G. Prior to issuance of the Project Completion letter, the Contractor shall submit copies of all hazardous waste manifests signed by disposal facilities and certificates of disposal to prove that the Contractor has legally disposed such materials.

10.11.01. Contractor's Storage of Regulated Material

A. Prior to the storage or use of any Regulated Materials, the Contractor shall submit to the Engineer a Regulated Materials Storage and Use Plan (Plan). The Plan shall include (i) an inventory of all Regulated Materials to be stored or used

at the Project site that equals or exceeds any of the following separate material phases: 55 gallons of liquid, 200 cubic feet of compressed gas, or 500 lbs. of solid; (ii) the maximum quantity of Materials to be stored; (iii) purpose of the Materials; (iv) the SDS for each Material; (v) a detailed description of how the Materials will be stored (including secondary containment where required by applicable regulatory agencies); (vi) a site plan drawn to scale; (vii) storage area maps drawn to scale; (viii) a detailed description of how the Materials will be monitored; (ix) a detailed description of how wastes from the Materials will be stored and/or disposed; and (x) a detailed description of the procedures to be followed in the event of an uncontrolled release of the Regulated Materials.

B. The Plan shall be submitted to the Engineer and favorably reviewed at least 30 Days prior to the storage or use of any Regulated Materials. The Plan shall be updated and submitted to the Engineer by the Contractor upon the addition of new Regulated Materials not listed previously or upon a 100-percent (or greater) increase in quantity of a Regulated Materials that is listed in the plan.

10.11.02. Regulated Material Discharges or Releases by Contractor

A. The Contractor is responsible for all discarded or abandoned Material, including Regulated Materials and Hazardous Waste, generated as a result of the Contractor's operations unless specifically noted otherwise in these Specifications. The Contractor shall comply with Article 3.09. Differing Conditions.

B. In the event of a discharge or release of a Regulated Materials from the Contractor's operation, the Contractor is responsible for notifying the proper authorities, providing containment of the Material, identifying the contaminants, investigating the extent of all contaminants, testing and removing contaminated Materials, disposing of contaminated Materials, and verifying the removal of all contaminated Materials. These activities shall be performed to the satisfaction of the Engineer at the Contractor's cost. The Contractor shall perform any Work and provide any and all documentation required by the District and by all Federal, State, and local agencies. he Contractor shall provide to the Engineer copies of all correspondence and reports related to these activities. All Work performed to accomplish these activities shall be in accordance with Federal, State, and local regulations.

C. In the event of a discharge or release of Regulated Material, the Contractor shall notify the Engineer immediately. Immediate notifications may be verbal. The Contractor shall submit a detailed written report to the Engineer within 24 hours of the discharge or release. The written report shall include: a description of events leading to the discharge or release; action taken to prevent or control the discharge or release; a description of the discharge or release; the quantity of Material discharged or released; method used to determine the quantity discharged or released; type of Material discharged or released; SDS for the Material(s) involved; a description of the area affected by the discharge or release; agencies notified and date and time of notification; and status of the

cleanup. The report shall also include the proposed investigation, cleanup, and verification sampling activities.

D. All expenses incurred by the Contractor as a result of or to remedy the discharge or release of Regulated Materials shall be borne solely by the Contractor; no additional compensation shall be made. The Contractor shall be responsible for signing the non-hazardous waste manifests and the hazardous waste manifests and for paying the State Superfund fees, the generator's fees, and other costs of disposal of these wastes unless specifically stated otherwise in these Specifications. The Contractor shall be identified as the owner and generator of the wastes associated with unauthorized releases or discharges.

10.11.03. Hazardous Waste Management by Contractor

A. In accordance with these Specifications, the Contractor must manage the Hazardous Waste generated:

1. Labeling: The Contractor shall completely fill out and affix a "Hazardous Waste" label to each Hazardous Waste container for the Contractor's operations. Each Hazardous Waste label shall contain, at a minimum, (i) the words "HAZARDOUS WASTE"; (ii) information on the generator (i.e., name, address, phone number); (iii) EPA identification number for the waste stream; (iv) EPA and/or California Waste Code; (v) waste accumulation starting date; (vi) identification and content of the waste; (vii) the physical state of the waste (i.e., solid or liquid); (viii) and the hazardous property (i.e., flammable, toxic, corrosive, reactive, etc.). If the primary container is placed inside a secondary container, then the Contractor shall also prepare and affix another Hazardous Waste label on the secondary container.

2. Secondary containment: The Contractor shall provide appropriate secondary containment for all storage areas for Hazardous Materials and Hazardous Waste. In the case of an installation with one (1) primary container, the secondary containment shall contain at least 110 percent of the volume of the primary container. In the case of an installation with multiple primary containers, the secondary containment shall contain 150 percent of the volume of the largest container or ten (10) percent of the aggregate internal volume of all primary containers in the storage facility, whichever amount is greater. If the storage facility or storage system is open to rainfall, then the secondary containment must be able to additionally accommodate the volume of a 24-hour rainfall as determined by a 25-year storm history.

3. Accumulation time limit: The Contractor shall properly haul and dispose of all Hazardous Waste within 90 Days from the accumulation starting date identified on each Hazardous Waste label or on the completion date of the Contract, whichever event comes first. The waste accumulation starting date for each waste stream begins when the first drop of the waste is placed in the container.

4. Hauling and disposal of waste: The Contractor shall be responsible for using appropriate Hazardous Waste haulers and disposing of all Hazardous Waste in accordance with Federal, State, and local regulations.

B. Hazardous Waste Manifests: The Contractor will be the generator for all regulated materials introduced to the worksite by the Contractor or for any unauthorized releases of regulated materials occurring as a result of Contractor activities. In such cases, the Contractor will sign the associated waste manifests. The Contractor will pay the State Superfund fees, generator fees, and other costs of testing and disposal of regulated material.

C. Prior to issuance of the Project Completion letter, the Contractor shall submit legible copies of all Hazardous Waste manifests signed by disposal facilities and certificates of disposal to document that the Contractor has legally disposed of such Materials.

10.12. Non-Regulated Material Management

A. Non-Regulated Material is any substance that is not required by any Federal, State, or local regulations to require special management, storage, transportation, disposal, or handling practices. The Contractor is responsible for managing options for reuse and/or transportation and disposal of non-Regulated Material in accordance with this Article.

10.12.01. Disposal at State-Permitted Landfill

A. Non-Regulated Material may be transported and disposed at state-permitted, non-hazardous waste landfills. The Contractor is responsible for and shall obtain all required permits and pay all fees and taxes for satisfying the requirements of any regulatory agency for the storage, testing, monitoring, usage, transportation, disposal, safety, and reporting, or for any other requirements regarding the management of non-Regulated Material on and off the Project site(s).

B. The Contractor shall test Materials in accordance with the requirements of the Contract Documents and at the landfill to be used.

C. Contractor shall submit to the Engineer copies of state-certified laboratory testing reports for the Materials to be disposed, including but not limited to metals, pesticides, petroleum hydrocarbons, volatile organic compounds, and asbestos using EPA Test Methods.

D. Nonhazardous Waste Manifests: Prior to issuance of the Project Completion letter, the Contractor must submit legible copies of all non-hazardous waste manifests signed by disposal facilities and certificates of disposal to document that the Contractor has legally disposed of such Materials.

10.12.02. Disposal at District-Owned Sites

A. This Article applies to reuse or disposal within the Project site or any other District-owned property.

B. Material exceeding the applicable Environmental Screening Levels (ESLs) per the latest guidelines from the applicable Regional Water Quality Control Board (RWCCB) is subject to a case-by-case approval by the Engineer, per the requirements below.

C. For non-Regulated Material to be reused or disposed of on site or at any District-owned site, the Contractor must obtain all required permits; agency and District approvals and agreements; and pay all fees and taxes for all services and Materials required in conjunction with the management, storage, testing, transportation, disposal, and reuse of non-Regulated Material. Material reused shall meet all other characteristic requirements of the Contract Documents.

D. Prior to the transportation and disposal of Materials, the Contractor shall provide all applicable regulatory agency approvals and supporting information for disposal of Materials, including but not limited to, the following:

1. Copies of all applicable regulatory agency permits, approvals, licenses, and environmental clearances;

2. Site-specific health and ecological risk assessment and/or compliance with applicable regulatory agency regulations or guidelines, including, but not limited to, the applicable ESLs per the latest guidelines from the applicable RWQCB;

3. Copies of documentation of communication by the Contractor with appropriate regulatory agencies on evaluation of regulatory requirements and regulatory agency approvals for disposal of Materials; and

4. Copies of state-certified laboratory testing reports for the Materials to be disposed including but not limited to metals, pesticides, petroleum hydrocarbons, volatile organic compounds, and asbestos using EPA Test Methods.

10.12.03. Disposal at Other Locations

A. This Article applies to reuse or disposal at any off-site location other than a state-permitted landfill, Project site, or other District-owned property.

B. For Material to be reused or disposed of offsite (other than a state-permitted landfill or District-owned property), the Contractor must obtain all required permits, agency approvals, and property owner agreements and pay all fees and taxes for all services and Materials required in conjunction with the management, transportation, disposal, and reuse of Materials.

C. Prior to the disposal of Materials, the Contractor shall provide all applicable regulatory agency approvals and supporting information for disposal of Materials, including but not limited to, the following:

1. Copies of all applicable regulatory agency permits, approvals, licenses, and environmental clearances;

2. Copies of documentation of communication made by the Contractor with appropriate regulatory agencies on evaluation of regulatory requirements and regulatory agency approvals for disposal of Materials; and

3. Copies of state-certified laboratory testing reports for the Materials to be disposed for chemicals of concern including but not limited to metals, pesticides, petroleum hydrocarbons, volatile organic compounds, and asbestos using EPA Test Methods.

4. If Material exceeds the RWQCB's ESLs, the Contractor shall provide a site-specific health and ecological risk assessment. At a minimum, this shall include soil testing of the Project's Natural Background Area (defined as: "native area representing natural geological characteristics not influenced by human activity at an appropriate distance away from project's boundary limits.") documenting that any RWQCB's ESL exceedances detected in the Materials also exist in the background area. The Contractor shall receive prior approval of the background sample locations and submit test reports.

D. Materials, the Contractor shall obtain written consent from the property owner and submit a copy thereof to the Engineer. Documentation of consent must include:

1. A written authorization from the property owner to accept Materials at duly noted quantities, types of Materials (e.g., soils, debris, etc.), and the disposal property location address; and

2. A written release from the property owner fully absolving the Santa Clara Valley Water District from any and all responsibility and legal liability toward any damage to life and environment in connection with the disposal of the Materials on the property.

E. Within 15 Days after the disposal of Materials at the property location, the Contractor shall submit an acknowledgement duly signed by the property owner certifying the date of receipt of the Materials, including quantity and types of

Materials received (e.g., soils, debris, etc.), to document that the Contractor has disposed of the Materials at the location designated in the agreement.

F. Non-hazardous waste manifests: Prior to issuance of the Project Completion letter, the Contractor must submit legible copies of all non-hazardous waste manifests signed by disposal facilities and certificates of disposal to document that the Contractor has legally disposed of such Materials.

10.13. Imported Earthfill Material

10.13.01. General Requirements

A. The Contractor shall not import earthfill material that is contaminated with Regulated Materials.

B. For each imported earthfill Material to be used on the Project, the Contractor shall submit to the Engineer state-certified laboratory testing reports for chemicals of concern including but not limited to metals, pesticides, petroleum hydrocarbons, volatile organic compounds, and asbestos using EPA Test Methods.

C. For each imported earthfill Material to be used on the Project, the Contractor shall execute and submit to the Engineer a completed Imported Materials Certification form, certifying that the imported material is not contaminated with Regulated Materials. This form is available from the Engineer. If the imported earthfill Materials are to be obtained from more than one source, the Contractor shall execute and submit a separate form for each source of earthfill Material. This form shall be submitted at least 30 Days prior to the delivery of the earthfill Material to the construction site and shall receive favorable review prior to delivery.

D. If Contractor uses Regulated Materials on the Project Site, the Contractor must immediately remove the Regulated Material and dispose of it in accordance with all applicable laws, ordinances, and regulations. Contractor must conduct necessary sampling and monitoring to verify that all Regulated Material has been removed. Contractor must verify to the satisfaction of the Engineer and/or to the appropriate regulatory agencies, that any surrounding areas, soils, or water have not been impacted by the Regulated Materials. The subsequent disposal of the Regulated Material shall be the responsibility of the Contractor. No compensation shall be made to the Contractor by the District for removal, disposal, replacement, transportation, or chemical analysis, or for any other costs associated with the removal, disposal, and replacement of the Regulated Material.

E. The Engineer may obtain soil samples and test them to monitor the Contractor’s compliance with these Provisions.

F. All imported earthfill Material is subject to approval by the Engineer.

10.13.02. Imported Earthfill Non-Regulated Material

A. If the imported earthfill Material exceeds the applicable RWQCB's ESLs, the Contractor shall provide a site-specific health and ecological risk assessment and/or comply with applicable regulatory agency regulations or guidelines. At a minimum, this shall include soil testing of the Project's Natural Background Area (defined as: "native area representing natural geological characteristics not influenced by human activity at an appropriate distance away from project's boundary limits.") documenting that any RWQCB's ESL exceedances detected in the imported earthfill Material also exist in the background area.

B. The Contractor's identification of the Natural Background Area and test reports are subject to approval by the Engineer.

10.14. Migratory Birds

A. The Contractor shall comply with all applicable Federal and State laws, rules, and regulations related to the protection of migratory birds, including, but not necessarily limited to, the Federal Migratory Bird Treaty Act (16 USC 703-712 50 CFR Part 21 and 50 CFR Part 10) and the California Department of Fish and Game Code Sections 2000, 3503, 3503.5, 3513, and 3800.

B. The Contractor shall carry out all activities in a manner consistent with the U.S. Fish and Wildlife Service's Migratory Bird Program. The Contractor shall not pursue, hunt, take, capture, kill, attempt to take, or possess any migratory bird listed in 50 CFR 10.13, or any part, nest, or egg of any such bird. Active nests are those containing either an egg (or eggs) or young and/or nests used by birds of prey, regardless of the presence of eggs or of young. To determine the occupancy of nests, the Contractor shall rely upon the professional expertise of a Qualified Biologist. See Section 19. Environmental.

C. The Contractor shall coordinate several measures, including (i) awareness and training of the Contractor's personnel on which bird species are protected, their nesting seasons, and seasonal variability; (ii) surveys to determine the presence of nesting birds in the Project area; (iii) establishment, maintenance, and removal of protective buffer zones around nests; (iv) installation and maintenance of exclusion devices; (v) nest prevention activities; and (vi) monitoring to ensure the adequacy of the compliance measures.

10.14.01. Scope of Work

A. The Contractor shall be aware of migratory bird nesting seasons (generally from January 15 to August 31) and variability; provide training to all Contractor personnel on the Project; monitor the Project site; perform preventative and deterrence measures to prevent birds from nesting; preserve and protect pre-established protective buffer zones; perform surveys to determine the potential for protected species to be in the Project area; establish new protective buffer zones around un-prevented nests, as required; install and/or maintain exclusion devices, such as netting and/or wire mesh screens; monitor to assure

the adequacy of the compliance measures; and perform any other Work as specified herein to comply with all applicable statutes.

B. The Qualified Biologist shall monitor regulatory compliance, train Contractor personnel, and coordinate with the Engineer in conformance with (i) this Article; (ii) the Project specific Mitigation Monitoring and Reporting Program (MMRP) requirements relating to this Article; and (iii) all applicable permit conditions. The Qualified Biologist shall:

1. Provide bird nesting awareness training for all personnel working on the Project, including all Subcontractors.

2. Monitor the Project site for nest starts and occurrences of active bird nests.

3. Document the location, status, and species of bird for each active nest.

4. Monitor the Work to ensure that protected birds are not disturbed in a manner that could result in noncompliance.

5. Establish protective buffer zones around active nests as specified herein.

6. Ensure protective buffer zones are maintained and nests are not disturbed. Advise when protective buffer zones are no longer needed and can be removed.

7. Monitor the maintenance and effectiveness of bird exclusion devices.

8. Provide recommendations concerning vegetation management, installation of additional exclusion devices, and maintenance of such devices to prevent bird nesting. Advise when exclusion devices are no longer needed and can be removed.

C. Within 14 Days of the First Chargeable Day, the District will release the site to the Contractor. Prior to the release, the Engineer and the Contractor shall assess the site to determine the presence of nesting birds and any existing protective buffer zones and exclusion devices within or near the construction areas. In no case shall the District maintain responsibility for the site for more than 14 Days after the First Chargeable Day. Upon release of the site, the Contractor assumes complete responsibility for the site, including Work site monitoring, existing protective buffer zones, and exclusion devices and shall perform all required Work as specified herein.

10.14.02. Migratory Bird Surveys

A. The Qualified Biologist shall perform migratory bird surveys prior to any Project related activity that could pose the potential to affect migratory birds.

B. The Contractor shall include activities for Qualified Biologist surveys on Project Schedules with assurance that the appropriate migratory bird surveys have been coordinated with the Qualified Biologist and will be performed in advance of activities.

10.14.03. Migratory Bird Monitoring

A. The Contractor is responsible for ongoing monitoring to ensure that migratory birds, their active nests, eggs, and young are not harmed in any way.

B. The Contractor and Qualified Biologist shall inspect all areas that may be affected by Project activities, including all vegetation, grounds, structures, and bridge(s), with sufficient frequency as needed to identify any new and partially built bird nests.

C. At the direction of the Engineer and the Qualified Biologist, the Contractor shall be responsible for the removal of any inactive or partially built bird nests with the exception of raptor nests. No birds, nests with eggs, or nests with hatchlings shall be disturbed, nor shall raptor nests be removed unless specified in the Special Provisions, Article 19. Environmental.

10.14.04. Protective Buffer Zones

A. Existing protective buffer zones, if any, are shown on the Drawings or shall be communicated to the Contractor prior to the District releasing the site. In addition to District-established buffer zones, new protective buffer zones shall be required if a nest is established or discovered during the Contractor's activities. In the event that an active nest is discovered in the Project area, or in adjacent areas considered to have the potential to be disturbed by the Contractor's activities, the Contractor shall notify the Engineer and establish a protective buffer zone around the nest. The exact location of the boundaries of protective buffer zones shall be established by the Qualified Biologist and approved by the Engineer. The Contractor shall install temporary fencing at the boundary of each new protective buffer zone except as otherwise Directed by the Engineer. The fencing shall be Type ESA Temporary Fence per Caltrans Article 14-1.03. The Contractor shall attach signs labeled "Nesting Bird—Access Prohibited" at least every 50 feet along the fencing. The Contractor shall exclude Project activities to preserve and protect all protective buffer zones, including existing ones, at all times.

B. In the event that an active nest is discovered by the Qualified Biologist, the Biologist shall immediately notify both the Contractor and the Engineer of the active nest and of the applicable protective buffer zone.

C. The Qualified Biologist shall inspect all active nesting-bird protective buffer zones(s) on at least a weekly basis until such time as the nest is no longer active as confirmed by the Qualified Biologist. Once a nest is no longer active, the protective buffer zone shall be removed.

D. The Contractor shall be responsible for any added costs or schedule Delays as a result of the establishment of new nests or of new protective buffer zones due to the Contractor's failure to perform bird exclusion responsibilities.

E. The Contractor shall monitor protective buffer zone operations during the Project. Requirements for the protection of active nests may vary depending on the location and the species involved. The following are general guidelines to be followed by the Contractor when an active nest is encountered:

1. Stop any activities that may harm the nest.

2. Contact the Engineer immediately.

3. Only the Qualified Biologist should approach the nest and only if necessary.

4. The Contractor shall inform personnel of the presence of an active nest and take steps, described above, to avoid disturbing it.

5. Until inspected by the Engineer or Qualified Biologist, a 20-foot-radius protective buffer zone shall be established around the nest of any non-raptor, ground nesting bird, and a 50-foot-radius protective buffer zone around nests established in shrubs, trees, on structures, on Equipment, etc., except for raptor nests. Furthermore, the protective buffer zone shall be 250 feet for nesting raptors (including hawks), owls and burrowing owls, falcons, eagles, herons, and egrets. The Qualified Biologist may recommend, for approval by the Engineer, modification of these zones.

6. Refer to Section 19. Environmental for additional specific buffer zone requirements.

10.14.05. Exclusion Devices

A. The Contractor shall install nesting exclusion devices to prevent potential establishment or occurrence of a nest in the Project area during Project activities. The Contractor shall maintain all nesting exclusions devices, including existing ones, throughout the nesting season or until completion of Work in an area makes the devices unnecessary. The Contractor shall be responsible for the maintenance, repair, or replacement of exclusion devices until all of the Work is complete. The Contractor shall remove and dispose of all exclusion devices, including those installed by the District, when Work in the area is complete.

B. Bird exclusion devices shall be installed during the non-nesting season (generally September 1 through January 14). The Contractor shall obtain favorable review from the Engineer when installing bird exclusion devices during the nesting season (generally January 15 through August 31). At a minimum, all exclusion devices shall be inspected daily by the Contractor and weekly by the Qualified

Biologist to ensure integrity of the devices and to prohibit birds from nesting without causing them harm.

10.14.06. Nest Prevention

A. The Contractor is hereby notified that all areas to be cleared of vegetation may be suitable nesting habitat for migratory birds. The Contractor shall perform all necessary clearing prior to the nesting season if at all possible. If clearing must occur during the nesting season, the Contractor shall obtain prior approval from the Engineer. If vegetation must be cut and maintained to prevent birds from nesting, it must be cut to less than six (6) inches in height and removed.

B. The Contractor shall inspect and monitor bare areas and gravel areas prior to commencement of the nesting season and as frequently as necessary thereafter and provide deterrence measures if necessary to prevent ground-nesting birds, such as killdeer, from establishing a nest.

C. Removal of vegetation (trees, shrubs, grasses, and herbaceous plants) shall be limited to areas shown on the Drawings designated for vegetation removal unless approval is obtained from the Engineer to remove vegetation from additional areas. No vegetation shall be trimmed back unnecessarily, including trees and/or shrubs growing near the right of way that overhang onto the worksite. Such overhanging foliage shall be protected and tied back if necessary. Landscaped areas and irrigation systems outside of the construction areas shall be preserved and protected from damage by the Contractor's activities.

D. Pre-established Vegetation Management Areas: Some areas of vegetation removal, clearing, and eradication may be established and cleared by the District prior to the First Chargeable Day. In these areas, the Contractor shall be responsible for the continued clearing and eradication of all re-sprouts.

10.14.07. Submittals

A. Submit a résumé of qualifications of the Qualified Biologist for the Engineer's favorable review. The Qualified Biologist's qualifications must meet the minimum requirements as specified for the Qualified Biologist listed in Section 19. Environmental. The résumé shall be submitted and must be favorably reviewed by the Engineer prior to any Work.

B. Submit migratory bird survey reports to the Engineer within two (2) Days upon completion of the survey and at least two (2) Days prior to commencement of Project related activities.

C. Submit the Qualified Biologists' training materials for favorable review by the Engineer, prior to presenting bird nesting awareness training to personnel.

D. Submit to the Engineer no later than the 15th Day of each month a monthly report prepared and signed by the Qualified Biologist that documents the activities of the Contractor, including, at a minimum, the status of awareness trainings

provided, the installation, maintenance, or removal of any bird exclusion devices or protective buffer zones and their locations and monitoring results, and report the current status of previously documented bird nests.

E. When requested by the Engineer, maintain and submit a log of weekly documentation (including photo-documentation) of the time, date, condition of the nests, and any nest-prevention actions taken during inspections.

F. Submit to the Engineer product data for nesting exclusion devices, fencing for protective buffer zones, and any shop Drawings as deemed appropriate by the Engineer.

G. If the Contractor wishes to modify the dimensions of any protective buffer zone or modify any bird exclusion device, a written proposal of such modification must be submitted and favorably reviewed by the Engineer. The submittal must contain the Qualified Biologist's written justification for the proposed modification and shall include a description of the anticipated effects on the active nest and on nesting birds.

10.15. Other Wildlife and Fish Species

A. The Contractor shall comply with all regulatory and permit requirements pertaining to other wildlife and fish species as identified in Section 19. Environmental.

10.16. Sensitive Plants and Vegetation

A. The Contractor shall comply with all regulatory and permit requirements pertaining to sensitive or listed plants and vegetation communities as identified in Section 19. Environmental.

10.17. Proper Pruning Techniques for Woody Vegetation Removal

A. An International Society of Arboriculture (ISA) Certified Arborist or Tree Worker is to be present at all times during pruning. Contractor shall comply with the following:

1. All pruning shall be in accordance with the most current editions of the Best Management Practices for Pruning (International Society of Arboriculture) and the American National Standard for Tree Care Operations (ANSI booklet Z133.1) and Pruning (ANSI booklet A300).

2. Pruning for clearance: Selectively remove only branches required for passage and movement of construction equipment.

3. Remove stubbed branches at the point of origin, outside the bark branch ridge.

4. No more than 25 percent of live foliage shall be removed from any tree at any one time (or in a given year).

5. Branch removal or reduction cuts (thinning cuts) are to be employed rather than heading cuts. Trees shall not be topped or headed back.

6. All cuts shall be distal to the branch bark ridge or, if present, the branch collar. The cuts shall be close to but shall not injure the branch collar. All final cuts shall be in one plane, with no torn bark.

7. Pruning cuts larger than 4 inches in diameter, except for dead or stubbed branches, shall be avoided.

8. Pruning operations shall be conducted in a manner that does not damage surrounding understory plants, if present.

SECTION 11. CONTRACT CLOSEOUT

11.01. Project Completion and Acceptance

11.01.01. Use Before Acceptance

A. The District has the right to utilize or to place into service any item of Equipment or other usable portion of the Work before Acceptance of the entire Project. The District's exercise of said right shall hereinafter be referred to as Use Before Acceptance.

B. Where Use Before Acceptance is identified in the Contract Documents, it shall be considered part of the Work; no additional compensation or payment shall be made.

C. Should the District desire Use Before Acceptance that has not been identified in the Contract Documents, the Engineer shall notify the Contractor in writing, identifying the specific portion or portions of the Work proposed for Use Before Acceptance.

D. The Contractor shall provide written notice within ten (10) Days after a request for Use Before Acceptance by the District stating whether the proposed portions of Work are suitable for Use Before Acceptance and if there are any associated costs, constraints, or other impacts.

E. Until Use Before Acceptance, the Contractor is responsible for all care and maintenance of all items or portions of the Work.

F. Unless the Engineer requires the Contractor to execute a Use Before Acceptance Guarantee as provided in Article 11.02.03. Use Before Acceptance Guarantee, upon the District's issuance of written notice of Use Before Acceptance, the District accepts responsibility for the protection and maintenance of all such items or portions of the Work described in the written notice, with the exception of any injury or damage resulting from the Contractor's actions or from negligence.

G. If, by reason of the District's unidentified Use Before Acceptance, the premium for the Contractor's bodily injury and property damage insurance is increased, the District shall reimburse the Contractor for the additional amount necessarily incurred, allocable to the area and the period of the District's use up to the date of Acceptance of the Work.

H. The District's Use Before Acceptance does not constitute Acceptance of the Work, or of any portion of the Work, by the District, nor does it relieve the Contractor of responsibility for correcting defective and/or deficient Work or Material found at any time before Acceptance of the Work or during the guarantee period after the District's Acceptance. Notwithstanding any Use Before Acceptance, the Contractor retains full responsibility for fulfilling all of the requirements of the Contract Documents.

11.01.02. Contractor's Responsibility to Manage Incomplete and Deficient Work

A. The Contractor is responsible for identifying and managing incomplete and deficient Work. Incomplete and deficient Work includes, but is not limited to, noncompliance items, rework items, and nonconforming tests; deficiencies relating to inspections by the building official; administrative requirements; and items of Work not complete per the Contract.

B. The preliminary final and final inspections shall not be conducted until:

1. the entire Work of the Milestone/Project is complete;

2. cleaning has occurred pursuant to Standard Provisions Article 11.04. Final Cleaning and to Special Provisions Article 22.06. Final Cleaning; and

3. deficient Work identified in all outstanding noncompliance notices and/or deficiency lists has been corrected.

C. For each Milestone Completion, the Contractor must include activities for conducting the preliminary final inspection, completion of deficiency list, and final inspection in the Contractor's Detailed Progress Schedules.

D. The District may withhold the estimated cost of the incomplete and deficient Work and consequences thereof until it is completed in accordance with the requirements of the Contract Documents.

11.01.03. Milestone Completion Preliminary Final Inspection

A. When the Contractor believes the Work of a Milestone or Project is complete, including final cleaning of the Work area associated with the Milestone, the Contractor shall submit to the Engineer a written certification that the Work of the Milestone is complete and shall request a preliminary final inspection of the work of the Milestone by the District.

B. Prior to requesting the inspection, the Contractor shall furnish the following Milestone Completion Certification to District:

"To the best of my knowledge, all Work of Milestone (#) has been completed, inspected, and tested and is in full compliance with the requirements of the Contract."

Certified by Contractor: _____ *Date:* _____
(Signature)

C. Within seven (7) Days of receipt of the Contractor's certification that all Work of a Milestone/Project is complete, the Engineer shall conduct a preliminary final inspection with the Contractor.

D. If the Engineer determines that, based on the results of the preliminary final inspection, the incomplete/deficient Work identified is greater in substance and/or volume than can be appropriately declared on a Deficiency List, then the Work is not complete enough to complete the preliminary final inspection. The Contractor shall be so notified in writing. The Contractor must complete the Work and reinitiate procedures for another preliminary final inspection. Any costs to the District for more than two (2) preliminary inspections may be charged to the Contractor.

E. If the results of the preliminary final inspection are satisfactory to the Engineer, a Deficiency List shall be prepared and issued to the Contractor. Neither the District's preparation of the Deficiency List, nor any omission from the Deficiency List of items of incomplete and/or deficient Work relieves the Contractor from completing all the Work required by the Contract.

11.01.04. Milestone Completion Final Inspection

A. Prior to requesting the milestone completion final inspection, the Contractor shall furnish the following milestone completion certification to the District:

"The work of Milestone (#) has been completed, inspected, and tested and is in full compliance with the requirements of the Contract. All Deficiency List items identified during the Preliminary Final Inspection have been completed."

Certified by Contractor: _____ *Date:* _____
(Signature)

B. Upon delivery of this certification to the Engineer and if the Engineer agrees with the Contractor's certification, a final inspection shall occur within ten (10) Days of the Contractor's delivery of the milestone completion certification.

C. If the Engineer determines the Work is deficient, the Contractor shall again be furnished with a Deficiency List identifying the observed deficiencies in the Work. After all deficiencies have been corrected, the Contractor must initiate procedures for another final inspection. If more than two (2) final inspections are required, any costs to the District for additional final inspections may be charged to the Contractor.

D. After Acceptance of the Contractor's milestone completion certification following the final inspection, the Engineer shall issue a milestone completion letter to the Contractor. This letter will establish the date of the completion of the milestone. The assessment of Liquidated Damages, if applicable, shall cease accruing as of the date of the milestone completion.

E. The Contractor's Detailed Progress Schedules must include activities for final inspection of milestones.

11.01.05. Project Completion

A. The Contractor shall certify that the entire Work of the Project is complete. Completion of the Project includes submission to and acceptance by the District of all milestone completion submittals. Article 22.05. Submission Closeout Items, describes in greater detail the submittal requirements for Contract Closeout.

B. Prior to the Engineer issuing the Project completion letter, the Contractor shall furnish the following Project completion certification to the District. This certification is in addition to any intermediate Milestone completion certifications:

"*The entire Work of the Project has been completed, inspected, and tested and is in full compliance with the requirements of the Contract Documents. All Deficiency List items have been completed. All items on the rework list have been completed. All Closeout Documents required by Article 22.05. Submission of Closeout Items, have been submitted to and accepted by the Engineer."*

Certified by Contractor: _____ *Date:* _____
(Signature)

C. The Contractor's certification shall also include the completion of all Deficiency List Work and the correction of all rework.

D. After acceptance of the Contractor's final certification, the Engineer shall issue a Project completion letter to the Contractor. This letter shall establish the date of the completion of Project. The assessment of Liquidated Damages, if any, shall cease accruing as of the date of Project completion.

11.01.06. Acceptance of Work

A. After issuing the Project Completion letter, the Engineer shall recommend that the District Board of Directors formally accept the Work.

B. Acceptance of Work shall be made by the District Board of Directors and only after the Engineer has recommended acceptance.

C. After the Board of Director's formal Acceptance of Work, the Clerk of the Board shall record a Notice of Completion of Contract and Acceptance of Work.

D. The District's Acceptance of Work establishes conformity with the Contract except for Delays in completion, latent defects, fraud, or such gross errors as amount to fraud, willful misconduct, or gross negligence, and are subject to any guarantee and warranty, express or implied. Determinations by the Engineer that the Work is complete or Acceptance of Work by the Board of Directors does not bar any action by the District against the Contractor pursuant to Article 11.02. Guarantee and Guaranty Bond.

11.02. Guarantee and Guaranty Bond

11.02.01. Guarantee

A. The guarantee period for any item of Equipment or usable portion of the Work that the District utilizes or places into service shall commence on the date of the Notice of Completion of Contract and Acceptance of Work.

B. The Contractor hereby agrees to make, at its own expense, all repairs or replacements necessitated by defects in Material or workmanship supplied or constructed under the terms of this Contract and to pay for any damage to other Work resulting from such defects that becomes evident within a minimum of three (3) years after the date of Notice of Completion of Contract and Acceptance of Work or within such period of time as may be prescribed by law. The Contractor further assumes responsibility for a similar guarantee for all Work and Materials provided by Subcontractors or by manufacturers of packaged Equipment components. The Contractor also agrees to indemnify, defend, and hold the District harmless from liability of any kind arising from damage due to said defects.

C. The Contractor-furnished Guarantee and Guaranty Bond specified herein shall be in addition to any Equipment, workmanship or Material warranties specified elsewhere in the Contract or as provided by the manufacturer. The Contractor shall provide copies of all warranties required of the Specifications in addition to the Guarantee and Guaranty Bond.

D. The Contractor shall execute and submit to the Engineer a completed Guarantee Form and Guarantee Bond for the Work in the format provided.

E. The Contractor shall, upon receipt of notice in writing from the District, promptly make all repairs arising out of defective Materials, workmanship, or Equipment. If the Contractor has failed to make the repairs with due diligence within ten (10) Days after giving this notice to the Contractor, the District is hereby authorized to make such repairs. In case of emergency, where, in the opinion of the District, Delay could cause serious loss or damage, repairs may be made without notice sent to the Contractor. The Contractor and its Surety shall be liable for any expense in connection with repairs performed by the District or by its agents.

F. Prior to the expiration of the guarantee period, the District reserves the right to hold a meeting and require the attendance of the Contractor and relevant Subcontractors and Suppliers at no cost to the District. The purpose of the meeting is to review guaranties, bonds, and maintenance requirements and to determine the required repair or replacement of defective items.

G. For the purpose of this Article, Acceptance of the Work or a portion of the Work by the District shall not extinguish any covenant or Agreement on the part of the Contractor to be performed or fulfilled under this Contract that has not, in fact, been performed or fulfilled at the time of such acceptance. All covenants and

agreements shall continue to be binding on the Contractor until they have been fulfilled.

11.02.02. Guaranty Bond

A. The Contractor shall furnish a written Guaranty Bond in the format provided below prior to issuance of the Project Completion letter. The Guaranty Bond shall be executed by both the Contractor and the surety (who must be an admitted surety in accordance with California Code of Civil Procedure Section 995.670). This Guaranty Bond shall be for a period of three (3) years after the date of Notice of Completion of Contract and Acceptance of Work and shall cover all Work.

B. The amount of the Guaranty Bond shall be no less than 15 percent of the total Contract Price(s).

SANTA CLARA VALLEY WATER DISTRICT

GUARANTEE FORM

Guarantee for

(Project Name and Project Number)

City, State

We hereby guarantee the Project commonly known as _____ has been completed in accordance with the requirements of the Contract Documents and further agree that the Work to be free of defects in workmanship, Materials, and Equipment and to remain free of such defects for a period of three (3) years from the date of Acceptance of Work by the District's Board of Directors.

We agree that if any defects in Materials, workmanship, or Equipment become evident, we shall, within ten (10) Days after written notice of such defects, commence to repair or replace the same together with any other Work that may be damaged or displaced in so doing.

In the event of our failure to comply with the above-mentioned conditions within a reasonable time after being notified, or should the emergencies of the case require repairs or replacements to be made before we can be notified or respond to notification, we do hereby authorize the Santa Clara Valley Water District to proceed to have the defect repaired and made good at our expense; we shall pay the cost therefor upon demand.

The guarantee provided herein shall not be in lieu of, but shall be in addition to, any warranties or other obligations otherwise imposed by the Contract Documents and by law.

Contractor: _____

Signature: _____

Title: _____

Date: _____

SANTA CLARA VALLEY WATER DISTRICT

GUARANTY BOND

BE IT KNOWN BY THESE PRESENTS: That

WHEREAS, the Santa Clara Valley Water District, State of California, has awarded to _____ (hereinafter designated as "Principal") a Contract for _____; and

WHEREAS, said Principal is required under the terms of said Contract to furnish a Guaranty Bond for the faithful performance of said Contract's guarantee.

NOW, THEREFORE, we, the Principal and

_____ as Surety, are held and firmly bound unto the Santa Clara Valley Water District (hereinafter called "District") in the sum of

_____

Dollars ($_____) lawful money of the United States, for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH that if the above Principal, or heirs, executors, administrators, successors, or assigns shall in all things stand to and abide by, and well and truly keep and perform the covenants, conditions and agreements in the said Contract and any alteration thereof made as therein provided, to be kept and performed at the time and in the manner therein specified, and in all respects according to their true intent and meaning, and shall indemnify and save harmless the District, its officers, agents, and employees, as therein stipulated, then this obligation shall become null and void; otherwise it shall be and remain in full force and effect.

And the said Surety, for value received hereby stipulates and agrees that no change, extension of time, alteration, or addition to the terms of the Contract or to the Work to be performed thereunder or to the Specifications accompanying the same shall in any way affect its obligation on this bond, and does hereby waive notice of any such change, extension of time, alteration, or addition to the terms of the Contract or to the Work or to the Specifications.

In the event suit is brought upon this bond by the District and judgment is recovered, Surety shall pay all costs incurred by the District in such suit, including a reasonable attorney's fee to be fixed by the Court.

IN WITNESS WHEREOF two identical counterparts of this instrument, each of which shall for all purposes be deemed an original thereof, have been duly executed by the Principal and Surety above named, on the _____ Day of _____, 2_____.

_____ (Seal) _____ (Seal)
_____ (Seal) _____ (Seal)
_____ (Seal) _____ (Seal)

Principal *Surety*

Address: _____
_____

NOTE: Signature of those executing for Surety must be properly acknowledged.

11.02.03. Use Before Acceptance Guarantee

A. For Equipment or components of Equipment or other usable portions of the Work utilized or placed into service for the District's benefit during the progress of the Work and prior to Acceptance of Work, the Contractor shall submit the guarantee certificate below on the Contractor's letterhead.

(Contractor's Letterhead)

USE BEFORE ACCEPTANCE GUARANTEE

FOR

EQUIPMENT OR OTHER USABLE PORTION OF THE WORK INSTALLED BY CONTRACTOR

AND

USED BY DISTRICT BEFORE ACCEPTANCE OF WORK

We (Name of Contractor), agree to maintain and repair as recommended by the manufacturer the following described Equipment (system) or other usable portion of the Work that has been utilized or placed into service by the personnel of the District prior to Acceptance of Work. The guarantee provided herein shall not be in lieu of, but shall be in addition to, any warranties, performance bond, payment bond, or other obligations otherwise imposed by the Contract Documents and by law.

Owner: Santa Clara Valley Water District

Description of Equipment or other portion of the Work: _____(Include manufacturer name, model number, serial number, and such other information as needed to positively identify the Equipment/system or portion of Work.)

Location of Equipment: _____

Installed under: (Contract Number and Contract Title)

Date Installed: _____

Date of first utilization or placement into service by the District: _____

This guarantee is effective upon date shown herein under, and shall remain effective until the District's Acceptance of Work.

Name of Contractor: _____

By: _____

Address: _____

Phone: _____

License No.: _____

Date: _____

11.03. Submission of Closeout Items

A. At completion of construction and prior to issuance of the Project Completion letter by the District, the Contractor shall deliver the following documents to the Engineer in the following form:

1. One original set of As-Built Drawings in accordance with Article 14.11.01. As-Built Drawings.

2. Field Test Records (two) 2 copies): Unless required to be submitted elsewhere in the Specifications, field test records shall be submitted as a closeout item bound into three ring vinyl binders with clear plastic spine label pockets with all pages numbered. A complete, neat, word processed table of contents for each binder with page numbers for each entry must be provided.

3. Field survey record documentation.

4. Evidence of compliance with and approval of Contractor obtained permits and associated inspections of authorities issuing the permits.

5. Copies of all special guarantees, warranties, and bonds.

6. Release of Claims in accordance with Article 6.03. Final Payment.

7. Records indicating the District's receipt and acceptance of all tools, spare parts, and extra Material as specified in these Specifications.

8. Records indicating the District's receipt and acceptance of all O&M manuals as specified in these Specifications.

9. Any and all administrative paperwork required for closeout.

B. Accompany the closeout document submittal with a transmittal letter in duplicate containing the following:

1. Date
2. Santa Clara Valley Water District Project name and Project number
3. Contractor's name and address
4. Title and number of each document
5. Certification that each document as submitted is complete and accurate
6. Signature of Contractor

C. The Contractor shall turn over all keys to new and existing facilities to the Engineer. This includes keys that were loaned (if any) to Contractor staff by the District for use during the construction period. The Contractor shall provide a written description or schedule describing which keys correspond to which doors, gates, or other feature.

11.04. Final Cleaning

11.04.01. Scope and Schedule for Final Cleaning

A. Final cleaning is separate Work from cleaning done throughout the Project to maintain the Project site in a safe and presentable condition. Final cleaning shall be a comprehensive cleanup of all new and existing facilities affected by the Work prior to and finished within 30 Days of the District's approval for continuous use and occupancy. Final cleaning may be performed separately by structure or area at different time periods only if approved by the Engineer.

B. Completion of this Work shall be planned and scheduled to accommodate the operational requirements of this District facility.

11.04.02. Final Cleanup

A. Before final inspection, the Contractor shall clean the premises and, unless otherwise specified, remove from the worksite and areas adjacent to the worksite, all building Material, rubbish, debris, unused Material, concrete forms, falsework, temporary structures, and other Material and Equipment used during the construction. All parts of the Work shall be left in a neat and presentable condition to the satisfaction of the Engineer.

11.04.03. Structures

A. Structures shall have the interiors and exterior surfaces cleaned by a professional industrial janitorial service fully knowledgeable in proper and effective cleaning methods.

B. The structures shall be thoroughly cleaned and shall include, but shall not be limited to, the following cleaning activities:

1. Paint, glazing compounds, and other Material shall be removed from glazing and skylights. Glazing and skylights shall be washed and polished on both sides. Care shall be exercised so that the glazing is not scratched or damaged.

2. Interior surfaces, including walls, ceilings, light fixtures, doors, jambs, sills, piping, ducts, Equipment, electrical panels and conduits, handrails, guardrails, gratings, pipe trenches, drains, and miscellaneous fixtures shall be cleaned. Stains, spots, dirt, and dust shall be removed.

3. Temporary floor protections shall be removed; floors shall be vacuumed and washed; floors other than concrete shall be waxed and buffed.

4. Door and window hardware shall be cleaned and polished after all traces of stains, dirt, paints, and blemishes are removed.

5. Casework and plastic laminate surfaces shall be cleaned and polished.

6. Marks, stains, fingerprints, soil, and blemishes shall be removed from painted, decorated, or stained interior surfaces.

7. Spots, soil, paint, grout, plaster, concrete, and similar substances shall be removed from tile and the tile shall be washed.

8. Exterior walls, doors, and louvers shall be washed.

9. All interior and exterior signage shall be cleaned.

C. All concrete decks and floors shall be swept and washed. Stains, including oil stains, metal rust, and weld splatter shall be removed. Spills of construction Materials, including paint, concrete, grout, adhesives, insulating Materials, chemicals, and similar Materials shall be removed and the underlying surfaces cleaned.

11.04.04. Streets, Roadways, Concrete Slabs, Sidewalks, and Paved Areas

A. Streets, roadways, concrete slabs, sidewalks, and paved areas shall be cleaned and pressure washed so that they are free of debris, soil, and paint or construction Material spills. Painted construction markings on concrete and pavement shall be removed.

B. All access roads and maintenance roads shall be graded, removing wheel tracks and smoothing up such roads, and restored to their specified condition, or if none specified, to the condition then existing prior to the start of construction.

11.04.05. Storm Drainage Facilities

A. All gutters, V ditches, swales, storm drain pipe inlets, catch basins, drop inlets, and manholes shall be cleaned of soil, vegetation, and debris.

11.04.06. Unpaved Areas

A. Unpaved areas between new facilities and between new and existing facilities shall be cleaned of all debris and construction Material. These areas shall be graded or raked to a smooth uniform surface without leaving holes, depressions, or tire tracks.

SECTION 12. WORK AND CONTRACT TIME(S)

12.01. Summary of Work

A. The Work to be completed under this Contract shall consist of furnishing all tools, equipment, materials, supplies, and manufactured articles, and all labor, transportation and services, including fuel, power, water, and essential communications, and for performing Work or other operations required to construct the Santa Clara Valley Water District Residuals Remediation Project (SCVWD Residuals Remediation Project) as illustrated on the Plans and as detailed in these Specifications. Any quantities provided with Article 12.01. Summary of Work are approximate. Should there be a discrepancy between the quantities included herein and elsewhere in the Contract documents, those quantities specified elsewhere on the Contract shall govern.

B. The Work includes, but is not limited to, the following:

1. Mobilization of contractor's staff and workspaces.
2. Demolition as shown on the drawings.
3. Modification of piping on the inlet side of the existing gravity thickeners.
4. Replacement of the thickener mechanism rake arms and installation of new access hatches.
5. Modification of the thickener sludge withdrawal piping.
6. As a Supplemental Bid Item, replacement of two existing centrifuge feed pumps and repurposing them for sludge transfer.
7. Construction of one reinforced concrete sludge storage tank.
8. As a Supplemental Bid Item, construction of a second reinforced concrete sludge storage tank.
9. Construction of four new centrifuge feed pumps.
10. Modification of the existing belt press building for installation of two new centrifuges, new sludge conveyors and a new polymer storage and feed system.
11. Installation of new conveyors.
12. Construction of a new centrate wetwell and related piping/valving.
13. Replacement of existing loadout conveyors on the existing loadout structure.

14. Installation of permanent platforms for access to existing and new sludge conveyors.

15. Miscellaneous improvements to the existing Residuals Management System equipment and facilities.

16. Yard piping as shown on the drawings.

17. Related electrical and instrumentation & control work.

18. Testing and start-up of new and modified equipment and systems.

19. Restoration and demobilization.

12.02. Drawings

A. The Drawings accompany these Specifications and are made a part thereof.

12.03. Contract Time(s)

A. The Contractor shall complete all Work required under this Contract before the expiration of **550 Calendar Days** from the first chargeable Day of the Contract. The first chargeable Day of the Contract shall be defined in the NTP issued by the District.

B. The Contractor is advised that dry conditions may not exist and that flow in various watercourses encountered in this Project may occur. In no case shall any extension of time be granted if the basis of a Claim that water is flowing in a watercourse. No extension of time shall be given because of rain, or because of results of rain, except set forth in these Specifications.

C. Work shall include the following Milestones:

1. **Milestone 1:** Completion of establishing staging areas, field office facilities, temporary utilities and submitting immediate submittals following NTP. The Contractor shall be restricted from performing any site work during this period until available staging areas, field offices and temporary utilities have been established, accepted and made ready for use, and when the immediate submittals listed in Special Provisions Article 20.01.02. Immediate Submittals.

2. **Milestone 2:** Completion of Gravity Thickener inlet and outlet piping modifications, rake arm replacement, access hatch installation and related work on the Gravity Thickeners; modification of piping, installation of sump pump, piping, sample sink and instrumentation in

the Sludge Transfer Area; and replacement of the existing centrifuge feed pumps, if Alternative Bid Item No. 1 is accepted.

3. **Milestone 3:** Completion of the new and modified centrifuge, conveyor, sludge transfer, sludge feed, and polymer systems, including yard piping, site electrical work, electrical equipment, conduit, cable, panels, and SCADA and electrical testing and including improvements to Centrifuge Building B.

4. **Milestone 4**: Completion of the Operational Readiness and Functional Testing per Special Provisions Article 22.04. Testing and Facility Start-Up, and training for centrifuge, conveyor, sludge transfer, sludge feed, and polymer systems.

5. **Milestone 5:** Completion of the equipment System Commissioning Testing per Special Provisions Article 22.04. Testing and Facility Start-Up for centrifuge, conveyor, sludge transfer, sludge feed, and polymer systems.

6. **Milestone 6:** Completion of improvements in Centrifuge Building A and demolition and restoration work in the Sludge Transfer Area.

7. **Milestone 7:** Submittal and favorable review and approval of final Operations and Maintenance (O&M) manuals with as-built testing results, manufacturer installation certifications and warranties, and final Record Documents per Special Provisions Article 14.11. Maintenance of Record Documents.

8. **Milestone 8:** Demobilization, restoration of the site, and project completion.

D. Milestone Completion:

1. The Contractor shall complete **Milestone 1** before the expiration of 30 Calendar Days from the first chargeable Day of the Contract.

2. The Contractor shall complete **Milestone 2** before the expiration of 275 Calendar Days from the first chargeable Day of the Contract.

3. The Contractor shall complete **Milestone 3** before the expiration of 365 Calendar Days from the first chargeable Day of the Contract.

4. The Contractor shall complete **Milestone 4** before the expiration of 400 Calendar Days from the first chargeable Day of the Contract.

5. The Contractor shall complete **Milestone 5** before the expiration of 465 Calendar Days from the first chargeable Day of the Contract.

6. The Contractor shall complete **Milestone 6** before the expiration of 500 Calendar Days from the first chargeable Day of the Contract.

7. The Contractor shall complete **Milestone 7** before the expiration of 510 Calendar Days from the first chargeable Day of the Contract.

8. The Contractor shall complete **Milestone 8** before the expiration of 550 Calendar Days from the first chargeable Day of the Contract.

E. See Special Provisions Article 12.05. Liquidated Damages regarding assessments.

F. See Special Provisions Section 16 Work Constraints and Site Conditions affecting time of Work.

12.04. Inclement Weather

A. The time allowance for completion of Work is based upon the inclusion of 26 Days per Calendar Year for inclement weather, which, pursuant to Standard Provisions Article 3.08.02. Inclement Weather, may be excusable. This time allowance shall be prorated for partial years.

B. The Contractor shall comply with Standard Provisions Article 3.08.02. Inclement Weather.

12.05. Liquidated Damages

A. In accordance with Standard Provisions Article 5.08. Liquidated Damages, the District may assess as Liquidated Damages the following amounts:

1. **$1,000 per Day** for failure to complete all Work of **Milestone 1** within the time limit allowed.

2. **$6,000 per Day** for failure to complete all Work of **Milestone 2** within the time limit allowed.

3. **$6,000 per Day** for failure to complete all Work of **Milestone 3** within the time limit allowed.

4. **$6,000 per Day** for failure to complete all Work of **Milestone 4** within the time limit allowed.

5. **$6,000 per Day** for failure to complete all Work of **Milestone 5** within the time limit allowed.

6. **$6,000 per Day** for failure to complete all Work of **Milestone 6** within the time limit allowed.

7. **$3,000 per Day** for failure to complete all Work of **Milestone 7** within the time limit allowed.

8. **$2,000 per Day** for failure to complete all Work of **Milestone 8** within the time limit allowed.

9. $150 for each truck operated by the Contractor, subcontractors and suppliers arriving during normal work days and hours when Contractor and responsible personnel fails to be present to properly receive delivery, hence requiring the District to reject the delivery.

10. $500 for each truck operated by the Contractor, subcontractors and suppliers arriving outside of normal work days and hours whether Contractor and responsible personnel are present receive delivery or not. District reserves right to reject delivery and require Contractor to reschedule delivery during normal working days and hours.

11. $500 for each truck operated by the Contractor, subcontractors and suppliers for each truck found to be idling or queuing at the plant entry gate or in the surrounding neighborhood without prior approval by the Engineer.

12. $500 for each truck operated by the Contractor, subcontractors or suppliers arriving or leaving the project site during the restricted periods of truck traffic passing by the Rolling Hills Middle School. Contractor's attention is directed to Article 18.08 for restricted periods.

13. $500 for each truck operated by the Contractor, subcontractors or suppliers that is found to be using residential streets (such as Wimbledon Drive, Wedgewood Avenue, Roxbury Lane, Granada Way, etc.) not specifically listed in Article 18.08 as an allowable truck route.

14. $2,500 per hour between November 15 and March 15 (low production period – under 50 mgd) in excess of the time allowed for a scheduled or for any unscheduled plant shutdown due to action(s) by the Contractor.

15. $5,000 per hour between March 16 and November 14 (high production period) in excess of the time allowed for a scheduled or for any unscheduled plant shutdown due to action(s) by the Contractor.

12.06. Bonus

A. No Special Requirements.

12.07. Changes

A. No Special Requirements.

SECTION 13. GENERAL REQUIREMENTS

13.01. Abbreviations and Acronyms

A. In addition to the abbreviations provided under Section 1 of the Standard Provisions, the following abbreviations and acronyms shall apply for this Project:

ACIL	American Council of Independent Laboratories
AITC	American Institute of Timber Construction
APA	American Plywood Association
ASME	American Society of Mechanical Engineers
ICC	International Code Council
RWTP	Rinconada Water Treatment Plant

13.02. Definition of Key Terms

A. Shutdown: A shutdown is defined as that period of time during which a normal water treatment plant function and activity cannot take place that usually results in a stoppage or reduction in water production.

B. Unscheduled Shutdown: Shutdowns initiated by or due to action by the Contractor that are beyond that anticipated or allowed in the Contract. Causes of unscheduled shutdowns could include, but are not limited to, actions causing a power outage; contaminating water such that State water quality regulations are violated or are in imminent danger of violation; and impeding chemical feed systems, water quality monitoring, or process operations.

C. Operational: To be considered Operational, a facility or facility component must be functional in all manners intended for its use at its rated capacity and through its entire operation range. Operational facilities may require transmission facilities, storage facilities, process facilities, and support systems (e.g., chemicals, water, power, communication) to be fully functional and accessible. For a new facility to be considered operational, it must be installed and tested and District personnel must have received specified training by the Contractor in the facility's operation and maintenance.

D. Continuous Operation/Continuously Operational: A completed system operating continuously, 24 hours a Day, without interruption, and without the need for intervention other than normal Operational adjustments by the District's operating personnel.

13.03. Web-Based Construction Document Management System

13.03.01. Summary

A. The Contractor, and its subcontractors and suppliers shall utilize ProjectWise Construction Management (formerly EADOC) for submission of all data and documents throughout the duration of the Contract, unless specified otherwise in the Contract Documents. The

term “Copy” or “Copies” shall refer to electronic copies unless a hard copy is specified. Where a hard copy is specified, both electronic and paper versions shall be submitted:

1. ProjectWise is a web-based construction management application hosted by Bentley Systems, Inc. ProjectWise is a registered trademark of Bentley Systems, Inc.

2. ProjectWise is paid for by the District.

3. ProjectWise will be made available to all Contractor’s personnel, subcontractor personnel and suppliers working under the Contract.

4. ProjectWise will be made available to all Contractor’s personnel, subcontractor personnel and suppliers working under the Contract.

5. ProjectWise shall be the primary means of project information submission and management.

B. Related Sections:

1. Article 7.01, Submittal Requirements and Article 20.01, Additional Submittal Requirements.

2. Article 2.04. Requests for information.

3. Article 5.06. Progress Schedules.

4. Article 14.10. Operation and Maintenance Documents.

5. Section 21—Payment Procedures.

C. The Engineer (Construction Manager) will establish the Contractor’s access to ProjectWise by allowing access and assigning user profiles to accepted Contractor personnel. User profiles will define levels of access into the system and determine assigned function-based authorizations and user privileges to enter and access information in ProjectWise. Subcontractors and suppliers will be given access to ProjectWise by and through the Contractor. Entry of information exchanged and transferred between the Contractor and its subcontractors and suppliers on ProjectWise shall be the responsibility of the Contractor.

D. Within five (5) work days after receiving the Notice to Proceed, the Contractor shall submit:

1. List of Contractor's personnel responsible for ProjectWise administration, as well as that for the Contractor's subcontractors and suppliers.

2. Include descriptions of key personnel's roles and responsibilities for this project. Contractor shall also identify its organization's administrator on the list.

E. Data entered in a collaborative mode (entered with the intent to share as determined by permissions and workflows within the ProjectWise system) by the Engineer (Construction Manager) and the Contractor will be jointly owned.

F. The Contractor is responsible for managing, tracking, and documenting the Work to comply with the requirements of the Contract Documents. The District's acceptance via automated system notifications or audit logs extends only to the face value of the submitted documentation and does not constitute validation of the Contractor's submitted information.

13.03.02. Computer and Connectivity Requirements

A. The Contractor shall use computer hardware and software that meets the requirements of ProjectWise system as recommended by Bentley Systems, Inc. and as described herein to access and utilize ProjectWise. As recommendations are modified by ProjectWise, the Contractor shall upgrade its system(s) to meet or exceed the recommendations. Upgrading of the Contractor's computer systems shall not be justification for a cost or time modification to the Contract.

B. The Contractor shall ensure that connectivity to the ProjectWise system is accomplished through DSL, cable, T-1 or wireless communications systems. The minimum bandwidth requirement for using the system is 128 kb/s. It is recommended that a faster connection be used when uploading pictures and files into the system.

C. ProjectWise currently supports Chrome, Firefox, Internet Explorer, and Safari web browsers for accessing the application.

D. ProjectWise is a web-based environment and therefore, subject to the inherent speed and connectivity limitations of the internet. The Contractor is responsible for its own connectivity to the internet. ProjectWise response time is dependent on the Contractor's equipment, including processor speed, internet access speed, etc. and current traffic on the internet. The District will not be liable for any delays associated from the usage of ProjectWise including, but not limited to, slow response time, down time periods, connectivity problems, or loss of information. The Contractor shall ensure connectivity to the ProjectWise system (whether at the home office or

job site). Under no circumstances will usage of ProjectWise be grounds for a time extension or cost adjustment to the Contract.

13.03.03. Contractor Responsibility

A. Contractor shall be responsible for scanning or otherwise converting to electronic format all project submittals and Contractor correspondence, drawings, sketches, etc., and uploading them to the ProjectWise web site.

B. The Contractor shall be responsible for the validity of its information placed in ProjectWise.

C. Accepted users shall be knowledgeable in the use of computers, including internet browsers, email programs, CAD drawing applications, and Portable Document Format (PDF) document distribution program.

D. The Contractor shall utilize the existing forms in ProjectWise to the maximum extent possible. If a required form does not exist in ProjectWise, the Contractor shall include a form of its own or one provided by the Engineer (Construction Manager) (if available) as an attachment to a submittal.

E. PDF documents shall be created through electronic conversion rather than optically scanned whenever possible. If optically scanned, the document shall be converted through an Optical Character Reader so that all documents are searchable. If the documents have multiple sections, then the Contractor shall provide a “bookmark” for each section. The Contractor is responsible for the training of its personnel in the use of ProjectWise (outside what is provided by the District) and the other programs indicated above as needed. The Contractor shall disable all security so that copying and pasting of information from the PDF document is enabled.

F. The Contractor shall provide a list of key ProjectWise personnel for the Engineer’s (Construction Manager) acceptance. Contractor is responsible for informing the Engineer (Construction Manager) of additional personnel, subcontractors and suppliers to be added to the system, or of personnel, subcontractors and suppliers to be removed from the system. The Engineer (Construction Manager) reserves the right to perform a background check on all potential users.

13.03.04. Training

A. The District will provide training consisting of two web-based seminars in conjunction with a conference call. The training seminars are 2 hours each.

B. Contractor shall arrange and pay for the facilities and hardware/software required to facilitate the Contractor's own training.

13.03.05. ProjectWise Utilization

A. ProjectWise shall be utilized in connection with all document and information management required by these Contract Documents. Documents and information to be submitted electronically include, but are not limited to, the documents described below.

B. Submittals:

1. Submittals shall be in accordance with Section 7—Submittal Management and Section 20—Submittal and Quality Requirements.

C. Administrative documents: All correspondence shall be submitted using ProjectWise. Examples include, but are not limited to:

1. Written correspondence (letters, memos, etc.).
2. Requests for Information (RFI).
3. Non-Compliance Notices.
4. Survey requests.
5. Compliance documentation (test reports, QA/QC reports, certifications).

D. Schedules:

1. All schedules and associated updates shall be submitted in accordance with Article 5.06. Progress Schedules.

2. All schedules and associated updates shall be submitted as specified in these Contract Documents and as a native backed-up file of the scheduling program being used. The schedule shall be posted as a PDF file in the format specified in these Contract Documents and as a backed-up file.

E. Operation and Maintenance Documents:

1. Operation and Maintenance Documents shall be submitted in accordance with Article 14.10. Operation and Maintenance Documents.

2. In addition to electronic copies transmitted via ProjectWise, the Contractor shall provide hard copies of each final favorably reviewed Operation and Maintenance Documents submittal.

The number of hard copies to be provided shall be as required in Article 14.10, Operation and Maintenance Documents.

F. Financial Documents:

1. Schedule of Values.
2. Monthly applications for payment.
3. Change Order requests and proposals.
4. Change Order supporting documentation, including daily extra work reports.
5. Requirements for financial documents shall be in accordance with Section 21—Payment Procedures. Supporting material for financial documents shall be submitted on ProjectWise utilizing both the ProjectWise schedule of values format and as PDF attachments.

13.04. District-Furnished Reports

A. These reports are for reference only. Any reliance on data contained within such reports is at the Contractor's own risk.

13.04.01. Geotechnical Reports

A. A geotechnical investigation consisting of soil borings was carried out for the District. The results of the soil samples and laboratory test analyses are provided in the report titled "Residuals Remediation Project, Rinconada Water Treatment Plant, Geotechnical Exploration," dated April 2, 2020.

B. An electronic version of the report is available on the District's Construction Administration webpage: www.valleywater.org/Programs/Construction.aspx

C. A hardcopy of this geotechnical report is available for review at the District office, 5750 Almaden Expressway, San Jose, CA 95118. Reference is made to Standard Provisions Article 2.05. Examination of Drawings, Specifications, and Site of Work.

13.04.02. Environmental Report

A. The following environmental reports are referenced:

1. Rinconada Water Treatment Plant Residuals Remediation Project, Second Addendum to the Mitigated Negative Declaration March 2021

2. Rinconada Water Treatment Plant Reliability Improvement Project, Final Environmental Impact Report, January 2015, and Addendum Nos. 1, 2 and 3.

3. Rinconada Water Treatment Plan Residuals Management Project, Final Initial Study/Mitigated Negative Declaration, March 2013

B. The above documents are available for review at the District office, 5750 Almaden Expressway, San Jose, CA 95118. The Contractor is advised that these documents are for the Contractor's information only.

13.04.03. Hazardous Material Investigation Report

A. No Special Requirements.

13.04.04. Cultural Resources Report

A. No Special Requirements.

13.04.05. As-Built Documents

A. The as-built or record documents referenced represent the District's knowledge of the existing facilities relevant to the planned Work areas for the Project. The as-built or record documents are for reference only; the District does not guarantee their completeness or correctness. The District makes no representation, either expressed or implied, that the conditions indicated in the Drawings, documents, or records are representative of those existing at the Site, or that different conditions may not occur or material other than that indicated or in proportions different from those indicated may not be encountered.

B. Requirements for the Contractor to field-verify existing conditions are as specified in the Contract Documents.

C. Other subsequent, undocumented improvements may also be present and would not be reflected in the as-built or record documents. Contractor's overall understanding shall be based on the Drawings and on a reasonable understanding of the facilities from a general field inspection.

D. CAD files of the Drawings and Specifications will not be provided to the Contractor. The Contractor may request PDF copies of Drawings. If the Contractor uses the Drawings for any other purpose except as-builts for the Project, all title block information and authors of the Drawings shall be removed.

E. The following reference drawings are provided:

1. "Map and Construction Plan for Rinconada Water Treatment Plant Reliability Improvement Project, Project No. 93294057," volumes 1 and 2, dated January 28, 2015.

2. "Map and Construction Plan for Rinconada Water Treatment Plant Reliability Improvement Project, Project No. 93294057 – As-Built," In Progress

3. "Construction Plans for Rinconada WTP Residuals Management Project—As-Built," dated March 2017.

4. "Sludge Dewatering at Penitencia Water Treatment Plant Project #9323 and Rinconada Water Treatment Plant Project #9329," record drawings dated May 10, 1990.

5. "Map and Construction Plans for Rinconada Water Treatment Plant Zone W-1," as-built drawings dated March 18, 1968.

13.05. Contractor's Engineering and Design

A. The Contractor shall provide engineering and design of the following Work components:

1. Excavation safety plans including but not limited to shoring, excavation support and protection.

2. That work specified to be designed by the Contractor or its subcontractors, suppliers, manufacturers, or process control system integrators.

3. Other structures or items as specified herein or as indicated on the Drawings.

B. Calculation and Details

1. Calculations and details are considered a Deferred Submittal as defined in the CBC.

2. Calculations and details shall be complete, accurate, and in accordance with the requirements of the CBC and ASCE 7, and shall be signed and sealed by a Professional Engineer registered in the State of California. The licensed discipline (e.g., civil, structural, electrical) shall be appropriate for the design.

3. Calculations shall be clear and concise and show equipment and other non-structural component anchorage forces and the capacities of the anchorage elements proposed by the Contractor. The calculations shall substantiate a complete load path from the component or equipment being anchored into the supporting structure or foundation.

4. The calculations and details shall demonstrate a complete lateral and vertical load path and shall clearly indicate all forces imposed on the supporting structure.

5. When the Contract Documents require the CONTRACTOR to design structures or structural components, calculations and details for those structures and structural components, and their supports, anchorages, and attachments, are required.

6. When computer generated calculations and analyses are included as part (or as the whole) of the calculations, the calculations shall include, but not be limited to, the following: derivations of all input parameters; clear indication of the applicable load combinations and building code equations; diagrams of all members, geometry, loads, forces, reactions and deflections, for all components and connections; and output results demonstrating all stress, force, deflection and other Contract Document and building code requirements have been satisfied.

C. See Technical Specifications for additional information.

13.05.01. Seismic Design Criteria

A. See Technical Specifications.

13.05.02. Wind Design Criteria

A. See Technical Specifications.

13.05.03. Hydraulic Design Criteria

A. No Special Requirement.

13.05.04. Truck Loading

A. Cast products used shall be designed for H20-44 truck loading except where specified otherwise.

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SECTION 14. SPECIAL REQUIREMENTS

14.01. Engineer

A. The Engineer is the Deputy Operating Officer of the Water Utility Capital Division of the District.

B. The Engineer (Engineer of Record) and Engineer (Construction Manager) are authorized representatives of the Engineer to perform specific duties and are responsible for those duties. All project correspondence shall be directed to the Engineer (Construction Manager).

C. Where the term Engineer is unclear or ambiguous, the Engineer as described in 14.01.A shall issue a written clarification upon request.

14.02. Project Signs

A. The Contractor shall install and maintain three (3) District-furnished Project identification signs at the locations shown on the Drawings and in accordance with the notes and details thereon and as specified in these Specifications.

B. The signs shall be clearly visible to the public. The bottom edge of the sign shall be as shown on the Drawings. All hardware, posts, and fasteners shall be furnished and installed by the Contractor.

C. The signs are to be picked up at the sign painter whose address and telephone are:

5905 Winfield Boulevard San Jose, CA 95123, (408) 630-3800

D. Arrangements to pick up the signs shall be made by contacting the sign painter at least two (2) working days in advance of the date of when the signs are to be picked up.

E. The Contractor shall be responsible for transporting the signs to the job site and for ascertaining all information, dimensions, connections, and appurtenances required to provide satisfactory installation of the signs.

F. The signs shall be installed prior to the start of construction and shall be maintained throughout the construction of the Project. Signs and supports shall be maintained in a neat, clean condition; and damages to structures, framings, or signs repaired until Project Completion. Remove or paint over graffiti and repair signs. Signs shall be straightened whenever they are not plumb.

G. Upon completion and acceptance of the Project by the District, the Contractor shall remove the signs and framing and return them to the District warehouse at 5905 Winfield Boulevard, San Jose, CA 95123. Arrangement to return the signs shall be made by contacting Winfield Warehouse at (408) 265-2607, extension 3800, at least two (2) working days in advance of the date of when the

signs are to be returned. The Contractor shall restore the sign-removal areas, backfill holes with soil and/or repair previous pavement saw cuts in kind, and clean the surrounding areas.

H. Sign Installation

1. Project signs furnished by the District will be approximately four (4) feet wide and up to eight (8) feet high.

2. Sign support structure shall be two (2) 4-inch x 4-inch (surfaced four [4] sides) pressure-treated-wood post supports (grade No. 2 or better, straight, with no loose knots), one on each side of the sign. Fasten posts to District-furnished signboard with 4-inch-long minimum deck screws through posts, 8 inches on center. Top edges of each post shall have a .5-inch chamfer all around. Two-thirds of the height of each sign board shall be fitted into a nominal .75-inch-deep dado (verify in field) centered on each support post.

3. Mounting hardware shall be galvanized steel, concealed or recessed fasteners.

4. Posts shall be painted with exterior quality paint, white semi-gloss.

5. Finishes and paints shall be adequate to withstand continuous exterior weathering for four (4) years without fading or damage to the appearance.

6. Sign support posts shall be installed plumb with a minimum of three (3) feet of burial in 12-inch-minimum diameter holes backfilled with concrete. The bottom of sign board shall be approximately 12 to 18 inches above grade as directed by Engineer (Construction Manager). The top of the concrete shall be sloped away from posts all around.

14.02.01. Payment

A. Full compensation for doing all Work necessary to pick up and install the District furnished signs shall be included in the lump sum price Bid for mobilization.

14.03. Office Facilities

14.03.01. Engineer (Construction Manager) and Engineer (Engineer of Record) Offices

A. The Contractor shall provide and maintain office trailers as described below for the exclusive use of the Engineer and of representatives of the Engineer. The location and condition of the office facilities shall be approved by the Engineer (Construction Manager).

B. Office facilities, furnishings, and/or equipment specified in this Special Provisions Article 14.03. Office Facilities shall be furnished, installed, and in

operating condition prior to performing any other Contract Work under the Contract.

C. The office shall consist of two (2) 12-foot-wide by 60-foot-long office trailers. These trailers shall be no older than five (5) years when installed at the site.

D. The office trailers shall be insulated and of weather-tight construction. The trailers shall be rigidly mounted and level. Stairs with a landing at floor level and guardrails shall be provided for two (2) entrance doors at each trailer, each complete with deadbolt locksets. All locksets shall be keyed alike and ten (10) keys shall be provided. The door closest to the conference room shall be provided with a ramp with a slope of no greater than a 1-foot rise to a 12-foot run, landing, and conforming to the CBC and Americans with Disabilities Act (ADA) requirements for access. Ground surfaces within 20 feet of each trailer shall be either paved or covered with six (6) inches of Class 2, aggregate-base rock compacted to 90 percent relative compaction overlying high-modulus, woven, and soil-separation geotextile. Surrounding surfaces shall be sloped to drain away from the trailers.

E. The office trailers shall have four (4) offices plus a unisex bathroom. There shall be at least one (1) operable screened window per office room. All windows shall be fitted with mini-blinds. Each trailer room shall be adequately lighted, heated, ventilated, and air conditioned. HVAC equipment shall be capable of maintaining a 70 ºF temperature within each trailer. At least six (6) air changes per hour shall be provided in all rooms except the toilet room, which shall have ten (10) air changes per hour.

F. The Contractor shall provide electrical service of sufficient capacity for all loads to the office trailers, including an adequate disconnect switch and circuit breaker panel located inside each trailer. At least one (1) grounded 120-volt electrical receptacle shall be installed on the walls of each room with a maximum spacing between receptacles of eight (8) feet.

G. Fluorescent-type lights suitable for office use will be provided inside. At least 70-foot candles of initial, uniform lighting at desk level shall be provided in all rooms except the toilet room, which shall have 30-foot candles. A weatherproof light fixture will be provided outside near each entrance door.

H. The Contractor shall provide telephone and broadband internet service to locations within the temporary office as directed by the Engineer (Construction Manager). A minimum of eight (8) separate phone lines shall be provided. Five (5) new telephone handsets shall also be provided, all with speakerphone capabilities. One (1) telephone handset shall be suitable to allow a receptionist to connect to and transfer between at least four (4) incoming telephone lines. Internet-service-provider accounts shall be provided for four (4) separate computers. All calls pertaining to the job made from the telephone provided for the Engineer's use shall be at the Contractor's expense. Broadband connection shall meet the definition of the U.S. Federal Commission as any connection to the Internet with a minimum download speed of 75 MB/s and minimum upload speed of 15 MB/s or faster in at least one (1) direction. The District does not have a shortlist of service providers as long as the minimum download and upload speeds are met.

I. The service connection shall include all necessary software and hardware, such as Ethernet cards and modems, and will be compatible with latest supported Microsoft Windows operating system.

J. The office trailer shall include the installation and setup of a networking thirty-five (35) page per minute, multifunction color digital imaging system. The system shall include network scan, copy, print, fax, stapling, sorter, and 11 x 17 capabilities. The system shall be capable of supporting up to eight end users. The system shall also include a maintenance contract for the duration of the contract, to include parts, labor, and toner sufficient to support a monthly usage of 500 pages of color and 5,000 pages of black and white.

K. The Contractor shall provide water connections, a holding tank drain, and waste system for the toilet room. The toilet room shall contain a flush-type water closet, lavatory sink with hot and cold water, mirror, an electric five (5)-gallon water heater, toilet paper and paper towel dispensers, coat hooks, a shelf, and waste receptacle. The toilet room shall be ADA accessible. The Contractor shall maintain an adequate supply of toilet paper and paper towels during the duration of the Work. The Contractor shall pump the holding tank empty whenever it is 50 percent to 75 percent full during the Work and keep it adequately charged with chemicals.

L. The Contractor shall furnish weekly janitorial services in connection with the office for the duration of the Work. Cleaning shall include emptying waste receptacles, vacuuming and mopping floors, dusting, cleaning the toilet room, and washing windows. Cleaning shall begin after 4 p.m. during weekdays. The Contractor shall also provide pest control as required during the Work.

M. The following equipment and furnishings shall be provided by and installed by the Contractor for the exclusive use of the Engineer throughout the duration of the Work. These items shall be provided at the same time that the Engineer's office is provided. The Contractor shall be responsible for all maintenance, repair, and technical support required for the supplied equipment. The

Contractor shall retain ownership of these equipment and furnishings after Project Completion.

1. Four (4) steel desks, 60 inches x 30 inches, with a minimum of five (5) side drawers and one (1) center drawer; Hon model HON-32261-WK or equal. Provide desk wings suitable for desktop computer use.

2. Seven (7) upholstered swivel desk chairs with arm rests; Hon model HON-4002GG32W or equal.

3. Five (5) metal five-drawer legal-size filing cabinets with locks and keys.

4. One (1) conference table approximately 4 feet x 8 feet.

5. Four (4) two (2)-tube fluorescent table-mounted adjustable-arm (to change fixture location and angle) desk lamps.

6. One (1) mobile print/clamp system rack, 12-clamp capacity, SAFCO SAF-5076 or equal; 12 each print clamps, 36 inches long; SAFCO SAF-5004-6 or equal.

7. Forty (40) linear feet of wall-mounted shelving, 12 inches deep, sized to hold continuous books without sagging; locations as directed by the Engineer (Construction Manager).

8. Twelve (12) identical padded metal folding chairs; KI model KRG-103-BE-0G3 or equal.

9. One (1) Work table, 29-inch desk height, 30-inch x 72-inch top; Bevis model BVS-FTE3072WA or equal.

10. Five (5) waste receptacles; Rubbermaid model RUB-R2956-0 or equal.

11. Bottled drinking water cooler with hot and cold water, small refrigerator, microwave oven, coffee machine, and paper cup dispenser. Provide five (5) five (5)-gallon water bottles and 400 paper cups each month for the duration of the Work.

12. One garment rack with top storage shelf, umbrella holder, and space for a minimum of six (6) clothes hangers; Vogel Peterson Model VOG-SGN-BK or equal.

13. Three (3) dry-erase presentation white boards, magnetic 48 inches x 72 inches, with wall mounting brackets; Quartet Model QRT-2547 or equal.

14. Two (2) dry-erase presentation white boards, magnetic 36 inches x 48 inches, with wall mounting brackets; Quartet Model QRT-2544 or equal.

15. Five (5) metal bookcases, with three (3) adjustable shelves each, commercial grade, nominal dimensions 34 inches wide x 12 inches deep x 47 inches high; Hon Model HON-S48ABC-K or equal.

N. All of the above equipment shall be new (except where specifically noted), or shall be used equipment (no older than three [3] years) in excellent condition acceptable to the Engineer (Construction Manager).

14.03.02. Contractor's Office

A. The Contractor shall provide and maintain at the Project site a suitable trailer (or trailers) office for Contractor's use. Location of Contractor and Subcontractor office trailers shall be at the Contractor's staging area shown on the Drawings and shall be as approved by the Engineer (Construction Manager) . At this office shall be kept Project copies of the Contract Documents, Project progress records, all Progress Schedules, submittals, and other relevant documents, which shall be accessible to the Engineer (Construction Manager) and to other District employees during normal working hours.

14.03.03. Removal and Disposal

B. Prior to issuance of the Project Completion letter by the District, the Contractor shall remove and dispose of its temporary facilities, material, and equipment and restore the site to its original or better condition.

14.03.04. Payment

A. Full compensation for doing all Work necessary to provide office facilities, including operating and maintenance costs as specified herein, shall be included in the lump sum price Bid for mobilization.

14.04. Use of District Facilities

A. Contractor's employees shall not use District restrooms, offices, lunch rooms, parking spaces, work rooms, or similar facilities.

B. Contractor will not be allowed to use District owned equipment in the facility including forklifts and man-lifts, unless specifically authorized by these Specifications.

14.05. Temporary Utilities

A. Temporary Electrical Power General

1. The Contractor shall provide adequate jobsite electrical distribution facilities conforming to the California Electrical Code and all applicable safety regulations.

2. The Contractor shall provide all labor materials, equipment and incidentals for installation and connection to the plant's electrical grid to provide primary power within the staging areas. It is the Contractor's responsibility to provide power poles, power lines, all step-down transformers, circuit breakers and other electrical distribution equipment required to provide power to the staging areas and Contractor's offices. The District will pay electrical energy costs associated with these connections. During planned plant shutdowns, the electric power to the staging areas will not be available and the Contractor will need to provide necessary back-up power to the staging areas.

3. The Contractor may use existing available 120V receptacles when approved by the Engineer (Construction Manager) where:

   a. They directly adjoin areas of work.
   b. Where Contractor's use does not impede District use of these receptacles or the security of these facilities.
   c. Where Contractor's use does not trip circuit breakers or ground fault protection (if exists).
   d. The Contractor provides ground fault protection if not present and otherwise required.
   e. Locations and time constraints that are approved by the Engineer (Construction Manager).

4. Engineer (Construction Manager) may revoke authorization for use of existing receptacles by the Contractor at any time without additional cost to the District.

5. The Contractor shall provide and pay for other sources of electrical power used for all other work.

6. The location of the temporary electrical service equipment and routing of overhead power and communication lines shall be mutually agreeable to the Contractor and the Engineer (Construction Manager). Overhead lines shall be avoided above all roadways and road intersections where practical. The location of the temporary electrical service equipment shall be mutually agreeable to the Contractor and the Engineer (Construction Manager).
7. Generators shall not be located less than 100 feet of the work areas of District staff and building ventilation systems and not less than 250 feet of residential houses.

B. Temporary Electrical Power During Electrical Shutdown Work

1. The contractor, at no additional cost to the District, shall maintain continuity of electrical service to all portions of the plant throughout the progress of work. The contractor shall provide all equipment and labor necessary to maintain continuity of electrical service.

2. The contractor shall supply adequately sized, reliable generators to temporarily power affected equipment and/or processes.

3. In certain special cases, this may require redundant generators capable of automatically starting in the event of a failure of the primary generator.

4. The contractor, at no additional cost to the District, shall supply fuel to power generators.

5. In the event of extended duration outages, refueling outside of regular work hours may be required and shall be provided by the contractor at no additional cost to the District.

6. The contractor, at no additional cost to the District, shall supply adequately sized fused disconnects, spice boxes, multi conductor cables, cable protectors, etc.

C. Temporary Lighting: The Contractor shall provide temporary lighting in all Work areas sufficient to maintain a lighting level during working hours not less than the lighting level required by California OSHA standards. As permanent lighting facilities are completed, these may be used in lieu of temporary facilities, provided, however, that bulbs, lamps, or tubes of such facilities used by the Contractor are replaced immediately prior to final Acceptance of the Work. All temporary exterior lighting shall be shielded and directed downward and toward the interior of the treatment plant to minimize its effects on treatment plant neighbors.

D. Temporary Heating, Cooling, and Ventilation: The Contractor shall provide means for heating, cooling, and ventilating all Work areas as may be required to protect the Work from damage by freezing, high temperatures, and weather or to provide a safe environment for workers. Unvented, direct-fired heaters shall not be used in areas where freshly placed concrete will be exposed to the combustion gases until at least two (2) hours after the concrete has attained its initial set.

E. Temporary Water: The Contractor shall (i) pay for and construct facilities necessary to furnish potable water for human consumption and non-potable water for use during construction; (ii) provide backflow-prevention devices properly sized for use on the metered, potable water connection; and (c) post ample signs throughout the Work area warning of the usage of non-potable water if non-potable water is being used. Contractor shall coordinate with

District to make necessary connections. All connections shall be provided and removed by the Contractor.

F. Temporary Sanitary Facilities: Sanitary facilities for the Contractor and all Subcontractors shall be provided by the Contractor. Sanitary facilities shall be of reasonable capacity, properly maintained throughout the construction period, and obscured from public view wherever possible. At least one (1) toilet shall be provided for every 10 workers.

G. Solid and Liquid Waste Disposal: The Contractor shall provide a sufficient number of waste receptacles, dumpsters, and bins to contain all solid and liquid waste generated from construction operations. Existing waste receptacles owned by the District shall not be used by the Contractor. Waste receptacles shall be emptied weekly at a minimum and more frequently when full.

H. Temporary Fire Protection: The Contractor shall provide portable, UL-rated, 20#, Class-A fire extinguishers at temporary Contractor, Engineer, and similar office spaces. In all other areas of construction operations, provide UL-rated, 20# or larger, Class-ABC, dry-chemical extinguishers or a combination of NFPA-recommended classes for the exposure. Comply with NFPA 10 and 241 for classification, extinguishing agent, and size required by location and class of fire exposure. Comply with the Uniform Fire Code and Cal/OSHA regulations for the number of fire extinguishers.

I. Temporary Propane Service: If required for construction operations and temporary facilities, the Contractor shall arrange with a Local propane vendor, at the Contractor's own cost, to provide adequate, temporary propane service. The Contractor shall also obtain and pay for all required permits and fees from authorities having jurisdiction. The Contractor shall pay all charges from the utility or vendor, including charges associated with the removal of the service at the end of the Work. The location of the temporary propane service Equipment shall be mutually agreeable to the Contractor and to the Engineer (Construction Manager). The Contractor shall provide all gas distribution system piping, regulators, and other incidentals necessary for safe service. Comply with NFPA 54, 55, and 58 as applicable to this Work.

J. Temporary Compressed Air: The Contractor shall provide compressors for compressed air for construction operations as required. Use of existing or new plant air compressor systems for construction operations is prohibited.

14.05.01. Payment

A. Full compensation for doing all Work necessary to provide temporary utilities shall be included in the Contract Price(s) for various items of Work involved; no separate payment shall be made.

14.06. Staging Area

A. Staging areas that are not already paved or covered with compacted aggregate base and that are used for parking vehicles and trailers; or for workshops, maintenance areas, Equipment, piping, formwork, rebar; or for storing masonry on pallets and metal product storage shall be graded, as required, and surfaced with a minimum of three (3) inches of compacted, aggregate-base rock over a high-modulus, woven, soil-separation geotextile. Areas storing aggregate base or other rock products shall also be placed on this same geotextile. The objective is to maintain separation between native and construction material. Areas storing soils and sand are not required to be surfaced with aggregate-base course.

B. Aggregate base shall be removed from all staging areas prior to Project Completion; surfaces shall be regraded to their original grades or to matching surrounding conditions as directed by the Engineer (Construction Manager).

C. Any soils contaminated with petroleum product or other Hazardous Material by the Contractor shall be removed by the Contractor and disposed of in accordance with Federal, State, and Local laws.

D. The Contractor is responsible for weed control in staging and material storage areas.

14.06.01. Payment

A. Full compensation for doing all Work necessary to provide staging areas as specified herein shall be included in the lump sum price Bid for mobilization.

14.07. District-Furnished Material and Equipment

A. (Not Used)

14.08. Salvaged Material and Equipment

A. The Contractor shall salvage the specified equipment at the Rinconada WTP and deliver the salvaged material to the District's Coyote Pump Station Facility, 18300 Peet Road, Morgan Hill, CA 95037. The Contractor shall notify the District at (408) 265-2600 at least one (1) week in advance of delivery. The Contractor shall provide all equipment and labor necessary to load, deliver, and unload the salvaged material.

1. Gravity Thickener Rake Arms
2. Centrifuge Feed Pumps (if replaced as part of Supplemental Bid Item No. 1).
3. Mixing Pumps
4. Mixing Tank

5. MCC-R

14.09. Tools and Spare Parts

A. The Contractor shall furnish special tools and spare parts specified in the Technical Specifications, or at a minimum, all special tools and spare parts recommended by the manufacturer for normal operation and maintenance of equipment. This includes special tools, instruments, accessories required for proper “in-plant” adjustment, maintenance, overhaul, and operation. Tools shall be high-grade, smooth, forged, alloy tool steel, or non-sparking material as is appropriate.

B. Special tools are considered to be those tools that, because of their limited use, are not normally available but that are necessary for the particular equipment, whether identified in the manufacturer’s standard manual or not.

C. The Contractor shall collect and store all spare parts required. All spare parts shall be carefully packed in sealed, weather-resistant cartons and all tools packed in metal tool boxes with locking clasps, each labeled with indelible markings, and shall be adequately treated for a minimum five (5)-year period of storage. Complete ordering information, including manufacturer’s name and address; part ordering information, including manufacturer, part number, part name, and equipment name and number(s) for which the part is to be used shall be supplied with the required spare parts. A list of spare parts, respectively, shall be placed in each storage container and a duplicate list included with the O&M manuals.

D. Unless otherwise specified or approved by the Engineer (Construction Manager), tools and spare parts associated with work in each Milestone shall be transferred to the District at the end of that Milestone completed. Refer to Article 16.01 regarding General Work Constraints for the work associated with each Milestone. The Contractor is responsible for the tools and spare parts until such time as accepted by the Engineer (Construction Manager) . Upon collection of all required tools and spare parts, as verified by the Engineer (Construction Manager) , the Contractor shall turn over all tools and spare parts to the Engineer (Construction Manager) with a complete inventory list. The inventory list shall include a description of all spare parts, the equipment they are associated with, the applicable Specification sections, the name and address of the supplier, and the delivered cost of each item. Copies of the actual invoice for each item shall be furnished with inventory to substantiate the delivery.

E. Special tools and spare parts shall be new and shall not be utilized by the Contractor.

14.10. Operation and Maintenance Documents

14.10.01. Scope of Work

A. The Work specified in this Special Provisions Section includes providing operation and maintenance (O&M) documents as specified herein.

B. O&M documents shall include the O&M manual for the complete system and/or the equipment maintenance data for pieces of equipment that operate on its own or as part of the complete system. The equipment maintenance data for each piece of equipment shall include booklets, literature, cut sheets, and any instructions that are packed with the equipment. The Contractor shall include information on all motors supplied with equipment and complete equipment maintenance summary sheets for every piece of equipment and instrumentation with an equipment number or tag number as specified herein.

C. O&M documents for the equipment specified under Article 14.10.06.B, and any other equipment called for in the Technical Specifications shall be provided in Article 14.10.05. Equipment, Products, and Systems Requiring O&M Documents.

14.10.02. Submittal Schedule

A. The Contractor shall submit Draft and Final O&M documents as required below in accordance with Section 7. Submittal Management.

B. The Draft O&M documents shall be submitted only after a favorable review of the shop Drawings.

C. Draft O&M documents shall be submitted and favorably reviewed by the District at least 3 weeks prior to:

1. Functional Testing; and

2. Training of each piece of equipment or system.

D. Make three (3) hard copy copies of draft O&M documents available at the Project site for use by construction personnel and by the District.

E. Make additions and revisions to the O&M documents in accordance with the Engineer's (Engineer of Record) review comments.

F. Three (3) hard copy final O&M documents shall be submitted and favorably reviewed within four (4) weeks after operator training (if applicable) or after final approval of equipment installation, whichever is earliest.

G. Reference is made to Article 12.05. Liquidated Damages for failure to submit O&M documents as required.

14.10.03. Document Contents

A. Contents for each unit of equipment and system as appropriate.

1. Description of unit and component parts.

a. Function, normal operating characteristics, and limiting conditions.

b. Performance curves, engineering data, and tests.

c. Complete nomenclature and commercial number of replaceable parts.

d. A listing of all equipment and their weights for all items weighing more than 100 pounds. A motor and speed reducer mounted on a common base shall be considered both individually and together in the listing. Other similar assemblies shall be similarly considered.

2. Operating Procedures

a. Start-up, break in, routine, and normal operating instructions.

b. Regulation, control, stopping, shutdown, and emergency instructions.

c. Summer and winter operating instructions.

d. Special operating instructions.

3. Maintenance Procedures

a. Routine and preventative maintenance operations.

b. Guide to “troubleshooting.”

c. Disassembly, repair, and assembly.

d. Alignment, adjusting, and checking.

4. Servicing and Lubrication Schedule: List of lubricants required, including time intervals for lubrication, adjustments, etc., on all new equipment furnished under this Contract and a list of all required lubricants, including a notation as to lubricant used initially in each item of equipment. For each required lubricant, a list of acceptable equivalents from at least one (1) different major manufacturer whose products are locally available near the Project site shall be provided.

5. Manufacturer’s printed operating and maintenance instructions.

6. Original manufacturer’s parts list, illustrations, assembly drawings, and diagrams required for maintenance.

a. Predicted life of parts subject to wear.

b. Items recommended to be stocked as spare parts.

7. Each Contractor’s coordination Drawings as-installed, color-coded piping diagrams.

8. List of original manufacturer's spare parts to be left with the District at completion of construction; manufacturer's current prices; address, phone number, and FAX number of authorized repair facilities; address of factory; and recommended quantities to be maintained in storage.

9. Other data as required under pertinent sections of these Specifications.

B. Contents for each electrical and electronic system as appropriate.

1. Description of System and Component Parts

   a. Function, normal operating characteristics, and limiting conditions.

   b. Performance curves, engineering data, and test data.

   c. Complete nomenclature and commercial data.

2. Circuit Directories of Panel Boards

   a. Electrical service.

3. As-installed, color-coded wiring diagrams.

4. Operating Procedures

   a. Routine and normal operating instructions.

   b. Sequences required.

   c. Special operating instructions.

5. Maintenance Procedures

   a. Routine and preventative maintenance operations.

   b. Guide to "troubleshooting."

   c. Disassembly, repair, and assembly.

   d. Adjustment and checking.

6. Manufacturer's printed operating and maintenance instructions.

7. List of original manufacturer's spare parts, manufacturer's current prices, address, phone number, FAX number, and recommended quantities to be maintained in storage.

8. As-installed control diagrams by controls manufacturer. For each control device, provide a hard copy printout of the control program, annotated to describe all logic sequences. Provide a detailed description for modifying the control program.

C. The Contractor shall be required to fill out the Mechanical equipment summary sheet, electrical equipment summary sheet, and instrumentation/controls equipment summary sheet electronically. The District will provide electronic copies of the forms to the Contractor at the beginning of construction. The electronic forms currently reside in the District's form control system (FC 1792). Examples of the forms are included at the end of this Section.

D. O&M documents shall be applicable to equipment actually furnished with general sections related to other models deleted. Manuals shall be rejected if not satisfactorily marked.

E. Such other information as may be required to provide comprehensive information on all systems, subassemblies, and components to enable operation, service, maintenance, removal and repair shall also be provided.

F. If, at the time of the Project Bid, any manufacturer, supplier, or Subcontractor offers for use or sale an electronic copy of operations and/or maintenance information, it shall be provided with the paper information.

14.10.04. Document Format

A. General Requirements: Information and data shall be provided in the English language and per the customary Imperial System units of measure and weight (feet, inches, pounds, degrees in Fahrenheit, etc.). Supplemental metric units shall be included upon request by the Engineer (Engineer of Record).

B. Paper: white 20-pound bond minimum for typed pages.

C. Size: 8½ inches X 11 inches.

D. Binders

1. Commercial quality post or ring-type binders with durable plastic covers.

2. Minimum spine size of 1 inch.

3. When multiple binders are used, correlate data into related consistent groupings.

E. Text: Manufacturer's printed data or neatly word-processed information.

F. Drawings

1. Provide reinforced-punched binder tab; bind in with text.

2. Fold larger drawings to size of text pages and include in clear plastic pockets.

G. Provide fly leaf for each separate product or for each piece of operating equipment.

1. Provide typed description of the product and major component parts of equipment.

2. Provide indexed tabs for each product and piece of equipment.

H. Provide electronic files for all non-preprinted text (Word); spreadsheets (Excel); or CAD drawings (AutoCAD) included in the O&M manuals. These files shall become the property of the District for use in a master plan O&M manual, training programs, and other uses. The electronic file shall be a fully-indexed, complete version of the O&M Manual in a portable document format (pdf).

I. Depending upon the content of the O&M documents, the cover shall include appropriate titles as follows:

1. For complete systems, “O&M Manual and Equipment Maintenance Data,” for individual equipment, “Equipment Maintenance Data.”

2. Project name.

3. District name.

4. Equipment, product, or system name as appropriate.

5. Applicable tag number.

6. Date.

7. Manufacturer’s name and address.

J. Table of Contents

1. Neatly word-processed Table of Contents for each volume, arranged in systematic order.

2. List of each equipment piece or product included and indexed to the content of volume. Reference all District equipment numbers.

K. List with each product the name, address, telephone number, fax, and website URL (if available) of the following, and identify the area of responsibility for each:

1. Subcontractor or installer.

2. Maintenance Contractor, as appropriate.

3. Local source of supply for parts and replacement and list of recommended spare parts

L. Identify each product by product name and other identifying symbols as shown on the Drawings and as specified herein, including nameplate information and shop order numbers for each item of equipment furnished.

M. Product Data

1. Include only those sheets that are pertinent to the specific products.

2. Annotate each sheet to:

a. clearly identify specific product or part installed;

b. clearly identify data applicable to installation; and

c. delete references to inapplicable information.

N. Drawings

1. Supplement product data with Drawings as necessary to clearly illustrate:

a. relations of component parts of equipment and systems;

b. control and flow diagrams; and

c. coordinated drawings to ensure correct illustration of completed installation.

O. Written text as required to supplement product data for particular installation.

1. Organize in consistent format under separate headings for different procedures.

2. Provide logical sequence of instructions for each procedure.

P. Copy of each warranty, bond, and/or service contract issued, as applicable.

Q. Provide an information sheet for the District's personnel indicating:

1. proper procedures in event of failure; and

2. instances that might affect validity of warranties.

14.10.05. Equipment, Products, and Systems Requiring O&M Documents

A. Listed below are the equipment, products, and systems for which the Contractor is required to furnish O&M documents in conformance with this Special Provisions Section. The table also includes costs assigned to each manual for use in partial payments to the Contractor.

14.10.06. Payment

A. Full compensation for doing all Work required to provide O&M documents as specified herein shall be by the specified amount per each set of O&M documents as listed above.

B. Payment for each O&M document shall be made progressively in the following manner:

Specification No.	Description of Equipment, System	Unit Cost ($)
09 67 23	Resinous Flooring	$ 400.00
10 44 13	Fire Protection Cabinets	$ 400.00
10 44 16	Fire Extinguishers	$ 400.00
23 34 16	Centrifugal HVAC Fans	$ 400.00
26 05 10	Electric Motors	$ 800.00
26 05 15	Industrial Control Panels	$ 800.00
26 05 36	Wiring Devices	$ 800.00
26 09 13	Electric Power Monitoring	$ 2,000.00
26 09 23	Lighting Control Devices	$ 800.00
26 12 16	Panelboards and Dry Type Transformers	$ 800.00
26 29 00	Low Voltage Motor Control Centers	$ 2,000.00
26 29 13	Solid State Reduced Voltage Starting	$ 2,000.00
26 29 23	Variable Frequency Drives	$ 4,000.00
26 33 53	Uninterruptible Power Single Phase	$ 4,000.00
26 43 00	Surge Protection Devices	$ 800.00
40 91 00	Process Control Instrumentation Systems	$ 4,000.00
40 91 02	In-Line Liquid Flow Measuring Systems	$ 400.00
40 91 03	Liquid Flow Detection Devices	$ 400.00
40 91 06	Level Measuring Systems	$ 400.00
40 91 07	Level Detection Switches	$ 400.00
40 91 08	Pressure Measuring	$ 400.00
40 91 09	Pressure Detection Switches	$ 400.00
40 95 10	PLC Control Systems Hardware and Software	$ 4,000.00
40 95 13	Control Panels	$ 6,000.00
40 95 20	PLC SCADA Software	$ 4,000.00
43 21 29.05	Chemical Metering Pumps	$ 4,000.00
43 22 76	Magnetic Drive	$ 2,000.00
43 23 57	Progressive Cavity Pumps	$ 2,000.00
43 25 05	Submersible Sump Pumps	$ 2,000.00
43 25 06	Submersible Solids-Handling Pumps	$ 4,000.00
43 30 00	Valves, General	$ 2,000.00
43 30 12	Valves and Gate Actuators	$ 2,000.00
43 30 14	Butterfly Valves	$ 400.00
43 30 16	Check Valves	$ 400.00
43 30 18	Ball Valves	$ 400.00
43 30 22	Gate Valves	$ 400.00

Specification No.	Description of Equipment, System	Unit Cost ($)
43 30 24	Plug Valves	$ 400.00
43 30 46	Pressure Relief Valves	$ 400.00
43 30 52	Miscellaneous Valves	$ 400.00
43 30 58	Flap Gates	$ 400.00
43 41 45	Fiberglass Reinforced Plastic Tanks	$ 2,000.00
43 52 00	Hoists and Cranes, General	$ 2,000.00
43 52 04	Davit Crane	$ 2,000.00
43 62 11	Shaftless Screw Conveyors	$ 6,000.00
46 32 60	Polymer Blending System	$ 4,000.00
46 41 00	Mixers, General	$ 2,000.00
46 41 16	Hyperboloid Type Mixers	$ 4,000.00
46 71 36	Centrifuge Dewatering Equipment	$ 6,000.00
Various Specifications	Other Equipment Not Listed in table but called out in Special Provisions	$ 10,000.00
	Total	$100,000.00

1. Forty (40) percent of the amount stated in the list above after the Contractor submits a draft O&M document that has been favorably reviewed by the District according to Special Provisions Article 14.10.02. Submittal Schedule, paragraph C.

2. Sixty (60) percent of the amount stated in the list above after the Contractor submits a final O&M document that has been favorably reviewed by the District according to Special Provisions Article 14.10.02. Submittal Schedule, paragraph F.

Santa Clara Valley Water District

EQUIPMENT DATA SHEET

FC 1792 (06-20-2017)

▶ ***Use this form to transmit new, replaced, or changed equipment information to the Asset Management Unit. For new equipment, complete the entire form. For replaced or changed equipment, only complete the sections of the forms that have changed. Asset Management Unit will add the information to Maximo as needed.***

GENERAL INFORMATION

Asset Description: _____ *Equipment ID/Tag No.: _____

Facility: _____ *Maximo Record No.: _____

System: _____ *Existing Asset No.: _____

Location in Plant or Facility: _____ *Equipment ID/Tag No., Maximo Record No. and Existing Asset No. are not requred for new assets.

☐ New Asset ☐ Replaced Asset ☐ Changed Equipment

Purchase/Replacement Cost: _____

ASSET CLASSIFICATION

Class: _____

Subclass: _____

Type: _____

▶ ***For capital projects, contractor is required to fill in these fields. Complete attribute information based on asset classification selected. See SCVWD asset classification structure or contact Asset Management Unit Manager E. Baker (x2608) for more information.***

Attributes

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

MANUFACTURER

Name: Phone:

Address: Web Site:

Manufacturer's Local Representative

Name: Phone:

Address: Web Site:

PREVENTATIVE MAINTENANCE PROCEDURES (Include task, frequency, materials, and lubricants required)

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____

Lubricants	Spare Parts
1. _____	1. _____
2. _____	2. _____
3. _____	3. _____
4. _____	4. _____

LINKS TO EQUIPMENT REFERENCES	PICTURE
O&M Manual: Submittals: Drawings:	

14.11. Maintenance of Record Documents

A. The Contractor shall maintain at the site the following record documents:

1. As-Built Drawings (full size).

2. Specifications and Addenda.

3. Favorably reviewed submittals, including shop Drawings, product data, samples, calculations, and other submittals.

4. PCOs, Change Orders, DCOs, field orders, and other Contract modifications.

5. Field and shop testing records.

6. Survey records.

7. Correspondence.

B. The Contractor shall provide files and racks for orderly storage of the documents; maintain the documents in clean, dry, legible condition, and make all documents and samples available during regular business hours for inspection and reproduction by the Engineer.

C. The Contractor shall keep the record documents current with construction in progress. Completed construction Work shall not be permanently concealed until required information has been recorded on the As-Built Drawings.

14.11.01. As-Built Drawings

A. The Contractor is required to keep on site and available for inspection at any time an accurately marked, legible, up-to-date set of Contract Drawings (as-built Drawings) for the Work installed. The Contractor shall record as the Work progresses changes to the original Contract Drawings, including, but not limited to, the following items:

1. Field changes or adjustments in the final location or in the final dimensions or details of the Work.

2. Changes resulting from RFIs, Change Orders, DCOs, and other Contract modifications.

3. Locations of underground and above-ground utilities and appurtenances referenced to permanent, accessible features of the Work.

4. Details not included in the original Contract Drawings but incorporated into the Work, referenced to approved shop Drawings, product data, samples, calculations, or other submittals.

5. Location of items embedded or concealed from view (e.g., conduits, cables, junction boxes, piping, etc.).

B. Changes shall be clearly described on the Drawings by note as required.

C. All entries shall be dated, calling attention to the entry by a “cloud” drawn around the area or areas affected.

D. The as-built Drawings shall be kept in a safe place and protected from damage by weather and manhandling. As-built Drawings shall be stored apart from documents used for performing the Work and shall be kept in a dry, legible condition and in good order. Do not use as-built Drawings for construction at the job site.

E. Changed Work or conditions of the Work covered up or concealed by the Contractor in advance of recordation on the as-built Drawings shall be uncovered to allow accurate recordation of the change then re-covered all at the Contractor’s expense.

F. Changes shall be marked directly on the Contract Drawings in accordance with instructions provided in Appendix B. If there is insufficient space on a Drawing to mark up the change, the Contractor shall draw additional sketches to completely show the change and shall attach the sketches to the Drawing.

G. The Engineer has the right to review the Contractor’s as-built Drawings at any time to ascertain that they are being kept up to date and that they show sufficient detail. Should the Contractor’s as-built Drawings not be up to date or should they lack necessary detail per the as-built guidelines, the Engineer may withhold five (5) percent from each monthly progress payment until the Drawings are deemed acceptable by the Engineer. Such review by the Engineer shall not relieve the Contractor of its responsibility for keeping the as-built Drawings current and complete.

H. The construction as-built Drawings shall be stamped “As-Built” and shall be, at completion of construction, signed and dated by the Contractor and submitted as required in Article 11.03 Submission of Closeout Items.

14.12. Emergency Work

A. The Contractor shall have personnel available on call for emergency Work connected with those improvements, tie-ins, and modifications being completed as part of this Work. Contractor on-call personnel shall be able to be on site within two (2) hours of verbal notice, 24 hours a day, seven (7) Days a week. Telephone numbers for these individuals shall be provided to the Engineer (Construction Manager) and shall be kept current.

14.13. Dispute Review Board

A. A Dispute Review Board (DRB) process is required and shall be in accordance with Article 3.13. Dispute Review Board. The Three Party Agreement referenced in Article 3.13.01 provided in Appendix C.

14.13.01. Payment

A. Full compensation for doing all Work necessary to comply with the Dispute Review Board requirements as specified in these Specifications shall be included in the lump sum price Bid for Bid Item No. 27 Dispute Review Board. Payment shall be in accordance with Standard Provisions Article 3.13. Dispute Review Board.

B. All bidders shall bid the amount shown on the bid form for Bid Item No. 27 Dispute Review Board. This amount is estimated only, and the bid item will be used to reimburse the Contractor for the District's share of costs in accordance with Article 3.13. Dispute Review Board.

14.14. Escrow Bid Documents

A. The Contractor shall prepare and submit to the Engineer the Escrow Bid Documents in accordance with Article 3.14. Escrow Bid Documents.

B. Each Subcontractor whose total subcontract price exceeds **TEN (10) percent** of the total price proposed by the Bidder shall provide separate Escrow Bid Documents to be included with those of the Bidder.

C. Referencing Article 3.14.04.C, the Escrow Bid Documents of the apparent successful Bidder will be opened and **reviewed** by an appointed member of the District in the presence of the Bidder before the Contract is awarded. The apparent successful Bidder **and applicable Subcontractors as stated in paragraph "G" in this Article** shall attend this review.

D. Referencing Article 3.14.04.D, this review is to ensure that the Escrow Bid Documents are legible and **sufficient**. It will not include a review of, or constitute approval of, proposed construction methods, estimating assumptions, or interpretations of the Contract Documents. The **review** will not alter any condition or term of the Contract. Should the **review** indicate that any data is incomplete or missing, the Bidder shall supply the missing information within 24 hours or at such other time as is mutually agreeable.

E. Referencing Article 3.14.05.A, upon completion of the **review**, receipt of the apparent successful Bidder's Escrow Bid Documents will be acknowledged in writing by the District. The documents will be placed in escrow for the life of the Contract at an escrow firm within the greater Santa Clara County area chosen by the District. The District will pay for storage and maintenance of the Escrow Bid Documents.

14.15. Partnering

A. The Contractor shall arrange and pay for Professionally Facilitated Project Partnering sessions, included in the Contract under Bid Item 28. Partnering sessions will be held at project inception, following project completion and at intervals between six (6) months and nine (9) months between project inception and project completion. A total of five (5) partnering sessions will be held.

14.15.01. Payment

A. Payment for Partnering will be paid by the session as one fifth of the total bid price.

14.16. Insurance

A. Failure to file acceptable insurance documents within 10 Days after receiving the Notice of Contract Award letter shall be just cause for the District's annulment of award and forfeiture of the Bidder's security in accordance with the Instruction to Bidders, Section 23, Failure to Execute Contract. Failure to comply with the instructions below could also result in a delay in receiving the Notice to Proceed. The District will not be responsible for time lost or costs incurred due to failure to comply with these requirements. Please note the check-list of documents needed in Table 14.16.

B. Without limiting the Contractor's indemnification of, or liability to, the District, the Contractor must provide and maintain at its own expense during the term of this Contract or as may be further required herein the insurance coverages and provisions in this article.

C. The Contractor must provide its insurance broker(s)/agent(s) with a copy of these requirements and warrants that these requirements have been reviewed by the Contractor's insurance agent(s) and/or broker(s) who have been instructed by the Contractor to procure the insurance coverage required herein.

D. In addition to certificates, the Contractor must furnish the District with copies of original endorsements affecting coverage required herein. The certificates and endorsements shall be signed by a person authorized by the insurer to bind coverage on its behalf. **All endorsements and certificates are to be received and approved by the District before the Contract is executed.** In the event of a Claim or dispute, the District has the right to require the Contractor's insurer to provide complete, certified copies of all required, and pertinent insurance policies, including endorsements affecting the coverages required herein.

E. If your insurance broker has any questions about the above requirements, please advise him/her to call Mr. David Cahen, District Risk Manager at (408) 630-2213.

14.16.01. Certificates of Insurance

A. Contractor shall furnish the District with a Certificate of Insurance. The certificates shall be issued on a standard ACORD Form.

B. Contractor shall instruct their insurance broker/agent to submit all insurance certificates and required notices electronically in PDF format to the designated District Contract Administrator and email a copy to scvwdplanroom@valleywater.org.

C. The Certificates of Insurance shall be uploaded to the web-based construction document management system; these Certificates shall be updated as often as necessary to maintain current and effective copies in the system.

D. The certificates must:

1. Identify the underwriters, the types of insurance, the insurance limits, the deductibles and the policy term;

2. Include copies of all the actual policy endorsements required herein; and

3. In the “Certificate Holder” box include:

   Santa Clara Valley Water District
   5750 Almaden Expressway
   San Jose, CA 95118
   Contract No. C0671

4. The Contract number must be included.

E. In the Description of Operations/Locations/Vehicles/Special Items Box:

1. Certificate Holder shall be named as Additional Insured;

2. District agreement or project number shall appear;

3. The list of policies scheduled as underlying on the Umbrella policy shall be listed; and

4. Waiver of Subrogation must be indicated as endorsed to all policies.

F. If Contractor receives any notice that any of the insurance policies required by this Contract may be cancelled or coverage reduced for any reason whatsoever, Contractor or insurer shall immediately provide written notice to the designated District Contract Administrator that such insurance policy as required herein is canceled or coverage is reduced.

14.16.02. Maintenance of Insurance

A. If Contractor fails to maintain such insurance as is called for herein, District, at its option, may suspend payment for work performed and/or may order Contractor to suspend all Contractor's work at Contractor's expense until a new policy of insurance is in effect.

14.16.03. Renewal of Insurance

A. Contractor will provide the District with a current Certificate of Insurance and endorsements within thirty (30) business days from the expiration of insurance.

B. Contractor shall instruct its insurance broker/agent to:

1. Submit all renewals of insurance certificates and required notices electronically in PDF format to: scvwdplanroom@valleywater.org

2. All renewals of Certificates of Insurance shall be uploaded to the web-based construction document management system.

3. Provide the following information in the "Certificate Holder" box:

   Santa Clara Valley Water District
   5750 Almaden Expressway
   San Jose, CA 95118
   Contract No. C0671

4. The Contract number must be included.

14.16.04. Required Coverages

A. **Commercial General/Business Liability Insurance**

1. **$2,000,000** per occurrence/ **$2,000,000** aggregate limits for bodily injury and property damage.

2. **$2,000,000** Products/Completed Operations aggregate to be maintained for at least three (3) years following acceptance of the Work by the District's Board of Directors.

3. General liability insurance must include the following:

   a. Be written on standard ISO forms, or inspected by the District Risk Manager;

   b. Include coverage at least as broad as found in standard ISO Form CG 00 01;

   c. Include Premises and Operations;

d. Include Contractual Liability expressly including liability assumed under this Contract;

e. If the Contractor shall be working within 50 feet of a railroad or light rail operation, any exclusion as to performance of operations within the vicinity of any railroad bridge, trestle, track, roadbed, tunnel, overpass, underpass, or crossway must be deleted or a railroad protective policy in the above amounts provided;

f. Owners and Contractors' Protective Liability;

g. Include Severability of Interest;

h. Include Explosion, Collapse, and Underground Hazards, (X, C, and U);

i. Include Broad Form Property Damage liability; and

j. Contain no restrictive exclusions (such as but not limited to CG 2153, CG 2144 or CG 2294)

4. The District reserves the right to require certain restrictive exclusions be removed to ensure compliance with the above.

B. **Business Auto Liability Insurance**

1. **$2,000,000** Combined single limit for bodily injury and property damage per occurrence, covering all owned, non-owned and hired vehicles.

2. **Excess or Umbrella policies** may be used to reach the above limits for the General Liability and/or Business Auto Liability insurance limits, however all such policies must contain a primacy clause and meet all other requirements as stated herein.

C. **Builders' Risk (Course of Construction) Insurance**

1. Covering all risks of loss less policy exclusions for an amount equal to the completed value of the Project with no coinsurance penalty provisions.

2. The Contractor's coverage shall provide the following:

a. Coverage shall be provided on an "all-risk" or "special forms" basis (including perils of earthquake and flood, unless waived by the District's Risk Manager), including coverage for "soft costs" such as design, engineering, and construction management fees.

b. Coverage shall be provided on the work and materials which are the subject to this Contract, whether in process or manufactured or finished, including "in transit" coverage to the final agreed upon destination of delivery, and including loading and unloading

operations, and such coverage shall be in force until the work and materials are accepted by the District's Board of Directors.

c. Builder's Risk policy shall name Santa Clara Valley Water District as loss payee and additional insured as its interests may appear at the time of the loss.

d. Deductible shall not exceed **$25,000** per occurrence and shall be borne by the Contractor, except that higher deductibles for earthquake and flood may be approved by the District's Risk Manager.

e. Loss, if any, shall be adjustable with and payable to the District as trustees for all entities having an insurable interest, except in cases as may require payment of all or a proportion of such insurance to be made to a mortgagee as its interest may appear.

f. The insurer shall agree to waive all rights of subrogation against the District.

g. If the Contractor fails to maintain such insurance as is called for herein, the District, at its option, may order the Contractor to suspend work at Contractor's expense until a new policy of insurance is in effect and on file with the District's project manager.

h. The policy shall provide Santa Clara Valley Water District the right to occupy the premises without termination of the policy until final acceptance of the project.

D. **Workers' Compensation and Employer's Liability Insurance**

1. Statutory California Workers' Compensation coverage covering all Work to be performed for the District.

2. Employer liability coverage for not less than **$1,000,000** per occurrence.

E. **Surety Bonds**

1. The Contractor shall provide the following surety bonds:

a. **Bid bond** A written guarantee from a bank or insurer submitted by the Contractor to the District ensuring that, upon acceptance of the bid by the District, the contractor will proceed with the contract.

b. **Performance bond** A written guarantee from a bank or insurer submitted by the Contractor ensuring payment of the contract in case Contractor fails in the full performance of the contract.

c. **Payment bond** A deposit or guarantee backed by a third party that all sums owed by the Contractor to its employees, suppliers, subcontractors and other creditors will be paid on time and in full.

14.16.05. General Requirements

A. Additional Insured Endorsement(s): Contractor must provide an additional insured endorsement for Commercial General/Business Liability (for both on-going and completed operations) and Business Automobile liability coverage naming the **Santa Clara Valley Water District, its Directors, officers, employees, and agents, individually and collectively**, as additional insureds, and must provide coverage for acts, omissions, etc. arising out of the named insureds' activities and work. Other public entities may also be added to the additional insured endorsement as applicable and the Contractor will be notified of such requirement(s) by the District. **NOTE**: This section does not apply to the Workers' Compensation and Professional Liability policies. The following shall also be added to the additional insured endorsement:

NOTE: Additional insured language on the Certificate of Insurance is NOT acceptable without a separate endorsement, such as Form CG 20 10, CG 2033, CG 2037. Note: Editions dated 07/04 are not acceptable.

1. **Primacy Clause** Contractor will provide evidence (either through the Certificate of Insurance, endorsement or language in the insurance contract) that Contractor's insurance is primary with respect to any other insurance which may be carried by the District, its Directors, its officers, agents and employees, and the District's coverage must not be called upon to contribute or share in the loss. **NOTE**: This section does not apply to the Workers' Compensation policies.

2. **Cancellation Clause** Contractor will provide endorsements for all policies stating that the policy will not be cancelled without 30 Days prior notification to the District.

3. **Acceptability of Insurers** All coverages must be issued by companies admitted to conduct business in the State of California, which hold a current policy holder's alphabetic and financial size category rating of not less than A- V, according to the current Best's Key Rating Guide or a company of equal financial stability that is approved by the District's Risk Manager. Non-Admitted companies may be substituted on a very limited basis at the Risk Manager's sole discretion.

4. **Self-Insured Retentions or Deductibles** Any deductibles or self-insured retentions must be declared to and approved by the District. At the option of the District, either: the insurer shall reduce or eliminate such deductibles or self-insured retentions as respects the District, its officers, officials, employees and volunteers; or the Contractor shall provide a financial guarantee satisfactory to the entity guaranteeing payment of losses and related investigations, claim administration, and defense

expenses. Contractor agrees that in the event of a claim they will pay down any agreed-upon SIR in a prompt manner as soon as bills are incurred in order to trigger the insurance related to the SIR.

5. **Subcontractors** The Contractor shall secure and maintain or shall be responsible for ensuring that all subcontractors performing the Contract secure and maintain all insurance coverages appropriate to their tier and scope of work in a form and from insurance companies reasonably acceptable to the District.

6. **Amount of Liability Not Limited to Amount of Insurance** The insurance procured by Contractor for the benefit of the District must not be deemed to release or limit any liability of Contractor. Damages recoverable by the District for any liability of Contractor must, in any event, not be limited by the amount of the required insurance coverage.

7. **Coverage to be Occurrence Based** Except for Professional Liability, all coverage must be occurrence-based coverage. Claims-made coverage is not allowed.

8. **Waiver of Subrogation** Contractor agrees to waive subrogation against the District to the extent any loss suffered by Contractor is covered by any Commercial General Liability policy, Automobile policy, Workers' Compensation policy described in **Required Coverages** above. Contractor agrees to advise its broker/agent/insurer and agrees to provide evidence (either through the Certificate of Insurance, endorsement or language in the insurance contract) that subrogation has been waived by its insurer.

9. **Non-compliance** The District reserves the right to withhold payments to the Contractor and/or order Contractor to suspend all Work at Contractor's expense in the event of material noncompliance with the insurance requirements outlined above.

14.16.06. Payment

A. Full compensation for doing all Work necessary to provide insurance as specified herein shall be included in the lump sum bid price for mobilization.

14.16.07. Non-Disclosure Agreement

A. The successful bidder will be required to sign the Non-Disclosure Agreement found in Appendix J.

CHECKLIST OF DOCUMENTS NEEDED TABLE 14.16

The following checklist is a summary of generally required insurance documents that may be used as guidance.

General Liability:	A.	Limits **($2,000,000)**	
	B.	Additional Insured (Endorsement)	
	C.	Waiver of Subrogation (COI, Endorsement or policy language)	
	D.	Primacy (COI, Endorsement or policy language)	
	E.	Cancellation Endorsement	

Auto Liability:	A.	Limits **($2,000,000)**	
	B.	Additional Insured (Endorsement)	
	C.	Waiver of Subrogation (COI, Endorsement or policy language)	
	D.	Primacy (COI, Endorsement or policy language)	
	E.	Cancellation Endorsement	

Umbrella (optional):	A.	Limits **($2,000,000)**	
	B.	Primacy (Endorsement or policy language)	

Workers Comp:	A.	Limits **($1,000,000)**	
	B.	Waiver of Subrogation (Endorsement or policy language)	
	C.	Cancellation Endorsement	

Builder's Risk:	A.	Limits **(equal to completed value of project)**	
	B.	Additional Insured (Endorsement)	
	C.	Waiver of Subrogation (COI, Endorsement or policy language)	
	D.	Cancellation Endorsement	

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SECTION 15. GENERAL COORDINATION

15.01. Coordination and Special Meetings

A. The Engineer (Construction Manager) shall conduct other coordination and special meetings in addition to progress meetings when appropriate. The purpose of these meetings is to discuss and coordinate shutdowns, outages, utility tie-ins, and any other special issues as deemed necessary.

B. The Contractor shall schedule meetings with manufacturers and installers of major units of construction that require coordination between Subcontractors. Major units of construction that require preinstallation meetings include:

1. Centrifuge feed pumps, centrifuges, polymer feed system and conveyors

   a. The contractor shall coordinate with the manufacturers of Vendor-Supply Control Panel (VCP) to ensure all portion of the specification is well understood. The contractor shall bring up critical details of the specification in those meeting so that manufacturers are aware of those critical details such as: "all VCP shall provide read only access to all proprietary software code for their proprietary PLC, HMI, and Touch Screen to District's SCADA staff." Please reference 46 71 36, 1.3, H as an example of those critical details.

2. Electrical

3. The control system

C. Date, time, and location for coordination and special meetings shall be as mutually agreed to by the Engineer (Construction Manager) and by the Contractor. The Contractor shall ensure attendance of appropriate Contractor staff, Subcontractors, and suppliers.

15.02. Integration and Coordination with District Operations

15.02.01. Overview of Existing Systems and Facilities

A. The following is a cursory overview of typical processes, functions, and Work at the Rinconada Water Treatment Plant (WTP) Residuals Management System. Not all items listed are shown on the Drawings.

1. Thickening – Settled solids from the existing sedimentation basins will continue to be routed to the two existing thickeners. No new thickeners are proposed, but it is proposed to operate the thickeners in parallel and

in a steady state mode, which will be necessary at high solids production rates.

2. Operationally, the thickeners will no longer be required to store sludge given that new sludge storage/mixing tanks will be constructed. Their primary function will be solids separation and thickening, i.e., increasing the solids concentration from approximately 0.5 – 1 percent to 2 – 4 percent. During construction, however, the thickeners will be used to store sludge.

3. Thickened Sludge Transfer – The existing temporary sludge transfer pump will be removed. The existing centrifuge feed pumps will be replaced and repurposed to route thickened sludge from the thickeners to the new sludge storage/mixing tank(s). One pump will be dedicated to each thickener to control sludge withdrawal rates. Additionally, the piping between the thickeners and the pumps will be modified to eliminate flow restrictions and simplify the system.

4. Sludge Storage/Mixing – The existing 15,000-gallon sludge storage tank and mixing pumps will be removed. One or two new 456,000-gallon tanks will be constructed (the second tank is an Alternative Bid Item). The tank(s) will be equipped with mechanical mixers to homogenize the sludge, which will reduce the amount of operator attention required during dewatering operation.

5. Dewatering – The two existing 3,050 pounds per hour centrifuges in the centrifuge building (Centrifuge Building A) will remain in service, and two new centrifuges of the same size will be installed in the existing belt press building (Centrifuge Building B) that was converted to storage when the Residuals Management Project was completed. Three centrifuges will be able to process the 95th percentile weekly average solids production value of 43,500 pounds per day in less than 40 hours of centrifuge operation. The fourth centrifuge will serve as a standby unit.

6. Centrifuge Feed Pumps – Four new centrifuge feed pumps will be installed. One pump will be dedicated to each centrifuge. No standby pump will be provided as the fourth centrifuge is a standby unit. However, interconnections in the discharge piping will be provided to allow an adjacent pump to be substituted for an out-of-service pump.

7. Polymer Storage/Feed – A new polymer storage and feed system will be installed in Centrifuge Building B. It will supply polymer to all four centrifuge feed pump discharge lines and to the thickener influent pipe.

8. Conveyor/Loadout System – The existing loadout structure and the existing inclined conveyors from the existing centrifuges will remain, and new conveyors will be installed to transfer dewatered solids from the new centrifuges to the existing loadout structure. The truck loading conveyors atop the loadout structure will be replaced to accommodate

the higher solids processing capacity required and to integrate the new conveyors from the new centrifuges. New platforms and stairs will be added to the existing loadout structure to improve access to equipment. A new platform and stairs will be constructed to provide access to the new conveyors.

9. Power Supply – The existing motor control center (MCC) in Centrifuge Building A will continue to supply power to the equipment in that building. Power to the new centrifuges in Centrifuge Building B will be supplied by new MCCs to replace the existing MCC (MCC-R) in that building.

10. Control System – Existing residuals management equipment will be disconnected from the existing hot standby PLC in Centrifuge Building A. Control of the existing and new components will be consolidated in a new programmable logic controller (PLC) installed in Centrifuge Building B. Current residuals processing functions and input/output connections on the existing hot standby PLC will be transferred to the new hot standby PLC. Other existing PLCs (two “Centrifuge”, two “Solid Discharge Conveyors”, and “Loadout Conveyor”) will remain in use. The existing residuals processing human-machine interface (HMI) in Centrifuge Building A will be connected to the new PLC in Centrifuge Building B, and a second HMI will be installed in Centrifuge Building B. All process monitoring and control functions will be available from both locations.

11. Operations

    A. The main water treatment plant is staffed 24 hours a day, every day of the year, by licensed water treatment professionals. Staff monitor all plant facilities, operate equipment and systems, and enter and exit the treatment plant grounds as required.

    B. The Residuals Management System is typically staffed 10 hours per day Monday through Thursday, but the work schedule can vary depending on solids production at the main water treatment plant and other factors.

    C. Chemical deliveries for the various treatment processes occur on an almost daily basis.

    D. Deliveries of various supplies and material occur on an almost daily basis.

    E. Training and staff meetings occur on a regular basis.

    F. Security guards check vehicles and people entering the gate(s) and patrol the property.

12. Maintenance

    A. Various maintenance staff work at the treatment plant or use it as a resource center for work at other District facilities. Staff enter and exit the treatment plant grounds regularly each day and night as required.

13. District Staff

    A. District staff of various professional disciplines work inside the operations building.

15.02.02. Requirements of an Operational Facility or System

A. The Rinconada WTP is the regular source of potable water for a large portion of the service area of the Santa Clara Valley Water District. Facility operation must continue as described below at all times, 24 hours a day, every day of the year, during the construction of this Work. The plant has a rated production capacity of 80 million gallons per day. Facilities or conditions required to keep the existing treatment plant operational include, but are not limited to, the following:

1. Raw water pipelines and control and pressure-reducing valves.

2. All pipelines (settled water, backwash water and air supply, filtered water, sludge, washwater return, drains, plant water, overflows, bypasses, etc.).

3. All flocculation and sedimentation basins with sludge collection systems and connecting channels.

4. All filters.

5. Clearwell, including valve actuator power and instrumentation.

6. All backwash pumps, constant head tank, flow meter, and appurtenances.

7. All backwash blowers.

8. Plant electrical, instrumentation, and SCADA systems.

9. All existing chemical feed systems, including storage tanks, piping, pumps, control panels, instrumentation, diffusers, meters, mixers, and related facilities necessary to maintain uninterrupted, controlled feed of process chemicals.

10. Plant water (pumps, hydropneumatic tank, pipelines, and appurtenances) and compressed-air systems.

11. The existing standby power generators, fuel tank and supply piping, transfer and control panels, and all other accessories.

12. Operations building.

13. Washwater recovery basins.

14. Washwater/sludge pump station.

15. Residuals Management System

B. Conduct the Work and provide temporary facilities as required to keep the existing facility continuously operational.

C. Do not remove or demolish existing facilities required to keep the existing facility operational at the capacities specified until the existing facilities are replaced by temporary, new, or upgraded facilities or equipment. The replacement facilities shall have been tested and demonstrated to be operational prior to removing or to demolishing existing facilities.

D. This work shall be scheduled and constructed in such a manner as to result in the least possible disruption to the operations and staff of this existing water treatment facility. Modifications that affect or may affect the operation of the treatment facilities shall not be made without first obtaining written permission from the Engineer (Construction Manager) and Engineer (Engineer of Record). Disruptions or interference to one portion of the treatment process will also affect other processes since typically they are inter related and dependent upon one another. Process disruptions will generally reduce production capacity and/or water quality or interfere with activities needed to sustain plant operation in an efficient and economical mode.

E. This work shall be scheduled and constructed in such a manner as to not delay or deny access to any plant structure or area needed by District staff to complete their work assignments or for chemical or materials deliveries.

F. The work shall not result in the creation of dust, debris, mud, excavations, noise, odors, vibration, and vehicle traffic greater than that allowed by law, these Contract Documents, or necessary for the work.

15.03. Coordination of Work Activities

15.03.01. Work by Others

A. The Contractor shall coordinate its Work with the planned or ongoing Work of the District or of other District Contractors within or adjacent to the limits of the Contract Work in accordance with Article 4.15. Cooperation with Others. No additional payment shall be made or Claims considered for Delay caused due to the Contractor's failure to coordinate the Work.

B. The Contractor shall complete the following activities as requested by the Engineer (Construction Manager) to assist in the coordination of Contract Work with Work by others: attend planning meetings; review and comment on Project documents relative to coordination aspects; schedule Work to promote efficient installation of all improvements; move equipment, material, or vehicles to allow Work by others to proceed; and other reasonable activities.

C. The Contractor is advised that the following water treatment plant maintenance and miscellaneous improvements and Work may take place during the Work of this Contract:

1. District staff will be completing miscellaneous minor improvements, servicing, and repairs to all areas of this treatment plant during the course of this Work.

2. The District shall contract with a variety of firms during the course of this Work to complete improvements that are outside the scope of this Work.

3. District staff shall complete certain Work related to this Project as described under Special Provisions Article 16.01.02. Work Completed by District Staff.

D. The Contractor is advised that the known construction Projects may take place during the Work of this Contract:

1. Interim Site Restoration Project: Sitewide paving a grading shall take place concurrently with this Work.

2. Reliability Improvement Project Phases 3-6: Sitewide improvements to existing treatment plant unit processes, demolition of abandoned unit processes and the construction/commissioning of new unit processes shall take place concurrently with this Work.

15.03.02. Coordination With Others

A. The Contractor is advised that San Jose Water Company (SJWC) personnel will utilize the access road and gates located on the south side of the Rinconada WTP to gain access to their facility. The Contractor shall maintain continuous access required by SJWC and shall fully cooperate with SJWC personnel so as not to hinder or interrupt the assigned task of said personnel.

15.04. Construction Survey

A. The Contractor shall notify the District in writing a minimum of 10 working days before starting operations that require surveying reference benchmarks.

B. The District will establish survey control points and reference benchmarks for the use of the Contractor's surveyors unless existing benchmarks, in the sole opinion of the District, are adequate for Contractor's use.

C. The District will establish required benchmarks only once. Benchmarks that are damaged, destroyed, or removed will be replaced by the District at the Contractor's expense.

D. The Contractor shall be solely responsible for the measurements and layout of the Project from the given benchmarks. Any questions with regard to interpretation of project layout shall be submitted to the Engineer (Engineer of Record).

15.04.01. As-Built Surveys

A. The Contractor shall complete post installation surveys to acquire pipeline, structure and equipment as-built data.

B. The Contractor shall measure and record x, y, z coordinates for top of pipe, corner of structures, equipment, etc. Survey locations shall include the following: tees; horizontal angle points 11.25 degrees and greater; vertical grade breaks; horizontal curve information (BC, EC, and mid-point of curve); vertical curve information (BVC, EVC, and mid-point of curve); ends of casings; and appurtenance piping.

C. The Contractor shall submit as-built survey records to the Engineer (Construction Manager) on a weekly basis per Article 7.01. Submittal Requirements. As-built survey submittals shall include survey information collected the previous week.

The Contractor shall document the results of as-built surveys in the As-Built Drawings. Reference is made to Article 14.11.01. As-Built Drawings.

15.05. Public Notification

A. The Engineer is responsible for all written and oral communication with the public and with neighbors. The Contractor shall provide the Engineer (Construction Manager) with its planned start and finish dates for major construction operations three (3) weeks in advance of their occurrence to allow the District time to notify neighbors. The Contractor shall include in the submittals major Milestones, descriptions of the Work activities, and the start and end date(s) of each activity.

B. The Progress Schedule Submittals shall include, but shall not be limited to, the following activities: Material deliveries and haul-off, concrete pouring, traffic control measures, etc.

C. The Engineer shall provide the above information two (2) weeks in advance as well as 24-hour notices to all property owners and tenants adjacent to the Project site and to others potentially impacted by the construction activities. If, for any reason, any construction activity is anticipated to be delayed for more than one (1) week than that shown in the above submittals, the Contractor shall notify the Engineer (Construction Manager) immediately; submit the

revised planned start and finish dates; and explain the causes for the Delay. The Delay notice shall be given to the Engineer (Construction Manager) no later than one (1) week prior to performing the activity.

D. All payments for coordinating the Work and for providing submittals as specified shall be considered incidental and shall be included in the other items of Work; no additional payment shall be made.

SECTION 16. WORK CONSTRAINTS AND SITE RESTRICTIONS

16.01. General

A. The Contractor shall furnish all labor, materials, equipment and incidentals required to satisfy the requirements and restrictions for sequencing, scheduling, and coordinating construction so that it is integrated with the required water treatment plant water production, other construction projects at or near the project site, and other maintenance and operational activities of the District.

B. Work shall maintain treatment processes function/operation and be protective of water quality at all times.

C. The Rinconada Water treatment plant is a critical operation facility that must remain in continuous operation except as specified herein.

D. Work sequence and constraints discussed below do not include all items affecting completion of the Work but are intended to describe critical events necessary to minimize disruption of the existing facilities, to ensure compliance with water quality permit requirements, and to ensure completion of the Work within the Contract Time(s).

E. Contractor shall confine their work within the limits of the work and staging areas shown in the Drawings and as specified herein.

F. Contractor's shall observe Control Building access restrictions and establish route(s) to Engineer's Office from Contractor's work areas that will not interfere or encroach on Operations and Maintenance areas

G. The Contractor shall take all precautionary measures, as necessary, to not cause any disruption of the operation of the treatment plant.

H. All existing fire hydrants shall remain in service except for no more than one at any time that is out of service for new work and/or plant water piping modifications.

16.01.01. Overview of the Rinconada Water Treatment Plant Operation

A. The following is a cursory overview of typical processes, functions, and operational strategies at the Rinconada WTP. These are descriptions of current (existing) operations unless specifically noted otherwise. Not all items listed are shown on the Drawings.

1. Water treatment:

a. Water is pumped from the off-site Vasona Pump Station to Rinconada WTP or flows by gravity via raw water supply pipelines.

This, as yet untreated, water is often called “raw water”.

b. Pumped raw water flows through the ozone contactor structure and through the flash mix structure where the water is injected with several chemicals. These chemicals are added to aid in the coagulation of particles in the water and oxidize particulate matter.

c. After the flash mx structure the ozonated water piping splits and supplies water to the flocculation sedimentation basins.

d. Water flowing into these basins is further dosed with chemicals as needed for disinfection and to enhance settling of particulate matter. Settled water is collected in launders (troughs) on the surface of each basin.

e. Settled water flows to and through six Filters. Water enters the top of the filter and flows downwards through the filter media. Water entering the Filter from the clarifiers is typically called “settled” or “applied” water.

f. Periodically, a Filter is removed from service and is cleaned by reversing the flow of water through the filter media and blowing air into the filter media. This process is known as “backwashing”. Water for backwashing is either drawn from Rinconada Reservoir or pumped from the clearwells at high rates. Backwash water is also called "washwater".

g. After the Filter is returned to its normal downward flow mode of operation water is diverted to the treated water clearwells, Rinconada Reservoir, More Avenue Reservoir, and/or transmission pipeline system.

h. Filtered water is currently entirely routed via 60-inch diameter piping into the east clearwell. The east clearwell is connected with piping to the west clearwell and the treated water booster pumps. These pumps send water to the Rinconada Reservoir, More Avenue Reservoir (owned by San Jose Water Company) and directly to the West Pipeline for distribution.

i. Waste washwater from filter backwashing flows to the Washwater Recovery Basins. This water is gradually pumped back into the main raw water pipeline for treatment and re-use.

j. Settled solids from the flocculation/sedimentation basins and washwater recovery basins are routed to the gravity thickeners.

k. In the gravity thickeners, solids are thickened by gravity, then collected at the bottom of the basin and raked to a collection sump

for removal. The clarified effluent exits over the weir plates and out of the basin.

l. Thickened sludge is transferred to an existing existing 15,000-gallon sludge storage tank. The sludge is pumped out of this storage tank, injected polymer and fed to two existing 3,050 pound per hour centrifuges.

m. These centrifuges further separate the sludge into solids (sludge cake) and liquids (centrate). Sludge cake is conveyed to waiting trucks via the conveyor/loadout system, and the centrate is returned to treatment process via the washwater recovery basins.

2. Operations:

a. The treatment plant is staffed 24 hours a day, every day of the year by licensed water treatment professionals. Staff monitors all plant facilities, operate equipment and systems, and enter and exit the water treatment plant grounds as required for their duties. Supervisory operations, maintenance, and engineering staff are also based at the treatment plant. Full-time security personnel are also based that the plant.

b. Raw Water System Control Operations is based and staffed at the treatment plant. System Control Operators work independently in their own operations center and they work independently from the water treatment plant operators. This operation is staffed 24 hours a day, 365 days of the year. System Control Operators are tasked with operating the District's county-wide raw water infrastructure systems. This includes remote pump stations, valve stations, valve yards, turn outs to all three treatment plants, creeks and individual customers. The incoming 72-inch raw water pipeline on Rinconada plant property falls under their supervision.

c. Chemical deliveries for the various treatment processes occur on an almost daily basis. The arrival times of chemical deliveries are very difficult to predict as it depends upon the vendor’s delivery schedule and area traffic conditions.

d. Sludge is hauled from the facility on a regular basis, at least weekly by semi-trucks and trailers. Sludge from both the existing and new treatment systems will always require truck hauling to landfill. Trucking times are variable as is the number of trucks required to dispose of the sludge. Trucks and trailers or dumpsters

will also be parked near the Belt Press Building and Centrifuge Building daily.

e. Deliveries of various supplies and materials occur on an almost daily basis.

f. Training and staff meetings occur on a daily basis.

g. Many District vehicles are stationed at Rinconada WTP.

h. Security guards check vehicles and people entering the gate(s) and patrol the property.

i. District vehicles are fueled at gasoline and diesel storage tanks located at the Control Building parking lot.

3. Maintenance:

a. Various maintenance, instrumentation, and other technical staff work at Rinconada WTP or use it as a resource center for work at other SCVWD facilities. Staff enters and exits the water treatment plant grounds regularly each day and night as required by their duties.

b. District staff typically removes from service and complete maintenance on each clarifier during winter months. Other maintenance is commonly scheduled during this low water demand period. However, maintenance staff also respond to and work on unscheduled repairs as needed. Consequently, immediate access is needed to all areas of the plant for repairs, maintenance, and inspections.

4. Water Quality:

a. Water quality staff of various professional disciplines may work inside the Control Building, modular buildings, and adjoining areas completing laboratory testing, reporting, and research functions.

b. The San Jose Water Company owns and operates a 37-inch water transmission pipeline that transverses the treatment plant property from its More Avenue Reservoir to Granada Way in an existing easement. Work under this Project will cross over or under and be near this pipeline. Precautions to ensure its protection are required. Contractor shall notify the San Jose Water Company (SJWC) maintenance department (408-279-7866) two working days prior to any work in the SJWC easement. Additional notification shall be made each day excavations are made within the SJWC easement.

16.01.02. Maintenance of Rinconada WTP Operation

A. The Rinconada WTP is the regular source of potable water for a large portion of the service area of the Santa Clara Valley Water District. This is one of the most important public facilities in the South Bay Area. Facility operation must continue

to operate as described below at all times, 24 hours a day, every day of the year during the construction of this Work, except for planned and approved outages and shutdowns. The plant has a rated production capacity of 80 million gallons per day (mgd).

B. This Work shall be bid, scheduled, and constructed in such a manner as to result in the least possible disruption to the operations and staff of this existing water treatment facility and to protect water quality at all times. Modifications that affect or may affect the operation of the treatment facilities shall not be made without first obtaining written explicit permission from the Engineer (Construction Manager) and Engineer (Engineer of Record). Disruptions or interference to one portion of the treatment process will also affect other processes, since typically they are inter-related and dependent upon one another. Process disruptions will generally reduce production capacity and/or water quality or interfere with activities needed to sustain plant operation in an efficient and economical mode. Disruptions include, but are not limited to:

1. Removing a process unit from service or impeding the operation of a process unit. Process units include, but are not limited to: raw water piping, Ozone Contactor, Flash Mix Facility, Flocculation/Sedimentation Basins, east and west and connecting Filter gallery piping of any type, Filters, West and East Clearwells, treated water and backwash pumps, filter backwash equipment, Rinconada Reservoir, More Avenue Reservoir, More Avenue Pump Station, Gravity Thickeners, Centrifuge Feed Pump Station, Centrifuge Building, Load-Out Structure, Washwater Recovery Basins, Lower Sludge Drying Basins, Electrical Equipment Pad, various unit substations, transformers, motor control centers, and sitewide SCADA system.

2. Removing from service, restricting, or impeding the function of any utility for example, water (any type), electricity, natural gas, compressed air, laboratory gases, drains, sanitary sewer, storm drain, sludge piping, underflow piping, telephone, fire protection, instrumentation serving any portion of a process unit, Control Building, Centrifuge Building, Belt Press Building, Load-Out Structure, Filter galleries (all levels and connecting spaces), warehouse, laboratory and office areas, or other plant structures. This includes utilities owned by the San Jose Water Company that exist on the Rinconada WTP site. This also includes any plant water pumping facility and any water transmission pipeline.

3. Removing from service, restricting, or impeding the function of any treatment chemical storage, metering, conveyance, mixing, or application system. Existing treatment chemical systems include: sodium hypochlorite; aqua ammonia; anionic, cationic, or nonionic polymers;

potassium permanganate; alum; ferric chloride; caustic soda; phosphoric acid; and powered activated carbon.

4. Removing from service, restricting, or impeding the operation of the treatment plant SCADA (supervisory control and data acquisition) system, fire alarm systems, fire sprinkler system, or security systems.

5. Stopping or altering the function of any process monitoring instrument (e.g., turbidity, pH, temperature, streaming current, chlorine residual monitoring of any type, ammonia residual, particle counters, etc.).

6. Delaying or denying access to any plant structure or area needed by District staff to complete their work assignments or for chemical or materials deliveries.

7. The creation of dust, debris, mud, excavations, noise, odors, vibration, and vehicle traffic greater than that allowed by law, these Contract Documents, or necessary for the Work.

C. The District may postpone, at no additional cost to the District, any and each Contractor request for work (otherwise allowed by these Contract Documents) that would disrupt plant operations (submitted in accordance and complying with these Contract Documents) for up to 2 weeks due to operational constraints.

D. Extra precautions are necessary to ensure that no damage occurs to existing facilities including piping, pumps, motors, mixers, instrumentation, electrical distribution, chemical piping, utilities, roads, basins, Filters, interiors of structures, and structures in general that are to remain in operation and are not to be modified or replaced. All temporary facilities, barriers, materials, equipment, and labor required to ensure that no damage occurs shall be provided by the Contractor as part of the Work and at no additional cost to the District.

E. All interruptions, outages, interferences, or temporary shutdowns of plant facilities and operations shall be identified, fully described, and authorized before work is to be done. Requested times and dates for these interruptions, outages, interferences, or temporary shutdowns shall be scheduled on the construction progress schedules described in the Special Provisions. A schedule of all planned interruptions, outages, interferences, or temporary shutdowns of plant facilities and operations shall be submitted every month in accordance with the Special Provisions. This schedule shall include a minimum 6-month planning horizon.

16.01.03. Violations of State Drinking Water Permit

A. The Rinconada WTP operates under the terms of a Drinking Water Permit issued by the California State Water Resources Control Board, Division of Drinking Water (DDW) This permit specifies the water quality limits that this water treatment plant must meet prior to delivering treated water to consumers.

B. Work Must Not Adversely Affect Water Quality:

1. Perform the Work in a manner that will not prevent the Rinconada WTP from complying with the drinking water quality requirements established by State and Federal regulations. Drinking water quality requirements are maximum contaminant and action levels listed in the following documents:

   a. California Safe Drinking Water Act & Related Statutes – January 1, 2012

   b. California Regulations Related to Drinking Water – June 21, 2012

   c. Title 22 of California Code of Regulations.

   These documents are periodically updated as required by State and Federal regulations.

2. Copies of these documents and updates can be obtained from the DDW.

C. The Contractor shall bear the cost of any penalties, fines, clean-up costs, or damages imposed on the District by the State for violations caused by actions of the Contractor. See the Standard and other sections of the Special Provisions.

16.01.04. Definition of Key Terms

A. SHUTDOWN: A shutdown is defined as that period of time during which a normal water treatment plant function and activity cannot take place that usually results in a stoppage or reduction in water production.

Prior to any shutdown, the Contractor must have sought and received shutdown-specific written permission from the Engineer (Construction Manager) that the proposed shutdown is acceptable and in conformance with the Contract Documents. Prior to granting permission, the Engineer (Construction Manager) and Engineer (Engineer of Record) will review the detailed shutdown plan prepared by the Contractor that includes shutdown schedule, planned sequence of work, milestones and projected times of completions of activities, any anticipated problems, list of all parties involved in the work, Contractor's supervisory personnel, actions desired of District and Engineer (Construction Manager) staff, and contingency plans. The shutdown plan must be submitted in sufficient time for the Engineer (Construction Manager) and Engineer (Engineer of Record) review, consideration, and coordination with District staff. This shall be a minimum of 30 working days prior to the proposed shutdown. Allow sufficient time for review and resubmittal of the shutdown plan until acceptable to the Engineer (Construction Manager) and Engineer (Engineer of Record). An acceptable shutdown plan prepared by the Contractor is fully descriptive of the work, addresses the impact on water treatment plant facilities and processes, and is in compliance with the Contract Documents. The District may postpone any and each shutdown for a period of up to 2 weeks due to operational constraints without additional compensation or change in Contract Time.

B. OUTAGE OR SPECIAL OUTAGE: An outage or special outage is defined as that period of time during which a normal water treatment plant function and activity cannot take place that usually results in a reduction in water production or interference with a normal operation or function.

Prior to any outage, the Contractor must have sought and received outage-specific written permission from the Engineer (Construction Manager) that the proposed outage is acceptable and in conformance with the Contract Documents. Prior to granting permission, the Engineer (Construction Manager) and Engineer (Engineer of Record) will review the detailed outage plan prepared by the Contractor that includes an outage schedule, planned sequence of work, milestones and projected times of completions of activities, any anticipated problems, list of all parties involved in the Work, Contractor's supervisory personnel, actions desired of District and Engineer (Construction Manager) staff, and contingency plans. The outage plan must be submitted in sufficient time for the Engineer (Construction Manager) and Engineer (Engineer of Record) review, consideration, and coordination with District staff. This shall be a minimum of 30 working days prior to the proposed outage. Allow sufficient time for review and resubmittal of the outage plan until acceptable to the Engineer (Construction Manager) and Engineer (Engineer of Record). An acceptable outage plan prepared by the Contractor is fully descriptive of the work, addresses the impact on water treatment plant facilities and processes, and is in compliance with the Contract Documents. The District may postpone any and each outage or special outage for a period of up to 2 weeks due to operational constraints without additional compensation or change in Contract Time.

C. OPERATIONAL: To be considered operational, an existing facility or facility component must be functional in all manners intended for its use, at its rated capacity. For a new facility to be considered operational, it must be installed, tested, documented, and if required by the Work, District personnel must be trained in the facility's operation and maintenance. Written operations and maintenance manuals (in compliance with the Specifications) must also be completed, received by the Engineer (Construction Manager), and be favorably reviewed for a new facility to be considered operational. All specified spare parts shall be delivered to the District through the Engineer (Construction Manager).

16.01.05. General Restrictions and Requirements

A. At all times, including plant shutdowns, outages and special outages, the following must be in operation and available:

1. Access through both lower and upper More Avenue entrances and Granada Gate.

2. Plant telephone, internet access, fire alarm, security, closed circuit television, and radio systems.

3. Electricity and SCADA access for the Control System Operators (raw water operations) including but not limited to electrical engineering

assistance, auxiliary generators, and special cabling and electrical equipment.

4. Electricity to the Control Building Engineer's construction office spaces, and any trailers provided for temporary use of District staff. Portable generators, equipment, cables, and appurtenances shall be provided by the Contractor to meet this requirement.

5. Plant potable and utility water, sewer, drains, storm drainage, compressed air, and natural gas systems with the exception of tie-ins as shown in the Drawings.

6. For service outages less than one week, the Contractor shall provide temporary facilities such as portable restrooms, portable hand washing stations, and temporary eye washing stations in critical areas as directed by the Engineer (Construction Manager). Plant air outages may be covered through the temporary use of the existing backup natural gas air compressors. All deviations from normal operations to be approved by the Engineer (Construction Manager).

7. Access for District, chemical delivery, and sludge hauling vehicles to all plant facilities on paved or compacted aggregate base (temporary, 4-inches of compacted aggregate base minimum unless greater thicknesses are shown on the Drawings) or trench-plated roadways. Temporary roadways that do not allow chemical delivery or sludge haul trucks to use without tire slippage and rutting shall be improved by the Contractor with greater thicknesses of compacted aggregate base and a minimum of 2-inches of temporary asphalt concrete until truck travel is satisfactory to the Engineer (Construction Manager).

8. Access for chemical delivery vehicles to all chemical storage tanks and truck unloading connection points, and chemical storage (totes, drums, sacks, pallets, etc.) areas, existing and new facilities when ready, on paved or compacted aggregate base (temporary, 4-inches of aggregate base minimum unless greater thicknesses are shown on the Drawings and as specified above) or trench-plated roadways. Trucks may be delayed up to one hour if the District's agreement with the particular chemical delivery company allows for this delay. During all phases of construction routes for chemical delivery and sludge hauling shall be maintained for all active delivery and sludge locations on the plant site. These routes shall be approved by the Engineer (Construction Manager)and changes to the routes to accommodate construction activities shall be submitted to the Engineer (Construction Manager)two

weeks prior to implementation. Approved routes shall be provided to the District 5 days prior to implementation.

9. The parking spaces in the parking lot between the Control Building and Rinconada and More Avenue Reservoirs outside of the area outlined for Contractor employee parking.

10. Unobstructed access to at least one roadway serving the Control Building chemical storage (lower level) areas for chemical deliveries, truck and trailer turnaround space, maintenance, and operations.

11. The treatment plant and transmission system supervisory control and data acquisition system (SCADA), fire alarm, and security systems. This also includes all instrumentation conduits and their conductors.

12. More Avenue Pump Station and its appurtenant facilities.

13. Fueling station at upper More Avenue parking lot.

B. Community water consumption varies seasonally and the water treatment production adjusts to match these water consumption needs. This is the reason for the seasonal water production constraints listed in this Section. There is always a minimum level of water production required for consumer uses and community fire protection.

C. The Contractor shall not schedule deliveries outside of normal working hours as defined in the Special Provisions.

D. Work hours, days and other schedule constraints are described in the Special Provisions, Article 18.02.

E. The Contractor shall informally meet with the Engineer (Construction Manager)and representatives of District operations and maintenance staff every weekday near the end of the operations shift change to inform them of the construction status and known impacts or potential impacts on treatment plant operations.

F. Saw-cutting of metallic mechanical equipment (such as gravity thickener rake arms) shall not be permitted for any demolition work (blow-torches are allowed). Dry concrete saw-cutting shall not be permitted. Wet concrete saw-cutting shall be permitted with proper management of slurry and prevention of slurry reaching plant underdrain and drain systems. Saw cutting of piping is permissible.

16.01.06 Mandatory Production Schedule

A. The dates provided below are typical of seasonal water production which is dependent upon demand.

MANDATORY RINCONADA WTP WATER PRODUCTION SCHEDULE	
Dates	**Minimum Water Production Capability, million gallons per day**
March 16 to November 14	80
November 15 to March 15	40

16.01.07 Production Constraints

A. Requirements for 80 Million Gallons Per Day Minimum Water Production:

The plant must have the following facilities intact, serviceable, and operational (at a minimum, together with associated appurtenant facilities) to have a production capacity of 80 million gallons per day (mgd):

1. Raw water pipelines with control valves and flow meters.
2. All pipelines (raw, settled, applied, backwash water supply, backwash air supply, washwater, filtered water, sludge, washwater return, drains, plant water, filter-to-waste, overflows, bypasses, etc.). Temporary pipelines, conduits, and channels where needed to convey water between process units.
3. Flocculation and Sedimentation Basins, their pipelines, channels, and appurtenances.
4. All six Filters.
5. East and West Clearwells.
6. All existing treated water booster and backwash pumps.
7. Both existing backwash air blowers.
8. Plant electrical, instrumentation, SCADA, fire alarm, and security systems. This also includes the 12 kV electrical power equipment and distribution systems. Existing systems to remain in service unless being replaced and if being replaced, they must remain in service until the replacement is complete.

9. All existing chemical feed systems including storage tanks, piping, pumps, diffusers, meters, mixers, and related facilities necessary to maintain uninterrupted, controlled, feed of process chemicals. Interruptions to the feeding of process chemicals are not allowable. As necessary and where specified, the Contractor shall provide approved temporary facilities (e.g., piping, tanks, feed pumps, compressed air, control panels, instrumentation, electrical feeds and equipment, appurtenances, and other utilities) to ensure a continuous and reliable operation of all chemical feed systems. Chemical systems include, but are not limited to, sodium hypochlorite, powered activated carbon, alum, ferric chloride, caustic soda, phosphoric acid, aqua ammonia, and cationic, anionic, and nonionic polymers. All new chemical systems as soon as they are installed and become operational and extensions and modifications to existing chemical systems.

10. Plant water (pumps, pipelines, and appurtenances) and compressed air systems, water pump station by northern (lower) entrance gate off of More Avenue.

11. The existing standby power generators, diesel fuel tanks, and supply piping, transfer and control panels, and all other accessories for the project duration. New electrical panels, and other accessories once they become operational. Existing systems to remain in service unless being replaced and if being replaced, they must remain in service until the replacement is complete.

12. Control Building and Centrifuge Building A.

13. Rinconada and More Avenue Reservoirs.

14. Washwater Recovery Basins until removal from service for demolition. Washwater Recovery Facility, pumps, and piping.

15. Solids handling facilities (Gravity Thickeners, Centrifuge Feed Pump Station, Centrifuge Building, centrate wet well, Load-Out Structure, pumps, sludge storage and loading area, etc.)

16. Lower Sludge Drying Basins.

17. More Avenue Pump Station.

B. Requirements for 40 Million Gallons Per Day Minimum Water Production:

The plant must have the following facilities intact, serviceable, and operational (at a minimum, together with associated appurtenant facilities) to have a production capacity of 40 million gallons per day (mgd):

1. Raw water pipelines with control valves and flow meters.

2. All pipelines (raw, settled, applied, backwash water supply, backwash air supply, washwater, filtered water, sludge, washwater return, drains, plant

water, filter-to-waste, overflows, bypasses, etc.). Temporary pipelines, conduits, and channels where needed to convey water between process units.

3. Three (3) Flocculation and Sedimentation Basins, their pipelines, channels, and appurtenances.

4. Four (4) Filters.

5. East and West Clearwells.

6. All existing treated water booster and backwash pumps.

7. Both existing backwash air blowers.

8. Plant electrical, instrumentation, SCADA, fire alarm, and security systems. This also includes the 12 kV electrical power equipment and distribution systems. Existing systems to remain in service unless being replaced and if being replaced, they must remain in service until the replacement is complete.

9. All existing chemical feed systems including storage tanks, piping, pumps, diffusers, meters, mixers, and related facilities necessary to maintain uninterrupted, controlled, feed of process chemicals. Interruptions to the feeding of process chemicals are not allowable. As necessary and where specified, the Contractor shall provide approved temporary facilities (e.g., piping, tanks, feed pumps, compressed air, control panels, instrumentation, electrical feeds and equipment, appurtenances, and other utilities) to ensure a continuous and reliable operation of all chemical feed systems. Chemical systems include, but are not limited to, sodium hypochlorite, powered activated carbon, alum, ferric chloride, caustic soda, phosphoric acid, aqua ammonia, and cationic, anionic, and nonionic polymers. All new chemical systems as soon as they are installed and become operational and extensions and modifications to existing chemical systems.

10. Plant water (pumps, pipelines, and appurtenances) and compressed air systems, water pump station by northern (lower) entrance gate off of More Avenue.

11. The existing standby power generators, diesel fuel tanks, and supply piping, transfer and control panels, and all other accessories for the project duration. New electrical panels, and other accessories once they become operational. Existing systems to remain in service unless being replaced and if being replaced, they must remain in service until the replacement is complete.

12. Control Building and Centrifuge Building A.

13. Rinconada and More Avenue Reservoirs.

14. Washwater Recovery Basins until removal from service for demolition. Washwater Recovery Facility, pumps, and piping.

15. Solids handling facilities (Gravity Thickeners, Centrifuge Feed Pump Station, Centrifuge Building, centrate wet well, Load-Out Structure, pumps, sludge storage and loading area, etc.)

16. Lower Sludge Drying Basins.

17. More Avenue Pump Station.

16.01.08 Construction Sequence

A. Work sequence and constraints discussed below **do not include all items** affecting completion of the Work but are intended to describe critical events necessary to minimize disruption of the existing facilities, to ensure compliance with water quality permit requirements, and to ensure completion of the Work within the Contract Time(s). The constraints and sequence of events described herein are not all inclusive, and additional items affecting the completion of the Work will be required to ensure compliance with the contract documents.

1. Mobilization

2. Demolition of the North Washwater Recovery Basin including relocation of existing plant drains and relocation of a control panel for the Washwater Recovery Pump to the South Washwater Recovery Basin

3. Placement of structural fill and construction of the new Sludge Storage Tank(s) and Centrate Wetwell B

4. Demolition work in Centrifuge Building B

5. Remodeling of Centrifuge Building B and placement of new centrifuges, conveyors, polymer storage and feed equipment, plumbing modifications, ventilation equipment, electrical and control system modifications, and other Work shown on the drawings

6. Construction of the new Centrifuge Feed Pumps and related facilities

7. Installation of yard piping in areas that do not affect traffic circulation

8. Electrical site work including new conduits, cables, handholes and junction boxes

9. During the Winter 2022 (November 15, 2021 to March 15, 2022) outage window:

    a. Modification of Gravity Thickener inlet and outlet piping

    b. Installation of access hatches in the Gravity Thickeners

c. Replacement of centrate return piping to the Gravity Thickeners

d. Other Gravity Thickener Work shown on the drawings

e. Replacement of the existing Centrifuge Feed Pumps, if Alternative Bid Item No. 1 is accepted

f. Piping modifications in the existing Centrifuge Feed Pump area (to be repurposed as Sludge Transfer Pumps)

g. Installation of remaining yard piping

h. Replacement of the existing truck loading conveyors

i. Modification of Switchgear 3 and associated electrical work

10. Construction of new conveyor access platforms

11. Construction of new conveyors for Centrifuges 3 and 4

12. Modifications to Centrifuge Building A, including addition of new flow meters/control valves on the centrifuge flushing water piping, drain modifications, addition of a safety shower, installation of new polymer piping and leveling of the lower level floor

13. SCADA system programming and testing

14. Operational Readiness Testing

15. Functional Testing

16. Start-up of new and modified systems

17. System Commissioning Testing

18. Demolition of existing mix tank and mix pumps

19. Site Restoration

20. Punchlist Completion

21. Demobilization

16.01.09. Outage Constraints

A. The water treatment plant is a critical operation facility that must remain in continuous operation except as specified herein. Construction shall be scheduled and performed in a manner to maintain continuous operation of the treatment plant except during the specified shutdown period. The Rinconada water treatment plant is one (1) of three (3) plants that is the primary regular

source of potable water for the treated water service area of the Santa Clara Valley Water District. Operation of the potable water treatment plant must continue at all times, 24 hours a day, every day of the year except during the specified shutdown period.

1. While the plant is in operation, the Contractor shall allow access to the Solids Load-out Structure and other components of the Residuals Management System. The Contractor shall provide the Engineer (Construction Manager)a 14-Day written advance notice so that the District can schedule truck loadout services. The Contractor shall request in writing to the Engineer (Construction Manager)any additional roadway restrictions necessary to construct the Solids Load-out and Sludge Tank facilities, electrical conduit and mechanical piping installations. Approval of additional roadway restrictions will be based on the District's ability to maintain operational functions .

B. The Contractor shall take all precautionary measures as necessary so as not to cause any disruption of the operation of the treatment plant. The activities discussed below do not include all items affecting the operation of the plant but are intended to describe certain actions that could disrupt the normal function, or cause shutdown, of the plant:

1. Contractor removing a process unit from service or impeding the operation of a process unit.

2. Contractor removing from service, restricting, or impeding the function of any utility, such as water, electrical, gas, telephone, compressed air, sanitary sewer, storm drain, sludge piping, overflow piping, and instrumentation system.

3. Contractor removing from service, restricting, or impeding the function of any portion of District's SCADA system.

4. Contractor delaying or denying access to any District plant structure or area needed by District staff to complete their Work assignments.

C. Extra precautions are necessary to ensure that no damage occurs to existing facilities including piping, pumps, motors, instrumentation, utilities, roads, interiors of structures, and structures in general that are to remain in operation and are not to be modified or replaced. All temporary facilities, barriers, materials, equipment, and labor required to ensure that no damage occurs shall be provided by the Contractor as part of the Work and at no additional cost to the District.

D. All interruptions, outages, interferences, or temporary shutdowns of plant facilities and operations shall be identified, fully described, and authorized before work is to be done. Requested times and dates for these interruptions, outages, interferences, or temporary shutdowns shall be scheduled on the construction progress schedule under Article 5.05. A schedule of all planned interruptions, outages, interferences, or temporary shutdowns of plant facilities

and operations shall be submitted every month in accordance with Section 20. This schedule shall include a minimum 2-month planning horizon.

E. The Contractor may assume that the following periods will be available for Facility or Plant outages to accommodate Contract Work, subject to the Engineer (Construction Manager) approval. The Contractor shall follow the procedures for submitting requests for outages to the District for approval, prior to the start of any work.

1. At the District's discretion, short outages of the Residuals Management facilities during high production demand periods from March 16 to November 14 in any year will be approved, unless the District determines water demands cannot be met. Short duration outages of the Residuals Management System will occur between the hours of 4 p.m. Thursday and 6 a.m. the following Monday, unless otherwise approved by the District or Engineer (Construction Manager). A minimum of seven (7) days is required following any outage to allow the Plant to recover and before subsequent outages may occur. Short duration outages apply to the following periods:

   a. Partial Plant Outages, Spring/Summer/Fall between March 16 and November 14, 2021.

   b. Partial Plant Outages, Spring/Summer/Fall between March 16 and November 14, 2022.

2. Partial Plant Outages – At the District's discretion, short plant outages for Residuals Management facilities during low production demand periods for up to seven (7) consecutive days between November 15 and March 15 will be approved, unless the District determines water demands cannot be met. Unless otherwise approved by the Engineer (Construction Manager), a minimum of seven (7) days is required following any outage to allow the Plant to recover and before subsequent outages may occur.

3. Full Plant Outages, Winter 2022 (November 15, 2021 to March 15, 2022) and Winter 2023 (November 15, 2022 to March 15, 2023) – At the District's discretion, full plant outages during low production demand periods for up to seven (7) consecutive days between December 15 and February 15 may be approved, if the District determines water demands can be met. No more than two full plant outages total may be requested each winter. Contractor shall provide notification to the District of any planned Full Plant Outages by November 1. A minimum of seven (7) days is required following any outage to allow the Plant to recover and before subsequent outages may occur.

16.01.10. Plant Outages

A. Prior to approval by the Engineer (Construction Manager)of any plant, facility, system or equipment outage, the Contractor shall submit an Outage Request Form (see example in Appendix D) at least 21 calendar days in advance of the planned outage. Accompanying the Outage Request Form shall be the Contractor's lockout/tagout plan including an outage-specific Lockout/Tagout Posted Procedure form (see example in Appendix D).

B. Table 16.01-1 contains a partial list of outages required for the completion of the Work and the constraints which must be accommodated by the Contractor. Additional outages will be required depending on the Contractor's means and methods and shall be identified in the Contractor's baseline schedule, all subsequent schedule updates and in look-ahead schedules.

Table 16.01-01. List of Major Equipment and Facility Shutdowns

No.	FACILITY	ACTIVITY	AFFECTED OPERATIONS	DATE	ALLOWABLE DURATION	COMMENTS
01	Washwater Recovery Basins	Demolish existing washwater return pump and piping in north basin and relocate wiring from VFD to the pump in the south basin.	Washwater recovery pumps are out of service. Therefore, the entire plant might need to be shut down.	Summer 2021	3 days	Must be done to allow construction of the sludge storage tank(s).
02	Existing Conveyors	Relocate disconnect panels on the loadout structures.	All conveyors and centrifuges.	Winter 2022	1 week	The disconnects conflict with the new access platforms and stairs.
03	Existing Conveyors	Remove existing truck loading conveyors; install new truck loading conveyors.	Truck loading from the existing truck loading conveyors	Winter 2022	1 month	Can still use gates on inclined conveyors from existing centrifuges and the temporary centrifuge.
04	Centrifuge Bldg B	Prior to demolishing existing MCC-R in the belt press building, connect the existing VFD for the washwater return pump to MCC-3A2.	Washwater recovery pump VFD is out of service. Therefore, the entire plant must be shut down.	Winter 2022	1 day	MCC-3A2 must be in place and tested.
05	Gravity Thickener 1	Replace thickener rake arms; install acces hatch; conduct leakage test; make minor changes to thickener equipment.	Gravity Thickener 1 shut down, drained and sludge removed	Winter 2022 or Winter 2023	2 months	This could be done in the winter of 2022 if the contractor has the resources to do the work.
06	Gravity Thickener 2	Replace thickener rake arms; install acces hatch; conduct leakage test; make minor changes to thickener equipment.	Gravity Thickener 2 shut down, drained and sludge removed	Winter 2022 or Winter 2023	2 months	One week between shutdowns is required.
07	Gravity Thickeners	Modify thickener inlet piping and put existing flow meters and MOVs in a vault.	Entire plant (cannot send sludge from the clarifiers to the thickeners)	Winter 2022 or Winter 2023	1 month	A temporary bypass around the affected pipes is acceptable to shorten the shutdown.

Table 16.01-01. List of Major Equipment and Facility Shutdowns

No.	FACILITY	ACTIVITY	AFFECTED OPERATIONS	DATE	ALLOWABLE DURATION	COMMENTS
08	Gravity Thickeners	Modify and bury outlet piping and valves and install new flushing and sample piping.	Flow from Gravity Thickeners to Sludge Transfer Pumps (or Existing Centrifuge Feed Pumps if not already replaced)	Winter 2022	1 week	The thickeners can still be in service and accumulate sludge.
09	Gravity Thickeners	Modify centrate return piping (increase from 4" to 6".	Gravity Thickeners 1 and 2	Winter 2022	1 week	Can be done while thickeners are out of service for other work.
10	Existing Centrifuge Feed Pumps	Install new piping and sludge transfer pumps; connect sludge transfer pipes to existing centrifuge feed pipes.	Centrifuges 1 and 2	Winter 2022	1 week	This work could be done sequentially to allow one centrifuge to remain in service.
11	Centrate Wetwell PS	Connect new centrate line from Centrate Wetwell PS serving Centrifuges #3 and #4.	Centrate Pump Station shutdown, Centrifuge 1 and 2 shutdown	Winter 2022	2 days	Decant from the gravity thickeners must go to the new washwater recovery basins after this connection is made.
12	Centrate Wetwell PS	Connect new sump pump discharge in transfer pump area to the centrate return line to the gravity thickeners.	Centrifuges 1 and 2	Winter 2022	1 day	This can be done without a shutdown if the centrate is directed to the new washwater recovery basins.

Table 16.01-01. List of Major Equipment and Facility Shutdowns

No.	FACILITY	ACTIVITY	AFFECTED OPERATIONS	DATE	ALLOWABLE DURATION	COMMENTS
13	6" Sludge Piping and Polymer Piping	Open cut the loadout structure entrance to install new sludge and polymer piping.	Truck loading area	Winter 2022	1 week	The work might not require a Plant Shutdown if the Contractor can sequence the work to maintain one truck lane open at all times. Work would be more efficient though if a shutdown was allowed and the Contract had full access to the install pipe across entire truck lane area.
14	6" Sludge Piping	Connect new centrifuge feed pipes to existing centrifuge feed pipes east of Centrifuge Building A, and connect the two existing centrifuge feed pipes to the new sludge transfer pipes.	Centrifuges 1 and 2	To be determined by Contractor	2 days	This must wait until the sludge storage tank(s) and the centrifuge feed pumps are ready to operate.
15	Existing Polymer Piping in Centrifuge Building A	Connect new polymer feed piping to existing piping.	Thickener inlet polymer feed and Centrifuges 1 and 2 shutdown	To be determined by Contractor	2 days	Could be done sequential so that one centrifuge can remain in operation.
16	SCADA System	Connect SCADA system for the new centrifuges and polymer system to the existing SCADA system.	Entire residuals management system and possibly LCPs 8 and 17 and RIO 4.	Winter 2022	1 week	All SCADA system and HMI testing must be completed prior to shutdown. Might be able to run some parts of the system in local manual or use the temporary centrifuge.

Table 16.01-01. List of Major Equipment and Facility Shutdowns

No.	FACILITY	ACTIVITY	AFFECTED OPERATIONS	DATE	ALLOWABLE DURATION	COMMENTS
17	New MCC-3A2 and MCC-3B2	Connect to existing 800A breakers in SWGR-3.	SWGR-3 main breaker opened, affects the following: • Centrifuge Feed Pumps • Centrifuge 1 • Centrifuge 2 • Polymer feed/mixing pumps • Conveyors • Sludge mixing pumps • Thickener Sludge Collectors • MCC-R in belt press building (see separate MCC-R impacts)	Winter 2022	3 days	This could be done at the same time as the feeders to MCC-3A1.
18	SWGR-3	Install Feeders from Bus A and Bus B to MCC-3A1.	NETA Testing will require de-enegization of Unit Substation US-3A XFMR. Impacted areas include: • Centrifuge Feed Pumps • Centrifuge 1 • Centrifuge 2 • Polymer feed/mixing pumps • Conveyors • Sludge mixing pumps • Thickener Sludge Collectors • MCC-R in belt press building (see separate MCC-R impacts)	Winter 2022	5 days	Contractor may be able to isolate each Bus and install the new feeder/breaker for each Bus, one at a time.

Table 16.01-01. List of Major Equipment and Facility Shutdowns

No.	FACILITY	ACTIVITY	AFFECTED OPERATIONS	DATE	ALLOWABLE DURATION	COMMENTS
19	Centrifuge 1 Control Panel (RCENTCP01)	Intercept Feeder from SWGR-3 to RCENTCP01B and route to existing MCC-3A1.	All equipment and facilities powered from SWGR-3	Winter 2022	Weekend 4 pm Thursday to 6 am Monday Temp Shutdown	SWGR-3 feeds more facilities than just the Residuals Management System.
20	Centrifuge 2 Control Panel (RCENTCP02)	Intercept Feeder from SWGR-3 to RCENTCP02B and route to existing MCC-3A1.	All equipment and facilities powered from SWGR-4	Winter 2022	Weekend 4 pm Thursday to 6 am Monday Temp Shutdown	SWGR-3 feeds more facilities than just the Residuals Management System.
21	Conveyor Control Panels (RDWTCNVCP01, RDWTCNVCP02 AND RDWTCNVCP03)	Intercept Feeder from SWGR-3 to Conveyor Control Panels and route to existing MCC-3A1.	All equipment and facilities powered from SWGR-3	Winter 2022	Weekend 4 pm Thursday to 6 am Monday Temp Shutdown	SWGR-3 feeds more facilities than just the Residuals Management System.

C. Work sequence and constraints described in these Special Provisions do not include all items affecting completion of the work, but are intended to describe critical events necessary to minimize disruption of the existing facilities, and to ensure completion of the work within the Contract Time. Contractor's attention is directed to Article 18.02 regarding Hours of Work constraints.

D. Outages shall be subject to the time constraints described previously.

E. The 30-day System Commissioning Test shall commence upon successful completion and acceptance of all prior testing.

F. Do not remove or demolish existing facilities required to keep the existing facility operational at the capacities specified until the existing facilities are replaced by temporary, new or upgraded facilities or equipment. The replacement facilities shall have been tested and demonstrated to be operational prior to removing or demolishing existing facilities.

G. The work to remove, replace and/or install switchgear, electrical systems, VFDs, pump motors, local control panels, air handling units, ducts, etc. as part of a prescribed shutdown or outage shall have all testing, training, and start-up activities completed, be made operational and connected to all necessary power, control systems (both locally and remotely to RWTP), and all other supporting systems to enable the District's immediate use of the installed equipment.

H. The Contractor shall incorporate the constraints of this Section in preparing the construction schedules required under Standard Provisions Article 5.06.

1. The Contractor shall obtain construction schedules from subcontractors and suppliers, and assume responsibility for correctness.
2. The Contractor shall incorporate schedules from subcontractors and suppliers into Progress Schedule to plan for and comply with sequencing constraints.

16.01.11. Work by the District

A. The District will drain water, sludge, and chemical structures and pipelines to point that the material can be drained by existing installed equipment (e.g., drain piping, sump pumps). The maximum rate such process pipelines can be drained will depend upon the type of material, existing valves, drain piping, appurtenances, receiving bodies, and material disposal requirements. Up to 20% of the full volume of the material contained in the process pipeline, tank or sump shall remain to be removed and disposed of by the Contractor as required for completion of the Work. This material may be collected and transported by the Contractor to be disposed of appropriately on site as approved by VW on a case by case basis. The Contractor shall discuss the desired schedule for draining with the Engineer (Construction Manager) a minimum of thirty (30) working days in advance of such operations so that the Contractor's Work can be coordinated with District capabilities. The Contractor shall assume that all existing valves,

sluice gates, and stop logs have significant leakage (e.g., requires barriers, pumping and water control).

B. Additional District staff will monitor the Contractor's activities during execution of the following special Work. The Contractor shall provide a minimum of thirty (30) working days notification to the Engineer (Construction Manager) to arrange monitoring of the specific Work under the classifications described below:

1. Any hot tapping or tie-in to existing equipment or facilities in operation.

2. Shutdown of any pipelines.

C. Draining Existing Chemical Pipelines: District staff shall isolate and drain existing chemical pipelines for modification or replacement by the Contractor. Some residual chemical will remain for the Contractor to dispose of in a safe and legal manner. Flushing, disposal of residuals, cleaning, protection of plant facilities and on-site personnel, and all other Work are the responsibility of the Contractor.

D. Gravity Thickeners – The District will remove existing sludge from within Gravity Thickener 2 and make available to the Contractor at the start of the low production demand period. Thirty (30) working days advance notice in writing from the Contractor is required for the work in Gravity Thickeners. The District will remove at least approximately 80% of existing sludge and water from within the Gravity Thickeners and the Contractor shall anticipate disposal of up to the remaining 20% of sludge and water. The Contractor shall be responsible for a minimum disposal of 4 inches of sludge and water in the gravity thickeners.

1. Following the work in Gravity Thickener 2, the Contractor shall allow for a 14-day Plant recovery period followed by a 7-day sludge removal period for Gravity Thickener 1 (21 days total) for the District to make available Gravity Thickener 1 for work there.

2. At the District's discretion, the order of availability for Gravity Thickeners 1 and 2 may be reversed based on Plant capacity and sludge volume at the time of the work.

E. Washwater Recovery Basin No. 2 – Ten (10) working days advance notice in writing from the Contractor is required for the work in the Washwater Recovery Basin No.2. VW will remove at least 80% of existing sludge and water from within washwater recovery basin no. 2 and Contractor shall anticipate disposal of up to the remaining 20% sludge and water. The Contractor shall be responsible for a minimum disposal of 4 inches of sludge and water in the Washwater Recovery Basin No. 2. The Contractor shall schedule activities for work within the Washwater Recovery Basin No. 2 after the facility has been turned over by the District. Prior to the start of any demolition work in Washwater Recovery Basin No. 2, the Contractor shall construct the concrete encasement of the existing washwater return pipe, and modify the electrical power and controls for the Washwater Recovery Basin No. 1 washwater return pump, as indicated on the drawings.

F. Contractor's attention is direction to Article 22.01. Project Completion and Acceptance and Article 11.01.01 regarding Use Before Acceptance.

16.02. Utilities

A. The Contractor's attention is directed to Standard Provisions Article 4.10. Preservation of Property and Article 4.25. Utilities.

16.02.01. Utility Coordination

A. The Contractor is responsible for coordination of Work near utilities and for the protection of the utility during construction.

B. The telephone numbers of owners of known utilities that may be encountered are:

Town of Los Gatos	(408) 354-6854
City of San Jose	(408) 535-3500
AT&T Telephone	(800) 331-0500
PG&E Gas and Electric	(800) 743-5000
San Jose Water	(408) 279-7900

16.02.02. Protection of Existing Utilities

A. In no case shall any service (e.g., gas, water, electricity, telephone, etc.) be interrupted. If it is impractical to support the utility across trench excavations, the Contractor may remove the services, provided a temporary bypass has been installed and is operational prior to the removal, and is approved by the utility.

B. Telemetry cables are critical to the operations of District water supply facilities. Therefore, advance notice from the Contractor in writing is required for any scheduled telemetry cable service interruptions.

1. The Contractor shall notify the Engineer (Construction Manager)two (2) weeks in advance of any activities that will result in cutting or splicing of a telemetry cable. The Contractor shall confirm this cutting or splicing to the Engineer (Construction Manager)the Day before it occurs and the Day when it occurs.

2. The Contractor shall exercise care to prevent accidental cutting of telemetry cables. Locating cables shall be performed by hand digging or by other nondestructive means.

3. The Contractor is responsible for any direct or indirect damages caused by its operations. In the event of accidental telemetry cable service interruption resulting from Contractor activities, the Engineer

(Construction Manager) may use District forces to make the repairs or direct the Contractor to make the repairs at no additional cost. If directed by the Engineer (Construction Manager) to do the repairs, the Contractor shall complete the repairs within four (4) hours. If District forces make the repairs, the Contractor shall reimburse the District for all direct and indirect costs resulting from the loss of telemetry cable service and repairs. If the Contractor makes the repairs, the cost damages resulting from the loss of telemetry cable service shall be deducted from the monies that are due or that may become due the Contractor.

16.02.03. Utility Installation/Relocation by Others

A. The utility owner shall relocate service connections as necessary within the limits of the Work or within temporary construction easements. The Contractor shall coordinate its activities and shall fully cooperate with the utility owner so as not to hinder or interrupt the assigned task of said personnel.

16.03. Protection of Existing Improvements

A. The Contractor's attention is directed to Standard Provisions Article 4.10. Preservation of Property.

16.03.01. Survey Monuments

A. No survey monuments, permanent markers for the District right of way, or District survey control points shall be removed or disturbed until the Engineer (Construction Manager) has recorded the locations thereof and a permit for such removal has been received from the agency having jurisdiction. When the construction Work has been completed, the Contractor shall replace the monuments accurately in the locations as referenced by the Engineer (Construction Manager).

B. If any marker or monument is destroyed by the Contractor without prior written approval of the Engineer (Construction Manager), the Contractor shall be responsible for the accurate replacement of the marker or monument (i) by a land surveyor licensed by the State of California; (ii) in accordance with the California Business and Professions Code Chapter 15 Land Surveyors, Section 8771; and (iii) at no expense to the District.

C. The Contractor shall provide new monuments at locations noted on the Drawings. The Contractor shall perform and submit a record of survey for the new monuments provided for all roadway alignments. The record of survey shall be examined by the county surveyor and recorded by the County Clerk-Recorder's Office.

16.04. Preconstruction Surveys

16.04.01. Preconstruction Survey Within the Project Limits

A. After the Contract has been awarded and before commencement of the Work, the Contractor shall conduct a thorough examination of the Work areas within the Project limits only after notification and coordination with the Engineer (Construction Manager).

B. The Contractor shall inspect the condition of all areas that may have potential impacts, including, but not limited to, existing improvements, levees, ramps, buildings, landscape planting, architectural finishes, the size of structural cracking or settlement, the rate of leakage, and any other conditions deemed appropriate. The presence of the Engineer (Construction Manager) shall in no way relieve the Contractor of the responsibility for completely and accurately documenting all existing conditions.

C. Records of all observations shall be prepared by the Contractor; every copy of all documents shall be signed by the authorized representative of the Contractor and provided to the Engineer (Construction Manager). Photographs and videos with dates shall be made by the Contractor and included in the record of observations. One (1) signed copy of every document, photograph, and video will be kept on file in the office of the Engineer (Construction Manager).

D. The above records, photographs, and videos are intended for use as evidence in ascertaining the extent of any damage that may occur as a result of the Contractor's operations during the prosecution of the Work.

E. Structural surveys, if required, shall be conducted by a licensed civil or structural engineer.

16.04.02. Surveys of Properties in the Vicinity of the Work

A. No Special Requirements.

16.04.03. Payment

A. Full compensation for doing all Work necessary to provide Preconstruction Surveys as provided herein shall be included in the Contract Price(s) for various items of Work involved; no additional payment shall be made.

16.05. Rights of Way

A. No Special Requirements.

16.05.01. District-Furnished Right of Way

A. No Special Requirements.

16.05.02. Contractor-Furnished Right of Way

A. Any additional rights of way desired by the Contractor for its convenience shall be acquired by the Contractor at no expense or obligation to the District. The Contractor shall provide the Engineer (Construction Manager) with copies of any agreements between the Contractor and property owners regarding disposal of excess materials generated by the Contractor's activities, storage of materials, or any use of property in conjunction with this Project. The agreement shall state that the agreement is solely between the Contractor and the property owner and that the District is not a party to the agreement and not responsible for compliance with any conditions stated in the agreement.

16.05.03. Temporary Construction Easements

A. No Special Requirements.

16.06. Access to Properties Owned by Others

A. The Contractor shall conduct the construction operations in a manner that cause as little inconvenience as possible to adjacent property owners.

B. Convenient access to driveways, houses, buildings, and businesses along the Work shall be maintained in operational condition; temporary approaches to crossings or to intersecting streets shall be provided and kept in good condition.

C. When construction operation is directly within the driveway area, temporary access shall be provided. The existing access shall not be closed until the temporary replacement access is usable. Once construction is completed, access shall be restored to a condition equal to or better than the existing condition prior to the Contractor's operation.

D. The Contractor shall comply with California Vehicle Code Sections 22500 Prohibited Stopping Standing or Parking and 22500.1 Additional Prohibited Stopping Standing or Parking Fire Lane regarding stopping, parking, or leaving any vehicle in front of a public or private driveway.

16.07. Access to the Job Site

A. The Project location is shown on a map included in the Drawings. The Contractor may use the existing roads to access and perform the Work subject to the restrictions specified herein.

B. It is the Contractor's responsibility to obtain any and all permits that may be required from all applicable regulatory agencies to move materials and equipment to the job site, dispose of excess material created by the Contractor's operation, and for traffic control to, from, and on the Project sites.

C. Access to the job site shall only be through the gates off More Avenue; the contractor shall not use the Granada Gate.

16.08. Access Roads Within the Job Site

A. The Contractor shall maintain access roads to all staging, office trailer, storage areas, and to other areas to which frequent access is required. The Contractor shall maintain access to all other existing facilities on the site, including access for delivery of materials and for maintenance and operation.

B. The Contractor is responsible for damages to buried utilities resulting from loads imposed on temporary roads constructed by the Contractor or other access routes used by the Contractor.

C. The Contractor shall maintain on-site access roads free of mud. Under no circumstance shall vehicles leaving the site track mud or dirt off the site onto public rights of way.

D. The Contractor shall be performing Work at an Operational facility that is critical and must remain in continuous operation at all times. The Contractor shall schedule and perform its Work such that there is no disruption to facility operations and access. Access to the facility and all portions of the facility shall be maintained at all times for the staff, chemical deliveries, and for all other delivery vehicles.

E. Trenching for irrigation piping and electrical conduits will cross the access roads at the Solids Load-Out Structure and at several other locations as shown on the Drawings. The Contractor shall coordinate the trenching activities with the Engineer (Construction Manager) and shall provide traffic steel plates as required to maintain plant access. No access interruption to any portion of the Plant will be allowed. The Contractor shall notify the Engineer (Construction Manager) at least ten (10) Days in advance of any planned trenching or excavation crossing any access road.

F. The Contractor shall provide a minimum of one (1) route for fire engine access to all structures (i.e., existing, new, and those under construction) at all times. Such a route shall be at least 20 feet wide and have a minimum of 13 feet 6 inches clear height. The Contractor shall post signs to indicate the vehicle travel route if it is not along the existing roadways so that travel route is evident to emergency vehicle operators. A turnaround adequate for a fire engine is required when any roadway to a structure is a “dead end” over 150 feet long.

16.09. District Use of Facilities/Premises Within the Work Area

A. The District reserves the right to access and use the entire Residuals Management System during performance of the Work to conduct operations and maintenance of District facilities. This includes the gravity thickeners, the centrifuge feed pumps, the centrifuges, the conveyors, the loadout structure, the existing mixing pumps, the existing storage tank, the centrate return/overflow/

drain wetwell and pumps, and the roadways in an around the Residuals Management System.

B. The Contractor shall coordinate all construction operations with the District to avoid conflict and to facilitate the District's use of the premises.

C. Unless otherwise altered by the Work, the Contractor shall restore the premises to preexisting condition, and shall immediately repair any damages to the premises caused by the Contractor's operations.

SECTION 17. SAFETY AND SECURITY

17.01. Safety

A. Contractor's work is occurring while the plant is in operation and may require common access to areas under construction by District staff or their agents to ensure proper operation of the plant. Common areas of concern include the Centrifuge Building A, Gravity Thickeners, Sludge Transfer Pump Station, Load Out Structure, Washwater Recovery Basins, and Centrifuge Building B (Belt Press Building). Contractor shall provide appropriate warning systems and protective measures that delineate the area that may pose a hazard to District staff that may need to enter these areas. If the area is not occupied or attended by the Contractor, the protected and/or restricted area(s) shall provide notice at the area of an on-call contact phone number for District staff to call if entrance to these areas is required and requires Contractor assistance to gain safe access. Contractor shall have on-site a responder within 2 hours of District request

B. When working on District or on Santa Clara County property, the Contractor shall erect temporary fences and install warning signs around any trenches left open outside the working hours indicated in Article 18.02 to prevent access to the trench.

C. Refer to Standard Provisions Section 8 for Safety and Security Management.

D. Confined Space entry shall require that contractor personnel be certified and trained in accordance with Article 8.07.

17.02. Safety and Health Program

A. Due to the nature of this Project, the requirements in Article 8.10. Safety and Health Program for Hazardous Waste Operations of the Standard Provisions, do not apply to the scope of Work.

17.03. Security Requirements at Job Site

A. Pets and Animal Restrictions:

1. Contractor is not allowed to bring pets or animals to the treatment plant site at any time. The treatment plant is a secure facility with a gated perimeter with its own security system in place while the facility is attended and operated 24 hours a day 7 days a week. Contractor shall not be allowed to provide their own animal protection for security purposes within the facility.

2. Special circumstances, such as the need for a seeing eye dog may be allowed, but shall be confirmed with the Engineer (Construction Manager). Any animals allowed on site need to be leashed or caged and attended to at all times while on treatment plant site.

17.03.02. Identification and Badging

A. Refer to Standard Provisions Article 8.17 for Identification and Badging.

17.03.03. Background Checks

A. Refer to Standard Provisions Article 8.18 for Background Checks.

17.03.04. Site Access Control

A. The District will maintain security checkpoints at the entrance gate. There are two facility entrances into the Rinconada Water Treatment Plant off of More Avenue. The security checkpoints will be staffed by District security guards during normal working hours and at other hours on an as needed basis. Roving guards may also patrol the property.

B. Contractor, when working in or utilizing the upper parking lot, will not prevent District access to the gas station for vehicles to fill up and for tanker truck refilling of the underground tank.

17.03.05. Mail and Postal Deliveries to the Project Site

A. Unless an exception is granted by the District, Contractor shall not have United States Postal Service, Federal Express, UPS, or similar mail and package deliveries addressed to the Rinconada Water Treatment Plant. Under no circumstance shall mail/packages be delivered to the reception areas of any District Facility.

SECTION 18. PERMITS AND REGULATIONS

18.01. Permits and Agreements

A. In addition to the permit requirements specified in this Section, the Contractor shall comply with other conditions listed below:

1. Contractor shall comply with all permit requirements from the agency having jurisdiction, including inspections and testing.

2. Contractor shall test the system in the presence of the Engineer (Construction Manager) prior to requesting an inspection by the agency having jurisdiction, unless otherwise authorized by the Engineer (Construction Manager).

3. Contractor shall notify the Engineer (Construction Manager) a minimum of 5 workdays in advance for the District to schedule an inspection by Santa Clara County Fire Department. Preferred inspection days and times may be requested but will be dependent on the availability of the Santa Clara County Fire Department Inspector.

4. As much as practical, Contractor shall request inspections by the agency having jurisdiction in an efficient manner, minimizing the number of times the inspector is called out.

5. Inspections required to be performed more than once by the agency having jurisdiction due to the Contractor's failure to comply with inspection requirements or due to the need to retest after a failed test shall be borne by the Contractor.

6. No system shall be placed into service until the inspector from the agency having jurisdiction has inspected and approved the work.

18.01.01. District-Obtained Permits

A. The District will obtain permits during the construction period for Work on this Project from the following agencies having jurisdiction:

1. Hazardous Material installation permit from the Santa Clara County Fire Department for the polymer feed system.

2. Town of Los Gatos Tree Removal Permits.

3. California Department of Fish and Wildlife – Woodrat relocation.

18.01.02. Contractor-Obtained Permits and Regulatory Deliverables

A. The Contractor shall obtain permits and pay for associated fees during the construction period for work on this Project from the following agencies having jurisdiction:

1. The Contractor will be responsible for obtaining permits for a Haul Route Permit from the authority(ies) having jurisdiction.

2. All permits required by Cal-OSHA for construction activities.

3. Transportation and disposal of hazardous materials.

4. Other permits as required by law, as required by these Specifications, and required by permits already obtained by the District from the agency having jurisdiction.

18.01.03. Operation Regulations

A. The District is not required to obtain a building permit from the local agency having jurisdiction (Town of Los Gatos), for this work as it is related to the conveyance of water per Government Code Section 53091 and 53096. However, the District's exemption from obtaining a permit does not eliminate the requirement that all work be performed in accordance with applicable California Building, Plumbing, Mechanical, Electrical, Fire and Energy Code requirements.

B. The treatment plant operations at the Rinconada Water Treatment Plant are regulated by the California State Water Resources Control Board, Division of Drinking Water (DDW). DDW's Field Operation Branches are responsible for the enforcement of the federal and California Safe Drinking Water Acts (SDWAs) and the regulatory oversight of the state's public water systems. The District works with the Northern California Field Operations Branch, District 17 of DDW.

1. The project improvements include modifications to the plant's treated water systems. The District will obtain any necessary amendment to the current DDW plant operating permit resulting from this work, as required.

C. The Rinconada Reservoir is regulated under the California Division of Safety of Dams (DSOD) for dams.

D. The Project involves installation of new chemical storage and feed system, which will require Fire Department permit(s). The Santa Clara County Fire Department regulates the Hazardous Materials Storage Ordinance for the Town of Los Gatos.

1. California's Secretary for Environmental Protection (CalEPA) has established a unified hazardous waste and hazardous materials management regulatory program (Unified Program) as required by statute (Health and Safety Code Chapter 6.11). The Unified Program referred to as the Certified Unified Program Agency (CUPA) consolidates,

coordinates, and makes consistent portions of the following six existing programs.

a. Hazardous Waste Generators and Hazardous Waste Onsite Treatment
b. Underground Storage Tanks
c. Hazardous Material Release Response Plans and Inventories
d. California Accidental Release Prevention Program
e. Aboveground Storage Tanks (Spill control and countermeasure plan only)
f. Uniform Fire Code Hazardous Material Management Plans and Inventories

18.02. Hours of Work

A. Unless noted otherwise, no Work, including material hauling to/from the site and equipment movement, shall be performed during the Days and hours restricted by and set forth in this Section.

1. Normal Working Hours and Days:

a. Normal working hours and days are defined as 8:00 a.m. to 5:00 p.m. on weekdays.

b. Normal working hours are in effect for all work except for certain work associated with Shutdowns, Special Outages, Outages, or to correct unplanned plant operational disruptions as defined in Article 13.02, Definition of Key Terms.

c. Work shall not take place between 5:00 p.m. and 8:00 a.m. on weekdays. The Contractor's attention is directed to Article 18.08 and 18.09 for Traffic and Parking Requirements for additional restrictions.

d. Unless noted otherwise on the Drawings or in these Specifications or as approved in writing by the Engineer (Construction Manager), no Work shall be performed on Saturdays or Sundays or on any holiday listed herein.

e. Holidays are defined as;

1) New Year's Day, Martin Luther King's birthday, Presidents' Day, Memorial Day, Independence Day, Labor Day, Veteran's Day, Thanksgiving Day, the Friday after Thanksgiving, and Christmas Day. If any of the above holidays should fall on a Sunday, the following Monday shall also be considered a holiday. If a holiday should fall on a Saturday, the previous Friday shall also be considered a holiday.

f. For additional restrictions to hours of Work refer to Section 16 .

2. General Schedule Constraints for all Work, Outages and Shutdowns

a. Plant shutdowns or outages shall be allowed only between periods as listed in Section 16. Work Constraints and Site Restrictions.

b. On the first day of a plant shutdown or outage, the District reserves the hours of 7:00 a.m. to 12:00 noon of that day to bring the plant down. District may turn the plant over to the Contractor earlier in the day if the District is ready.

c. The start time for a scheduled plant shutdown or outage begins based on the actual time District turns plant over for Contractor to begin work and perform Contractor's lock-out tag-out related to the outage or plant shutdown. Turnover of the plant to the Contractor is accomplished when the following is performed:

1) Contractor indicates valves they plan to have the District open and close on the Partial Outage or Plant Shutdown form (POPS form). Refer to Appendix D for a POPS form. Contractor shall submit the POPS form two weeks in advance of the plant shutdown meeting

2) The District will review the Contractor's POPS form that will be used for the plant shutdown or outage.

3) District establishes isolation, lock out and tag out of the system appropriate for allowing for alternative operational mode or complete shutdown for operational purposes only and adds any revisions to the POPS form.

4) Contractor will need to be present to walk through with District to witness the valves and other devices that District closed or opened for the plant shutdown or outage and Contractor can start their work at that time by implementing their lock out tag out procedures.

5) Contractor will establish additional isolation and confirm with District regarding any revisions to their POPS form. Contractor will issue a hard copy of the revised POPS form to the District.

6) Contractor's valve (and other devices) closures or openings on Contractor controlled work not yet operational must be witnessed by the District and allow for District to add lock out tag out to Contractor's isolation efforts.

7) Two copies of the updated list of lock out and tag out devices on the POPS form will be signed with date and time of day by the Contractor and District. The date and time on the POPS form will be the official start date and time of the plant shutdown or outage. The duration of the plant shutdown or outage will be filled out on both POPS forms in terms of days. However, the end of the plant shutdown or outage will be defined as the number of days allowed terminating at 10:00 a.m. This computed date and time of completion will be recorded on the POPS form.

8) The District will require 48 hours after the plant shutdown or outage period to bring the plant back into operation. This 48 hour period is not included in the shutdown duration period as defined on Section 16.

9) Turnover of the Plant from the Contractor to the District is considered complete when the all work for the shutdown or outage is completed, bacteriological testing results are acceptable and the Contractor has removed their locks and walked through with the District. District at that time will also remove District's lock. Upon confirmation that Contractor's and District's locks are removed in accordance with what is listed in the POPS forms, both parties will sign, date and record the completion time. Should the completion time recorded exceed the allowable shutdown or outage time, Contractor is subject to liquidated damages in accordance with Article 12.05.

3. Plant Shutdown and Outages Work Hours and Days

a. During plant shutdowns special outages and outages, the Contractor may work extended work hours complying with the following requirements:

1) Normal work hours and days for indoor and outdoor work shall be 8:00 a.m. to 8:00 p.m. Monday through Friday and 9:00 a.m. to 6:00 p.m. on Saturdays. However, no construction truck or tractor work on the outside of buildings is permitted on Saturdays (dump trucks, backhoes, jackhammers, or any motorized equipment, etc.) and no outside construction lighting or outside generators are permitted to operate on Saturdays (except regular security lighting or regular safety lighting).

2) No Sunday construction work is permitted.

3) Indoor work may be performed 24 hours a day, weekdays, Saturdays and holidays, but is subject to prior written approval by the Engineer (Construction Manager).

4. Contractor's attention is directed to the Technical Specifications of these Specifications regarding requirements for bacteriologic testing before the end of plant shutdowns and outages.

5. Refer to Section 16 for description of work and constraints for outages.

6. No excusable inclement weather delays will be allowed for work occurring during plant shutdowns or outages.

7. Truck deliveries shall not be allowed outside normal working hours defined in Article 18.02 and shall comply with Article 18.08. No exceptions shall be allowed during plant shutdowns or outages.

8. Requests for Extended Work Hours and Days

   a. Contractor must submit in writing to the Engineer requests to work outside of working days and hours allowed herein. Contractor's request shall include description of work Contractor plans to accomplish, construction activities, personnel and equipment to be utilized, and the days and hours outside the allowed working days and hours the work will be occurring. Unless it is considered an emergency by the District, requests shall be made three (3) working days in advance.

9. The Contractor may perform work related to relocation of the Dusky-Footed Woodrats as required in Article 19.09. beginning one hour after sunset to begin the nest removal(s), and haul off old nests until completed that evening. No other construction activities will be allowed during this time

18.03. Noise Pollution and Vibration

18.03.01. Noise

A. The Contractor is responsible for ensuring that noise produced by construction activities does not exceed the applicable local noise ordinance standards and is in full compliance with the performance standards set forth in this Section.

B. The project site is within the Town of Los Gatos. The Town Noise Ordinance (Chapter 16 of the Town Municipal Code) specifies noise limits for construction activities (Section 16.20.035) and sets exterior noise limits (Section 16.20.015 and 030). These limits are summarized below:

Project Noise Restriction	
Item	**Maximum Allowable Allowable Levels (1)**
Night-Time Noise Restrictions 10:00 p.m. to 6:00 a.m. – weekdays 10:00 p.m. to 6:00 a.m. – weekends and holidays	48 dBA L_{eq}(2) – Weekday Night 43 dBA L_{eq} – Weekend & Holiday Night
Construction Noise Weekdays 8:00 a.m. to 8:00 p.m. Weekends and holidays: 9:00 a.m. to 7:00 p.m.	85 dBA L_{max} at 25 feet from equipment or noise level at any point outside property boundary cannot exceed 85 dBA L_{max}

(1) As measured at District's property line.
(2) L_{eq} equivalent noise level; an average noise level that represents the level if a steady noise containing the same total noise energy as the fluctuating noise over the time period of interest

C. In addition to the requirements under Article 10.07. Noise Pollution and Vibration, the Contractor shall exercise precautionary measures listed below. Installation of these measures shall in no way relieve the Contractor of the responsibility of compliance with the noise criteria.

1. The Contractor shall construct temporary noise barriers (ready-made solutions by the acoustical industry or constructed onsite by the Contractor) to shield on-site construction and concrete demolition noise from nearby residences. The barriers shall be placed as close as possible to the noise source. Examples of barriers include portable acoustically lined enclosure/housing for specific equipment (e.g., jackhammer and pneumatic-air tools, which generate the loudest noise), temporary noise barriers (e.g., solid plywood fences or portable panel systems, minimum 8 feet in height), and/or acoustical blankets. Portable enclosures/housings shall be constructed with noise control curtains and lightweight frame structure, with a small door or opening facing away from residences, and fastened with Velcro. Acoustical blankets or curtains shall be set up on a supporting structure, such as a cyclone-type fence or on guy-wire strung between temporary supports. At a minimum, temporary noise barriers shall be installed for any construction activity located within 50 feet of residences and for any use of the hydraulic breaker or wrecking ball within 100 feet of residences.

2. "Quiet" models of air compressors and other stationary noise sources where technology exists shall be utilized.

3. Unnecessary idling of internal combustion engines shall be prohibited.

4. Locate stationary noise sources as far from residences as feasible. If they must be located near receptors, adequate muffling (with enclosures where feasible and appropriate) will be used as necessary to comply with local noise ordinance limits. Any enclosure openings or venting will face away from sensitive receptors.

5. All construction equipment shall be maintained and properly tuned in accordance with manufacturer's specifications. All equipment shall be checked by a certified mechanic and determined to be running in proper condition prior to operation.

6. Mobile equipment staging, parking, and maintenance and equipment staging areas shall be located as shown on the Drawings or as directed by the Engineer (Construction Manager).

7. Locate material stockpiles as far as feasible from residential receptors.

8. No music system including personal or vehicle radio, tape, or CD players or the like shall be audible at the property line.

9. The Contractor shall post readily visible informational signs at the entrance to the construction site indicating that the site is a "NOISE CONTROLLED ZONE" and that persons and machinery may be barred from the site for violations of the noise control plan and regulations.

D. Noise Monitoring and Compliance: The District may conduct noise monitoring to monitor Contractor's compliance with the noise criteria. District may select one of the noise monitoring techniques listed here:

1. Monitoring procedures in accordance with the United States Federal Highway Administration's Technical publication titled "Measurement of Highway-Related Noise," Section 7 "Construction Equipment Noise Measurements for Highway-Related Projects" dated May 1996. http://www.fhwa.dot.gov/environment/noise/measurement/mhrn07.cfm

2. Spot monitoring through the use of a hand-held noise meter.

18.03.02. Noise Monitoring

A. Noise Monitoring: Monitoring shall be performed by the Contractor as directed by the Engineer (Construction Manager) using a type 1 sound-level meter, as specified by the latest ANSI standards, measuring a dynamic range of 40 120 dBA. Noise levels shall be A weighted with a minimum sampling rate of 64 samples per second (fast). Root mean square (RMS) sound pressure levels (SPLs) shall be expressed by the descriptors L (max) and Leq(h). Microphones shall be equipped with windscreens and shall be positioned as designated by the Engineer (Construction Manager). Spot readings shall be taken as directed by the Engineer (Construction Manager) to assure noise levels during Work operations are within the allowable limits. Noise monitoring equipment shall be

calibrated prior to each use. The noise monitor shall print data to a serial printer to provide immediate on site results. The Contractor shall keep a copy of all documentation and submit one (1) copy to the Engineer (Construction Manager) on the day of the reading.

18.03.03. Vibration Monitoring

A. No Special Requirements

18.03.04. Payment

A. Full compensation for doing all Work necessary to comply with the requirements of this Article shall be included in Bid Item 27; no additional payment shall be made.

18.04. Light Pollution

A. No additional outdoor lighting shall be permitted unless otherwise specified. Lighting from Contractor's trailers and equipment shall be blocked during night time use between the hours of 8:00 pm and 8:00 am, and lights turned off when not in use overnight.

B. For work during plant shutdowns, outages or work that must be performed during nighttime hours between the hours of 8:00 pm and 8:00 am or for safety purposes, Contractor may provide outdoor lighting that is in compliance with local ordinances for light and glare. All such lighting shall be shielded and not projected outside the limits of the staging and work areas and not extend beyond the property line of the Rinconada Water Treatment Plant site.

18.05. Air Pollution

A. *No Special Requirements.*

18.06. Spillage and Dust

A. Specified dust controls shall be implemented such that visible dust plumes are retained within the property lines. Dust controls include watering and other measures, such as preventing trackout, paving unpaved roads, covering or treating stockpiles, etc., with the extent of controls varying with the size of the Project.

18.07. Traffic Control

A. The Contractor shall prepare a Traffic Control Plan that must be approved by the Engineer (Construction Manager)prior to rerouting traffic or impacting any public roads. The traffic Control Plan shall address all traffic control measure as shown on the Drawings and specified in these Specifications.

1. Traffic control work shall include, but not limited to, flag persons, removing and replacing traffic control systems, fencing, railing,

barricades, crash cushions, channelizers, AC pavement, driveways, curb, gutters and sidewalk and pavement markings, and construction area signs necessary for traffic staging on public streets adjacent to or near the project area, and any other miscellaneous work necessary to complete the traffic control as specified in these Specifications and as directed by the Engineer (Construction Manager).

2. If any component in the traffic control system is displaced, or ceases to operate or function as specified during the progress of the work, the Contractor shall immediately repair said component to its original condition or replace said component and shall restore the component to its original location.

3. No stockpiling of materials or parking of equipment will be allowed on streets and sidewalks.

4. All construction signs shall be placed in the field and shall be visible to drivers and not covered or blocked by trees or other fixed objects.

5. The Contractor shall verify any sprinkler system conflicts before installing construction area signs in planting strips. Contractor shall replace landscaping upon removal of construction area signs, if needed, and as directed by the Engineer (Construction Manager).

6. The Contractor shall ensure levels of operation acceptable to the Engineer (Construction Manager), as well as perform inspections of traffic control zones on a daily basis.

7. All streets and sidewalk areas shall be swept clean in accordance with these Specifications.

B. Contractor shall provide flag persons as required by the Traffic Control Plan and when directed to by the Engineer (Construction Manager). Flag persons shall be stationed along the truck haul route during the day when 20 or more trucks are anticipated to arrive at the plant during a single day, or when directed to by the Engineer (Construction Manager) during the starting and ending times of Rolling Hills Middle School.

C. Contractor shall not interfere with Rolling Hills Middle School's existing traffic control personnel unless otherwise directed by the Engineer (Construction Manager).

D. The Contractor shall cooperate with the Town of Los Gatos and any other local authority having jurisdiction relative to handling traffic around the construction area.

E. The Contractor shall obtain, at Contractor's expense, a "Haul Route Permit" from the agencies having jurisdiction for transporting to and from the Project site construction materials and disposal of surplus materials over their streets.

F. Contractor shall avoid queuing construction traffic on More Avenue. Contractor's access entrance into the treatment plant off of More Avenue, as shown on the Plans, is situated on steep hill with limited visibility for traffic arriving and making left turns into the treatment plant. More Avenue is bordered by a residential neighborhood overlooking the job site and may be sensitive to trucks revving their engines on the hill, etc. Contractor shall provide necessary traffic control, including flagman or other approved controls to ensure safe access into the plant is not delayed and to avoid queuing onto More Avenue.

G. If queuing activity is observed on More Avenue, Contractor shall intercept other trucks arriving at an alternate location for temporary parking until the area along More Avenue is cleared. Contractor shall confirm with the agencies having jurisdiction as part of their haul route permit, what area(s) trucks would be temporarily parked and the days and hours that such area(s) may be used.

H. All traffic entering the treatment plant will be subject to District's security check-in procedures. These procedures may delay entrance into the plant from More Avenue. Contractor shall provide traffic control if security check-in creates delays which back up traffic on More Avenue to allow other traffic to safely negotiate around construction traffic. If necessary, backed up traffic maybe directed by the Engineer (Construction Manager)to enter District's upper More Avenue entrance for queuing until it is clear for traffic to check back in at the construction access entrance.

I. Contractor's flag persons provided for the Project shall be trained and experienced in the proper techniques for flagging and traffic control. The flag person shall comply with Caltrans Standards for Control of Traffic through work zones as described in the Caltrans Traffic Manual. If a flag person is not performing his/her duties to the satisfaction of the Engineer (Construction Manager), the Contractor shall be required to replace the flag person with a competent flag person or a police officer at the Contractor's expense.

J. The Contractor shall not block:

1. The one-way on-site access road used daily by chemical trucks to deliver chemicals.

2. The lower on-site access road used for sludge loading and exporting.

K. All vehicle speeds on unpaved roads shall be limited to 15 mph.

18.08. Truck Traffic and Hauling

A. Truck traffic and hauling related to construction activities for the Project shall conform to the local haul route permit and to the additional restrictions described herein.

B. Construction truck traffic and hauling will be required to use designated truck routes. Whereas cars may travel between Winchester Boulevard and More Avenue via the residential streets of Wimbledon Drive, Wedgewood Avenue,

and Roxbury Lane, construction trucks will not be permitted on those roadways. Truck traffic and hauling shall use the route from Highway 17 (from the Camden Avenue/San Tomas Expressway exit or the Lark Avenue exit) following Winchester Boulevard to Knowles Drive, and then to Pollard Road and More Avenue. Trucks over 9,000 pounds gross weight are not permitted on Highway 85 between its southern terminus at Highway 101 and its junction with Interstate 280. Thus, no trucks shall use the Highway 85 on-ramp or off-ramp on Winchester Boulevard. No truck traffic or hauling shall be permitted on any other streets unless noted elsewhere in these Specifications.

C. ruck traffic and hauling days and hours are restricted to normal working days and hours as defined in Article 18.02. Hours of Work, and shall not be allowed during holidays and weekends. Soil hauling to or from the Project site has the additional restriction of not being allowed between 7:00 a.m. and 9:00 a.m. and after 4:00 p.m. No extension in the hauling days and hours shall be allowed during plant shutdowns or outages.

D. The Rolling Hills Middle School is located at More Avenue and Pollard Road which is along the anticipated truck haul and delivery route. While the Rolling Hills Middle School is in session, the Contractor and the Contractor's subcontractors and suppliers shall not schedule truck arrivals between 8:00 a.m. and 9:00 a.m. Monday through Friday and between the half hour prior to and the half hour following the end of the school day. Long lines of cars and children exiting cars, riding bikes and crossing the street occur during these times. School sessions typically begin the second week of August and end the second week of June. The times that school starts and ends may vary throughout the week. The Contractor's attention is directed to the school web site at http://rollinghills.campbellusd.org or the Campbell School District web site at https://www.campbellusd.org for current information on school days and hours. Truck traffic occurring during these prohibited times will subject the Contractor to Liquidated Damages as specified in Article 12.05.

E. Exceptions to the truck traffic restrictions may be granted by the District on a case-by-case basis. The Contractor's waiver requests must be submitted in writing to the Engineer (Construction Manager) two weeks in advance of the date needed. A waiver request shall include, at a minimum, the date and times the truck traffic restrictions need to be lifted, the amount of truck traffic expected during this period, justifications for such waiver, and description of traffic control measures to be implemented by the Contractor.

F. The Contractor shall post information signs for truck drivers at approved locations along haul route indicating truck traffic hour restrictions. Signs shall be readily visible. Violators shall be warned or barred from the site at no additional cost to the District.

G. All hauling and delivery truck schedules shall be submitted to the Engineer (Construction Manager) for review within 72 hours of the actual occurrence. Failure to do so may lead to entry delays to other traffic or rejection of trucks entry without proper security clearances established at no additional expense

to the District.

H. The Contractor shall not perform any loading or unloading activities or any other related operations outside the Project limits. In addition, no loading, unloading or any other related operations shall be performed at or near the plant entry gates.

18.08.01. Truck Arriving Early, Truck Idling, and Queuing

A. The District actively seeks to avoid or minimize unnecessary disturbance of the neighborhood from construction activities. Accordingly, all Contractor's deliveries shall be coordinated to ensure that no Contractor delivery vehicles arrive at the site entry gates before 8:00 a.m., unless otherwise specified in these Specifications.

B. Idling times shall be minimized either by shutting equipment off when not in use or reducing the maximum idling time to 5 minutes (as required by the California airborne toxics control measure Title 13, Section 2485 of California Code of Regulations). Clear signage shall be provided for construction workers at all access points.

C. No idling or queuing shall take place on any residential streets in the surrounding neighborhood except for reasons noted below:

1. idling when the vehicle must remain motionless due to an official traffic control device, traffic control signal, or at the direction of a peace officer, or traffic conditions over which the driver has no control;

2. idling when being forced to remain motionless due to adverse weather conditions or due to mechanical difficulties over which the driver has no control;

3. idling to verify that the vehicle is in safe operating condition as required by Law;

4. idling at the site entrance for security checks or searches by District guards.

D. Contractor's attention is directed to Article 12.05 regarding Liquidated Damage Assessment for violating the arrival time or idling/queuing requirements.

18.09. Parking

A. Trucks, construction equipment and Contractor employee vehicles parking and access shall be in compliance with local permits and ordinances and as further specified herein.

B. All trucks, construction equipment and Contractor employee vehicles arriving at the site shall park within the designated staging and parking areas as indicated on the Drawings. Workers shall enter the site as soon as they arrive to the site.

C. No trucks operated by the Contractor, subcontractors or deliveries for construction or Contractor employee vehicles shall be parked on residential streets.

D. Contractor's workers shall not arrive onto the site more than thirty (30) minutes prior to the start of work nor remain on the site thirty (30) minutes after the end of work.

E. One staging area is designated exclusively for Contractor and subcontractor employee parking as shown on the Drawings.

8.10. Discovery of Archeological and Cultural Resources

A. No known archeological sites were discovered on the site. If, however, burials or archeological artifacts are encountered during construction, the Contractor shall halt the Work immediately within 20 feet of the find. A "No Work" zone shall be established utilizing appropriate flagging to delineate the boundary of this zone. The Contractor shall secure and protect the zone from vandalism. The Contractor's attention is directed to Article 10.05. Burial Sites and Article 10.06. Discovery of Archaeological and Cultural Resources for additional requirements.

18.11. Aesthetic Requirements

A. No Special Requirements.

18.12. Recreation

A. No Special Requirements.

18.13. Utilities and Service System

A. No Special Requirements.

18.14. Payment

A. Unless noted otherwise, full compensation for Work involved in complying with all requirements under Special Provisions Section 18 Permits and Regulations shall be considered incidental and included in the Contract Price(s) paid for the various items of Work involved; no additional time or payment shall be allowed.

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SECTION 19. ENVIRONMENTAL REQUIREMENTS

19.01. Compliance With NPDES General Permit

A. The Contractor shall prepare and submit Storm Water Pollution Prevention Plan (SWPPP) as required under NPDES General Permit. The SWPPP shall be in accordance with Section XIV SWPPP Requirements of the NPDES General Permit. Reference is made to Standard Provisions Article 10.02. Storm Water Pollution Prevention Plan.

B. The Contractor shall comply with the risk level 2 requirements of the NPDES General Permit.

19.01.01. SWPPP

A. The requirements for preparation of SWPPP are included in Article 10.02. Storm Water Pollution Prevention Plan. See Appendix G for reporting of temporary discharges.

19.01.02. Storm Water BMPs

A. No Special Requirements.

19.01.03. Payment

A. Full compensation for doing all Work necessary to comply with the NPDES General Permit, including the preparation and implementation of the SWPPP; all materials, labor, equipment, service, supervision, documentation, and submittals shall be considered incidental and included in the other items of Work; no additional payment shall be made.

19.02. Other Discharge Permits

A. The following non-storm water sources of water may be released to the District's washwater basins or lower sludge drying basins and allowed to be returned to the head of the plant for retreatment. The recycled water releases generated by the Project include:

1. Water from disinfection and testing of treated water piping systems and basins; refer to the Technical Specifications of these Specifications regarding piping and basin disinfection and testing water releases to be recycled to the head of the plant.

2. Water and sludge from draining and cleaning of the Gravity Thickeners, Existing Washwater Recovery Basins and Centrate Wet Wells.

B. District retains the right to not allow, or to set not-to-exceed limitations on, the Contractor's ability to reintroduce wasted waters generated from dewatering, disinfection and flushing back into the treatment process. In this case discharges from this activity would need to be collected in Contractor's containment and subsequent treatment system. Such discharges may be allowed under the NPDES General permit per Article 19.01, and if the treated water discharges meet the water quality requirements for the corresponding Risk Level, then Contractor will be able to make such discharges under the General NPDES Permit. Contractor shall be responsible for providing separate treatment system(s) to meet the water quality discharge requirements; Otherwise, Contractor will need to dispose of water off-site in accordance with all local, state and federal requirements.

C. If there is evidence that water may be contaminated by Contractor's operation, the releases are subject to testing for contamination prior to being released into treatment plant storage areas and recycled back into the head of the plant's treatment process. Contractor shall not release contaminated waters from construction activities into any treatment plant basins, wetwells clearwells or reservoirs. These are source waters for treatment through the plant. Contractor shall properly treat and/or dispose contaminated waters in accordance with all federal, state and local laws.

19.03. BMP Action Plan (Not Used)

19.03.01. Payment (Not Used)

19.04. Water Pollution Discharges

A. No Special Requirements.

19.05. Regulated Material Management

A. No Special Requirements.

19.05.01. Asbestos Management

A. No Special Requirements.

19.05.02. Lead Management

A. No Special Requirements.

19.06. Solid Materials Management

19.06.01. Definitions

A. Certified Facility: A reuse, recycling, composting, or materials recovery facility meeting the required Diversion percentages set forth in this Specification, which the Engineer (Construction Manager) (i) has determined can accept diverted material; (ii) has obtained all applicable Federal, State, and Local permits; and

(iii) is in full compliance with all applicable regulations for reuse, recycling, composting, and/or materials recovery.

B. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste does not include any of the above specified material/solid waste that contains contaminated or hazardous substances. Construction waste does not include excavated soil or groundwater.

C. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations. Demolition waste does not include any of the above specified material/solid waste that contains contaminated or hazardous substances.

D. Disposal: Removal off site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in a landfill or an incinerator acceptable to authorities having jurisdiction.

E. Divert/Diversion: Use of materials for any lawful purpose other than disposal in a landfill or in a transformation facility.

F. Post-Consumer Recycled Content: The percentage of a new product that contains materials that were recycled from product that was used by the end consumer and then collected for recycling.

G. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for use in some other form.

H. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in the same form in another facility.

I. Transformation Facility: A facility whose function is to convert, combust, or otherwise process solid waste by incineration, pyrolysis, destructive distillation, or gasification or to chemically or biologically process solid waste for the purpose of volume reduction, synthetic fuel production, or energy recovery. A composting facility is not a transformation facility.

19.06.02. Construction and Demolition Waste Management

A. The Contractor shall prepare and implement a Solid Materials Management Plan that results in a minimum end of Project rate of recycle/salvage of 75 percent by weight of total construction and demolition waste generated by the Work. Construction and demolition waste shall consist of the following materials: asphalt, concrete, masonry, wood/lumber and metals.

B. The Contractor shall submit a Solid Materials Management Plan identifying procedures to be used for management of construction and demolition waste generated by the Work, including the facilities to be used for both disposal and recycling/salvaging; the estimated quantities and percentages (by weight) of construction demolition waste disposed; and recycled/salvaged categorized by

waste type. For each facility listed in the waste management plan, the Contractor shall provide the facility name and address, facility owner name, and contact information. This submittal shall be approved by the Engineer (Construction Manager) prior to commencement of any Work on the Project site.

C. The Contractor is directed to the City of San Jose's Construction and Demolition Deposit Program Certified Facility List: http://www.sjRecycles.org/business/PDF/cddd_certified_list/ for Local construction and demolition waste recycling service provider listings. Additional recycling resources are available at www.ciwmb.ca.gov/condemo/ and at www.crra.com/cdc/index.html.

D. Annually on January 25, the Contractor shall complete and submit a solid material management report form, which documents materials recycled/salvaged and disposed and demonstrates compliance with the requirements specified herein, facilities utilized, and weights of construction and demolition waste generated by the Project, as well as attach receipts that verify materials and quantities disposed and recycled/salvaged. The form and receipts shall be included as a part of the Contractor's monthly progress pay request; the form is included in Appendix E. The Contractor shall also complete and submit the form with the request for final payment.

E. Full compensation for preparing the Solid Materials Management Plan and for completing the solid material management report form shall be considered as included in the Contract Price(s) for various items of Work involved; no additional payment shall be made.

19.06.03. Post-Consumer Recycled Content Requirements

A. At the conclusion of the Project, the Contractor shall list materials furnished/installed that contains PCRC and document the percent content for each material item listed. This information shall be included in the solid material management report form specified in Article 19.06. Solid Materials Management.

B. Full compensation for documenting the above specified information in the solid material management report form shall be considered as included in the Contract Price(s) for various items of Work involved; no additional payment shall be made.

19.07. Qualified Biologist

A. The Contractor shall employ a biologist meeting the qualifications of a Qualified Biologist as listed in Article 19.07. paragraph B. to supervise all biological resource Work for the Project. More than one individual may be required to comply with the requirements for a Qualified Biologist. At any time during the Contract, the District reserves the right to request a replacement biologist due to nonperformance or for reasons outlined in Standard Provisions Article 3.04. Character of Workers.

B. The Qualified Biologist shall have the training, experience and qualifications to effectively perform the biological tasks of Articles 19.08. Migratory Birds, 19.09.

Other Wildlife Species, and Article 19.10. Sensitive Plants and Vegetation. The Qualified Biologist shall supervise all migratory bird-related activities and compliance under Article 19.08. Migratory Birds. The Qualified Biologist shall possess educational and professional training in ornithology, habitat assessment, and migratory bird regulations; and shall be familiar with the species of birds and bird resources likely to be encountered on the Project. The Qualified Biologist shall have experience to identify sensitive species and habitats, implement protocols, collect and organize data and be capable of making appropriate decisions in the field. A minimum of one year of experience is required in performing biological, ecological or related scientific research for each required discipline.

19.08. Migratory Birds

A. Refer to Standard Provisions Article 10.14. Migratory Birds and Appendix F for additional requirements.

19.08.01. Regulatory Requirements

A. No Special Requirements.

19.08.02. General Nesting Seasons

A. The bird nesting season in the Project area is generally considered to be from January 15 through August 31. However, annual variation in climatic conditions can alter these periods by several weeks.

19.08.03. Protective Buffer Zones

A. No Special Requirements.

19.08.04. Exclusion Devices

A. No Special Requirements.

19.08.05. Nest Prevention

A. No Special Requirements.

19.08.06. Submittals

A. No Special Requirements.

19.08.07. Payment

A. Work involved in complying with the requirements of this Article shall be considered as included in the Contract Price(s) paid for the various items of Work involved; no additional time or payment shall be made.

19.09. Other Wildlife and Fish Species

19.09.01. Regulatory Requirements

A. The San Francisco dusky-footed woodrat (*Neotoma fuscipes annectens*) is listed by the California Department of Fish and Wildlife (CDFW) as a Species of Special Concern. This woodrat species has been documented on the Rinconada Water Treatment Plant site. Woodrat nests were found on the Project site, all of which are well-established twig lodges 3-5 feet tall and 3-5 feet in diameter with multiple entrances and active latrines.

B. The San Francisco dusky-footed woodrat (SFDFW) nest(s) affected by the Contractor's activities shall be relocated by the Contractor's Biologist to a nearby suitable location before the existing SFDFW nests may be removed. The Contractor shall assume there are 20 woodrat nests that are to be relocated by the Contractor.

C. The Contractor shall coordinate several measures, including awareness and training of Contractor's personnel of which the San Francisco dusky footed woodrat is classified as a Species of Special Concern by the CDFW.

19.09.02. Scope of Work

A. The Contractor's Biologist shall employ a qualified dusky-footed woodrat biologist.

B. The Contractor shall provide submittal materials in accordance with the Standard Provisions and this Section.

C. The Contractor's Biologist shall provide woodrat protection awareness training.

D. The Contractor's Biologist shall conduct a detailed SFDFW nest survey not more than seven (7) Days prior to the start of activities that may affect woodrats (including vegetation removal) on the Project site to identify all nests that would be impacted by the Contractor's activities. All SFDFW nests shall be mapped and flagged for avoidance.

E. The Contractor's Biologist shall properly establish new nearby SFDFW nest(s) prior to the relocation process to enable woodrats to relocate before the existing nest(s) are removed. The Contractor will provide the Engineer (Construction Manager) written notification and location(s) of where new nest(s) will be established. The Contractor shall not remove existing nest(s) until Engineer (Construction Manager) has inspected and approved the location(s) and installations of the new nest(s) and the SFDFW nest relocation plan has been submitted and authorized by the CDFW.

F. Areas within the valley oak woodland habitat that are outside of the proposed impact area shall be identified. These shall be referred to as the SFDFW mitigation area. Large woody material, if present, shall be relocated from areas within the valley oak woodland, where impacts are expected, to the SFDFW mitigation areas. After large woody material has been relocated to the SFDFW mitigation areas, all understory vegetation shall be cleared within the areas where impacts are expected without harming or disturbing the nest and within no more than one day prior to nest removal. Relocation of nest material shall commence only after the large woody debris and understory have been removed. All personnel conducting relocation activities shall wear safety gear during nest relocation activities.

G. After all cover (except the nests themselves) has been removed, each active nest shall be disturbed by the Contractor's Biologist to the degree that SFDFW leave the nest and seek refuge elsewhere. After the nests have been disturbed, the nest sticks shall be removed from the impact areas and piled at the base of newly placed large woody material within the SFDFW mitigation area. Removal of existing SFDFW nests is limited to night time to allow woodrats to escape and relocate under the cover of darkness. The Contractor's Biologist shall start the night time removal of the SFDFW nests one hour after sunset. (Refer to Section 18 regarding hours of work.) Nests shall be dismantled during the non-breeding season (between October 1 and December 31), if possible. If a litter of young is found or suspected, nest material shall be replaced and the nest left alone for 2-3 weeks, after this time the nest would be rechecked to verify that young are capable of independent survival before proceeding with nest dismantling. The spacing distance between the newly placed piles of sticks shall not be fewer than 25 feet from each other.

H. The Contractor's Biologist shall haul off the old nest materials immediately after the removals are completed to avoid woodrats seeking their old nests. The removed SFDFW nests shall not be left on site for later disposal.

I. The Contractor shall not perform any construction work in the vicinity of the nests that are marked in the field.

J. Contractor's Biologist shall monitor activities of the woodrats within the Project site on a monthly basis throughout construction including, at a minimum, the status of existing nests, constructed nests, removal of any nests or protective buffer zones, and their locations. The Contractor shall submit a monthly report,

prepared and signed by the Contractor's Biologist that documents the SFDFW monitoring activities.

19.09.03. Contractor Biologist

A. The Contractor shall employ a biologist that has the training, experience and qualifications to legally relocate woodrat nests, and to supervise all work under this Section. At any time during the Contract, the District reserves the right to request a replacement biologist due to non-performance or for reasons outlined in Article 3.04. Character of Workers.

B. The Contractor's Biologist shall:

1. Have experience and training in surveying, identifying, building new, relocating and removing dusky-footed woodrat nests. Biologist must have documented experience on at least two previous projects and professional training in performing work related to woodrats as specified herein.

2. Provide biological sensitivity and woodrat nesting awareness training for all Contractor personnel working on the Project, including all subcontractors. This training may be combined with the biologist training provided in Article 10.14. Migratory Birds, but is in addition to District administered training required in Article 19.13. Contractor shall provide a hard copy and electronic copy of training materials used to the Engineer.

3. Conduct a detailed nest survey, identify and establish new nearby SFDFW nests, and relocate nests as described in this Section.

4. Monitor activities of the relocated woodrats on a monthly basis throughout construction. Prepare a signed monthly report that documents the SFDFW monitoring activities

19.09.04. Submittals

A. Submit to the Engineer (Construction Manager) the following information for authorization prior to Contractor hiring a qualified biologist for SFDFW survey and relocation work as specified herein:

1. Prospective biologist's educational background.

2. Prospective biologists resume of experience on at least two previous projects where dusky-footed woodrat nest surveys and relocations were

performed, including the clients contact information as a reference for the work performed by the biologist.

3. Training received by prospective biologist that includes the name of the training course(s), date that such training took place, hours of instruction, and the training organization providing the training.

B. Submit to the Engineer (Construction Manager), prior to start of work within SFDFW nest areas, a report prepared and signed by the Contractor's Biologist (woodrat specialist) that documents graphically the location of the existing SFDFW nest locations and planned compliance with woodrat relocation guidelines from CDFW and this Section, and proposed new SFDFW nest construction locations. A project location map is also required. Submittal is subject to approval by the Engineer (Construction Manager) contingent upon authorization from the CDFW.

1. Contractor's attention is directed to Section 18 regarding District Obtained Permits.

2. Contractor's Biologist shall develop the needed documentation to obtain CDFW approval. It is assumed that the Contractor's Biologist will be able to establish the new nest sites within the Rinconada Water Treatment Plant site at locations that will not interfere with treatment plant operations.

3. The Engineer (Construction Manager) will act as the liaison with the CDFW in submitting the Contractor's Biologist's documentation including but not limited to SFDFW nest survey, removal and relocation plan for approval. Any changes or revisions to the Contractor's Biologist's documentation, as required by CDFW before issuance of a permit and/or Memorandum of Understanding, must be made by the Contractor's Biologist at no additional costs to the District.

C. Submit to the Engineer (Construction Manager), no later than the 15th day of each month, a monthly report prepared and signed by the Contractor's Biologist that documents the SFDFW monitoring activities.

19.10. Sensitive Plants and Vegetation

A. The Qualified Biologist shall have the experience, education and training necessary to perform the tasks of this Section. At any time during the Contract, the District reserves the right to request a replacement biologist due to nonperformance or for reasons outlined in the Standard Provisions Article 3.04. Character of Workers.

19.11. Proper Pruning Techniques for Woody Vegetation Removal

A. No Special Requirements

19.12. Pest Management

A. See Appendix K – Control and Oversight of Pesticide Use.

19.13. Environmental Awareness Training

A. The following applies to all Contractor and subcontractor Project personnel:

1. The Contractor is hereby informed that all supervisory level personnel must attend environmental awareness training before beginning work on the Project site. All other Contractor personnel must attend environmental awareness training within 7 days of beginning work on the Project site.

2. Environmental awareness training is in addition to the Contractor's Biologist training stipulated in Articles 10.14 and 19.09, will be administered by the District and include the following:

   a. A one hour training session for all supervisory level staff.

   b. One 30 minute tail gate type training session for all staff below the supervisory level.

   c. Training may be conducted at the District's headquarters building or virtually using Zoom or Microsoft Teams.

3. Upon Completion of training, personnel will be provided with the Environmental Awareness Training sticker to be placed on their hard hat and/or be required to sign a statement confirming that they understand the environmental requirements and agree to comply. The District may require training on an annual basis.

4. Contractor shall provide a hard copy and electronic copy of training materials used to the Engineer (Construction Manager).

19.14. Payment

A. Unless noted otherwise, full compensation for Work involved in complying with all requirements under Special Provisions Section 19 Environmental shall be considered incidental and included in the Contract Price(s) paid for the various items of Work involved; no additional time or payment shall be allowed.

SECTION 20. SUBMITTAL AND QUALITY REQUIREMENTS

20.01. Additional Submittal Requirements

A. This Section includes any additional submittal requirements. Also see Standard Provisions Section 7 Submittal Management.

20.01.01. General Requirements

A. Submittals shall be in accordance with Standard Provisions Article 7.05. Submittals to be Furnished by the Contractor unless otherwise modified herein.

20.01.02. Immediate Submittals

A. Physical construction Work cannot begin until the following immediate submittals have been favorably reviewed by the Engineer (Construction Manager) and Engineer (Engineer of Record) where applicable.

1. Section 03 Résumé of Project Superintendent
2. Section 05 Resume of Professional Scheduler
3. Section 08 Injury and Illness Prevention Plan
4. Section 08 Site Security and Protection Plan
5. Section 08 Site-Specific Safety and Health Plan

B. The following shall be submitted within 10 days after the date of issuance of the Notice to Proceed (NTP).

1. Contractor's preliminary progress schedule for the first 45 days of Work.

C. The following shall be submitted with 30 days after the date of issuance of the NTP.

1. Detailed Baseline Progress Schedule per Standard Provisions Article 5.06
2. Article 20.04.02 Contractor's Quality Control Plan
3. Resumes of all personnel required by Article 20.04
4. Qualifications of all proposed independent inspection and testing laboratories/agencies required by the Contract
5. Section 10 BMP Action Plan or Storm Water Pollution Prevention Plan

6. Section 18 Contractor-Obtained Permits

7. Section 19 Construction and Demolition Debris Management Plan

8. Technical submittals including:

   a. Centrifuge Dewatering Equipment per Technical Specification 46 71 36.

   b. Progressing Cavity Pumps per Technical Specification 43 23 57.

   c. Low Voltage Motor Control Centers per Technical Specification 26 29 00.

   d. Shaftless Screw Conveyors per Technical Specification 43 62 11.

20.01.03. Special Review Cycle

A. No Special Requirements.

20.01.04. Copies

A. The number of copies of submittals described herein supersedes the submittal copy requirements described in Standard Provisions Article 7.05. Submittals to be Furnished by the Contractor and in Article 9.12.02. Product Data and Samples.

B. The number of copies required is as follows:

1. Shop Drawings and product data: Electronic copy submitted via ProjectWise only.

2. Samples: Sufficient numbers to allow two (2) samples of all structural and architectural products involving color, finish, texture, etc. and one (1) sample of other products to be retained by the Engineer (Construction Manager) plus one (1) sample to be returned to the Contractor for the Contractor's use.

3. Draft O&M Manual: One (1) Electronic Copy (searchable, indexed, tabulated and organized PDF) and three (3) hard copies.

4. Final O&M Manual: One (1) Electronic Copy (searchable, indexed, tabulated and organized PDF) and three (3) hard copies.

5. It shall be the Contractor's responsibility to copy and/or to conform reviewed submittals in sufficient numbers for its files and for Subcontractors and vendors.

20.02. Exclusive Testing by the District

A. Not used.

20.03. Additional Testing Certifications

A. Any materials or products that come into contact with water that is returned to the headworks. The Project shall not use any products or materials that have not been tested and certified as meeting the specifications of NSF International/American National Standard Institute (NSF/ANSI) 61-2005 / Addendum 1.0-2005 (Drinking Water System Components—Health Effects). This includes, but is not limited to, tank/wetwell concrete, protective materials (coatings, linings, liners), joining and sealing materials (solvent cements, welding materials, gaskets, lubricating oils), pipes and related products (pipes, tanks, fittings), and mechanical devices (valves, separation membranes, impellers).

B. NSF/ANSI 61 certification shall be clearly identified in product, material and equipment submittals. Where NSF/ANSI 61 materials are not available, the contractor shall notify the Engineer (Engineer of Record) and Engineer (Construction Manager) and obtain approval prior to installation of non-certified materials/equipment.

C. The Contractor is required to retain an inventory of NSF/ANSI 61 certified products, materials and equipment installed on the Project (e.g. submittal number, quantity, location, date of installation, mill cert etc.) Mill Certs shall be provided to the Engineer (Engineer of Record) and Engineer (Construction Manager) prior to installation. Failure to track and comply with NSF61 requirements may result in rejection of Work.

20.04. Contractor's Internal Quality Control

A. Article 9.03 is incorporated herein by reference. Article 9.03 and Article 20.04 together describe the Contractor's Quality Control Program and associated requirements. In the event of conflicting requirements, Article 20.04 shall take precedence. Any unresolved conflicts between the Article 9.03 and Article 20.04 shall be resolved through the RFI process as described in Article 2.04.

B. The Contract requires that Contractor build and deliver the Work in conformance with the plans and specifications. The Contractor is responsible for ensuring that all labor, materials, products, and means and methods of construction will result in a Project that is free from defects which will allow for full and complete operation as a potable water treatment plant in the State of California.

C. To this end, it is the Contractor's responsibility to establish and maintain an effective Quality Control (QC) program. The Contractor's QC Program shall include a Contractor-employed QC Manager and staff as well as a Contractor's QC Plan which shall define specific standards, methods and procedures to be used for QC inspection and testing of the work of this Contract.

D. All materials, products, and equipment shall be new (except where noted), of the specified quality, and free of defects. Where samples have been submitted, the materials, products, and equipment incorporated into the work shall be equal to the samples that have been approved. Should materials, products, and equipment required by the work not be specified or described on the Drawings, the Contractor shall provide materials, products, and equipment of a high generally accepted quality standards that are comparable to the work and meets the identifiable needs of the work.

E. Materials, products, equipment, and work not conforming to the requirements of the Contract Documents shall be considered defective and will be subject to rejection. Defective materials, products, equipment and work, whether in place or not, shall be removed immediately from the site by the Contractor, at no additional cost to the District.

F. Perform and complete work in a careful, thorough manner.

1. The Contractor shall report apparent errors, conflicts, discrepancies, or omissions in the Contract Documents to the Engineer (Engineer of Record) and request instructions before proceeding with the work.

2. The Engineer (Engineer of Record) will issue written clarification or interpretation of Contract Document requirements in response to Contractor's requests and other sources of information.

G. Materials, products, and equipment that are specified to require testing and inspection at the point of origin shall receive and pass such testing and inspection prior to being shipped to the project site.

20.04.01 Description of Contractor's QC Program

A. The Contractor's QC program shall consist of plans, procedures, and Contractor's staffing assignments as necessary to ensure that the Contractor's performance of the work will meet the requirements of the Contract Documents. The program shall cover all construction activities, including Contractor's submittals, Contractor-furnished design, Contractor's shop drawings and the like. The Contractor's QC program shall cover quality control of construction activities both on-site and off-site, and shall be keyed to the proposed construction sequence and schedule.

B. The Contractor's QC Program shall be implemented by a QC Manager who shall report directly to the Contractor's Principal Officers.

C. Further, the Contractor's QC Manager is responsible for independently inspecting the Contractor's deliverables such that they meet the Contract requirements. The Contractor's Quality Control Manager shall not be the same individual as the Contractor's on-site Superintendent or Foreman and the QC Manager shall have no supervisory or managerial responsibility over the work force.

D. Notwithstanding the requirements of the specifications, all Contract work is subject to inspections and tests as determined by the Engineer's (Construction Manager). Inspections may be conducted by the Engineer's (Construction Manager) and his/her staff at any time. The Engineer's (Construction Manager) inspections and tests are for the sole benefit of the District and do not:

1. Relieve the Contractor of responsibility for providing adequate quality control measures;

2. Relieve the Contractor of responsibility for damage to or loss of the material before acceptance;

3. Constitute or imply acceptance of the work; or

4. Affect the continuing rights of the District after acceptance of the completed work.

20.04.02. Contractor's Quality Staffing Requirements

A. The Contractor shall provide qualified QC personnel with assigned QC functions reporting to a Field QC Manager. Quality Control personnel shall perform no other functions other than quality management and shall have no supervisory or managerial responsibility over the Work force.

B. The Field QC Manager has the overall responsibility to develop, manage, and implement the QC plan to ensure that all Work complies with the quality set forth in the Contract. The Field QC Manager shall be present on site, perform inspections throughout the Project duration, and bring in other QC personnel as necessary based on its expertise and on the need for continuous quality inspections at various Work areas. The Field QC Manager shall report directly to a senior manager of the Contractor to ensure organizational freedom, identify quality problems, and initiate and recommend solutions. The QC plan submittal shall include a letter signed by a principal officer of the Contractor's firm designating the Field QC Manager and quality staff and specifying the authority delegated to the Field QC Manager and staff to direct cessation or removal and replacement of defective Work.

C. The Field QC Manager shall be on site whenever Work is permanently incorporated into the Project to verify that it is being performed properly and to document different stages of all Work in progress.

D. To be considered qualified, the Contractor's quality personnel shall meet the minimum requirements listed below. The Contractor is responsible for ensuring that assigned personnel have appropriate qualifications above the minimum listed herein:

1. The Field QC Manager shall have, at a minimum, a bachelor's degree in engineering, architecture, or construction management and a minimum of ten (10) years' construction experience on construction projects similar to this Contract. The District will consider an additional

five (5) years' experience, for a total of 15 years' experience on construction projects similar to this Contract, as a substitution for a bachelor's degree. The Field QC Manager shall also have a certificate of completion of the course "Construction Quality Management for Contractors" or equivalent. (Note: This course is available through the Army Corps of Engineers and/or through the Naval Facilities Engineering Command.)

2. The Lead Test Coordinator shall have, at a minimum, a bachelor's degree in mechanical or electrical engineering, with a minimum of five (5) years' experience in the start-up of similar systems on major projects of similar size. The Lead Test Coordinator shall be responsible and devoted solely to managing, coordinating, and supervising all Work related to final testing, start-up, and commissioning of the facilities as described in the Specifications.

3. The Civil QC Inspector shall have a minimum of ten (10) years' experience in the type of civil Work being performed on this Project.

4. The Electrical QC Inspector shall have a minimum of ten (10) years' experience in the type of electrical Work being performed on this Project.

5. Mechanical QC Inspector shall have a minimum of ten (10) years' mechanical experience in the type of Work being performed on this Project.

6. The Certified Welding Inspector (CWI) shall have a current, certified welding inspector certificate with a minimum of ten (10) years' experience in the type of Work being performed on this Project.

7. The Coating Inspector shall have a current NACE CIP Level-3 certificate with a minimum of ten (10) years' experience in the type of Work being performed on this Project.

20.04.03. Definitions

A. Construction Quality Management (CQM) is the performance of tasks that ensure that construction is performed according to Contract requirements.

B. Contractor Quality Control (CQC) is the successful execution of a realistic plan which ensures that the required standards of quality construction are met and which will preclude problems resulting from poor quality or lack of quality.

C. Non-Compliance Notice (NCN) – a written notice to the Contractor from either the Engineer's (Construction Manager) or the Contractor's QC staff to the effect that a deficiency has been found in the work such that that portion of the work is considered to be defective or "non-conforming" as defined in the General Conditions of the Contract.

D. Corrective Action Report (CAR) – a written notice given by the Contractor to the Engineer's (Construction Manager) that defective or non-conforming work has been corrected or will be corrected within a mutually acceptable time frame.

20.04.04. Submittals

A. Not later than 30 calendar days following Notice to Proceed, the Contractor shall submit:

1. The Contractor's Quality Control Plan as described in Article 20.04.03 below.

2. The resumes of all personnel required by Article 20.04.04 of this Section.

3. The qualifications of all proposed independent inspection and testing laboratories/agencies as required under this Section.

B. Complete records of all letters, material submittals, shop drawing submittals, schedules and all other project documentation shall be promptly furnished to the Contractor QC organization by the Contractor. The Contractor QC organization shall be responsible for maintenance of these documents and records at the site at all times, and shall make copies available to the Engineer's (Construction Manager) on request.

20.04.05. Quality Control Plan

A. The Contractor shall prepare and submit the Project-specific Quality Control plan in accordance with Article 9.03. Contractor's Quality Control Program. The Contractor's QC Plan shall define procedures to manage and control the Contractor's equipment, materials, and personnel so that the completed project will comply with the Contract Documents.

B. The Contractor QC Plan shall identify Contractor's QC personnel, shall contain complete quality control procedures, testing and inspection instructions, copies of sample records to be kept, and forms to be used. The Engineer (Construction Manager) may allow the use of an interim Contractor QC Plan which shall not be valid beyond the first 90 calendar days following Notice to Proceed.

C. The Contractor shall not perform any portion of the Contract work which is not included in an accepted Contractor QC Plan (interim or final version).

D. The Contractor QC Plan shall include, as a minimum, the items listed below:

1. A description of the Contractor's quality control organization, including a chart showing lines of authority, and a reporting structure. The Contractor QC staffing shall include a Contractor QC Manager and a supporting staff as applicable to the project.

2. The Contractor QC reporting structure shall clearly provide for direct reporting access by the Contractor QC Manager to the Contractor's principal officers.

3. The names, qualifications (in resume format), duties, responsibilities, and authorities of the Contractor QC Manager and all members of his/her staff.

4. A copy of the Contractor QC Manager's certificate of completion of the course "Construction Quality Management for Contractors" or equivalent. (This course is available through the Army Corps of Engineers and/or the Naval Facilities Engineering Command.)

5. A copy of a letter to the Contractor QC Manager signed by a principal officer of the Contractor's firm which describes the responsibilities of the Contractor QC Manager and establishes his/her authority, including authority to stop work that does not conform with the Contract Documents. The Contractor QC Manager shall issue letters of direction to all other Contractor QC staff outlining duties, authorities, and responsibilities. Copies of these letters shall also be furnished to the Engineer (Construction Manager).

6. Contractor's procedures for scheduling, reviewing, certifying, and managing submittals, including those of subcontractors, offsite fabricators, suppliers, and purchasing agents.

7. Verification and acceptance testing procedures for each specific performance test required in Divisions 1 through 46 of the Specifications. Each procedure shall include: the test name, specification reference, feature of work to be tested, test frequency, and person responsible for each test. A complete matrix listing all operational, performance, and quality control tests and inspections shall be included in the QC Plan. The Engineer (Construction Manager) will review the matrix to determine which tests and/or inspections are to be paid by the District directly.

8. The Contractor's QC Plan shall provide a mechanism for the Contractor to respond to Non-Compliance Notices (NCN) which may be issued by the Engineer (Construction Manager) or by the Contractor's own QC staff. Further, the Contractor's QC Plan shall contain procedures for tracking construction deficiencies from identification through acceptable corrective action. These procedures shall establish a tracking method to ensure that deficiencies (i.e., non-conforming items of work) have been identified (documented in Non-Compliance Notices) and corrected (documented by Corrective Action Reports).

9. Proposed method for reporting achievement of quality control milestones, including proposed reporting formats (sample forms), as required, for:

a. Quality control plan for manufactured and fabricated items
b. Reports and test results for manufactured and fabricated items
c. Manufacturer's instructions
d. Certified copies of independent laboratory test results

10. Provide a sample of Quality Control forms applicable for the project considered. The Contractor QC Plan's forms may include, but not be limited to the following:

    a. Daily QC Inspection Reports
    b. Non-Compliance Notice
    c. Equipment Calibration Log
    d. Receiving and Storage Inspection Report
    e. Concrete Placement Checklist Form
    f. Source (factory) Inspection Report
    g. Welding Report
    h. Soil Tracking Report (excavation, disposal, backfill materials)
    i. Additional forms as required by the Contractor QC staff or by the Engineer (Construction Manager)
    j. Survey, compaction, etc.

11. A list of the major elements of work and the quality control tasks, measurements, tests and inspections associated with each major element.

12. A list of definable features of work (DFOWs). DFOWs are tasks that are separate and distinct from other tasks, have specific quality control requirements and/or have work crews unique to that task. A DFOW is identified by different trades or disciplines and is an item or activity on the construction schedule.

13. Contractor QC personnel qualifications (in resume form) including copies of each member's applicable certificates of training and/or qualification.

14. Qualifications and resumes of independent testing laboratories and principal laboratory personnel to be used in the work by the Contractor QC Manager. Identify which laboratory is to be used for each of the various types of testing and analysis found in the Contract Documents.

    a. The Engineer (Construction Manager) may require that specific testing be performed by an independent certified testing and inspection agency under direct contract with the District.

    b. In the event that the Engineer (Construction Manager) deems it necessary that a specific laboratory test or field test is to be arranged and paid by the District, and if that activity appears in

the Contract Documents as a responsibility of the Contractor, then the Contractor shall be directed to prepare a Contract Modification, under which the District will receive an appropriate monetary credit for the specific testing activity.

15. Quality control requirements for operational testing and start-up testing as specified in Sections and shall be incorporated into the Contractor QC Plan.

    a. Acceptance of the Contractor QC Plan by the Engineer (Construction Manager) is required prior to the start of construction. Acceptance of the Plan is conditioned upon satisfactory performance by the Contractor QC team during construction. The District reserves the right to require the Contractor to make immediate changes in its Contractor QC Plan and operations, including removal of personnel, as necessary, to obtain the quality specified. Engineer (Construction Manager) favorable review of the Contractor's QA/QC Plan shall not relieve the Contractor from any of its obligations for the performance of the work.

20.04.06. Contractor QC Coordination Conference

A. Following the Pre-construction Meeting, and before start of construction, the Contractor shall convene a Contractor QC Coordination Conference with the Engineer (Construction Manager).

B. The following topics shall be addressed at the Contractor QC Coordination Conference:

1. Status of the Contractor's Quality Control Plan.

2. Discussion of the adequacy of the Contractor QC forms contained in the Contractor QC Plan.

    a. Administration of the Contractor's QC Plan for both onsite and offsite work

3. Scheduling of subsequent Contractor QC follow-up meetings

20.04.07 Definable Feature of Work Quality Control Coordination Meetings

A. Quality Control Coordination Meetings

1. The Contractor shall provide, at a minimum, five (5) working days' advance notice and participate in the following three (3) quality control coordination meetings:

   a. Pre-Submittal Conference: Prior to the Contractor's submittal of the QA/QC Plan, the Field QA/QC Manager, its Superintendent and other relevant personnel shall convene a QA/QC Coordination Conference with the Engineer (Engineer of Record) and Engineer (Construction Manager)to review and discuss the QA/QC Plan. During the conference, a mutual understanding of the QA/QC Plan requirements shall be developed. Minutes of the meeting shall be prepared by the Contractor's Field QA/QC Manager.

   b. Preparatory meeting: Thirty (30) days prior to beginning work on each definable feature of work the Contractor's Field QC Manager, Superintendent, other QC personnel (as applicable), and the foreman responsible for the definable feature shall meet with the Engineer (Engineer of Record) and Engineer (Construction Manager). The meeting shall cover the following agenda, with the Minutes documented by the Contractor's Field QC Manager.

      - Review of the Contract Plans and Specifications,
      - Review reference codes and standards.
      - Check to assure that all required submittals have been approved.
      - Review relevant RFIs, field memos, and changes to the design of the definable feature of work.
      - Review QC requirements for the work including inspection, testing, and acceptance and tolerance requirements.
      - Review critical installation procedures and telltale signs of quality compliance.
      - Examine work area to assure that all required predecessor work has been completed, that all required deficiencies have been corrected and approved, and that all documented remaining deficiencies will not impair the construction of the planned definable feature of work.
      - Check availability of required resource and equipment to perform the work.
      - Review activity hazards to address safety precautions.

c. Third Meeting: One (1) work day before the beginning of construction of a definable feature of work, the Contractor's Field QC Manager, Superintendent, other QC personnel (as applicable), and the foreman and crew responsible for the definable feature shall meet with the Engineer (Engineer of Record) and Engineer (Construction Manager). The meeting shall cover the following agenda, with the Minutes documented by the Contractor's Field QC Manager.

- Review minutes of the preparatory meeting.
- Verify specified material and equipment is onsite.
- Establish level of workmanship and verify that it meets minimum acceptable workmanship standards.
- Compare with required samples and mockups as appropriate.
- Verify adequacy of QC for the work, including availability of test equipment
- Resolve all differences.
- The meeting shall be repeated for each new crew to work onsite, or any time accepted or specified quality standards are not met.

20.04.08. Coordination of Testing and Inspection

A. The Contractor shall perform specified or required tests per the Contract Documents. Upon request, the Contractor shall furnish to the Engineer (Construction Manager) duplicate samples of test specimens for possible testing by the District. Testing includes both materials testing as well as operational and/or acceptance tests when specified. If specified, operational and acceptance testing shall be performed by a District-approved testing agency. The Contractor shall perform the following activities and record and provide the following data:

1. Verify that testing procedures comply with contract requirements.

2. Verify that facilities and testing equipment are available and comply with testing standards.

3. Check test instrument calibration data against certified standards.

4. Verify that recording forms and test identification control number systems, identified in Contractor QC plan, including all of the test documentation requirements, have been prepared.

5. Results of all QC tests performed, both passing and failing tests, shall be recorded in the Contractor's Daily QC report. Include the Specification paragraph reference, location where tests were taken, and the sequential

control number identifying the test. Unless otherwise approved by the Engineer (Construction Manager) , actual test reports must be submitted with a reference to the test number and date of test within 5 working days following a test. An information copy of tests performed by an offsite or commercial test facility shall be provided directly to the Engineer (Construction Manager) . Failure of a testing or laboratory facility to submit timely test reports as required may result in withholding of payment for work performed and subsequent rejection of the test facility's services for the remainder of this Contract's work.

B. The Contractor may need to hire various independent inspection and testing agencies/laboratories to cover all work. These may include, but are not limited to the following:

1. Independent Certified Testing Laboratory for soil testings, e.g. Compaction testing for soil, evaluation of soil for landscaping.

2. Independent Certified Testing Laboratory analyzing chemical constituents of the soil to determine whether or not the soil is hazardous.

3. Independent Certified Inspection and Testing Agencies for conducting specialized inspections and testing related to architectural, mechanical and electrical work as required in the various sections of the Specifications.

None of the Independent Certified Inspection and Testing Agencies or Laboratories proposed and retained by the Contractor shall be associated with or affiliated with the Contractor or any of its subcontractors. Agencies or Laboratories charged with the responsibility of performing Special Inspections as defined in Section 1704 of the 2007 California Building Code shall be employed by the Engineer (Construction Manager) .

C. Where the required inspections and testing vary from the approved inspections and testing schedule, the Independent Inspection and Testing Agencies/Laboratories shall provide at least a five (5) working day advance notice to the Contractor and to the Engineer (Construction Manager) prior to the date of the inspection and testing for approval.

D. Within five (5) working days after the completion of the inspections or tests performed, the Independent Inspection and Testing Agencies/Laboratories shall submit to the Engineer (Construction Manager) , in duplicate copies, the results of the inspections and tests with a copy to the Contractor QC Manager, indicating observations and the results of tests and indicating compliance or non-compliance with the Contract. The forms used shall be those in the sample template from the Contractor QC Plan, as noted in Article 20.04.03 of this Section.

E. In addition, the Engineer (Construction Manager) may choose to verify the Contractor QC testing and inspections with his/her own testing. The Contractor shall cooperate fully with the District's own inspection and testing

agencies/laboratories and shall furnish samples of materials, design mix, equipment, tools, storage, and assistance as requested.

F. Re-testing or re-inspection required (including re-inspections by building officials having jurisdiction if applicable) because of non-conformance to specified requirements shall be performed by the same independent agency/laboratory on instructions by Engineer (Construction Manager) .

G. Contractor is responsible to coordinate all required inspections, tests, including any re-tests, by all independent inspection and testing laboratories/agencies so as to avoid unnecessary delays in the construction schedule. Re-test and/or re-inspection requests by the Engineer (Construction Manager) shall not be construed as construction delays.

20.04.09. Daily Reports

A. The Contractor QC Manager and his/her staff shall maintain current records, i.e. “Daily Reports” providing factual evidence that required quality control activities and/or tests have been performed. These records shall include the work of subcontractors and suppliers and shall be on an acceptable form as listed in the Contractor QC Plan. The records shall include, as a minimum, the following information:

1. Contractor/subcontractor and their area of responsibility.

2. Test and/or control activities performed with results and references to specifications/drawings requirements.

3. Provide a list of Non-Conforming Notices and Corrective Action Reports (NCN’s and CARs) issued each day. Contractor QC Manager shall compile daily data so that a trend log of Non-Conforming Notices can be published at the end of each month during construction.

4. Submittals and deliverables reviewed, with contract reference, by whom, and action taken.

5. Offsite activities, including actions taken.

6. Instances of conflicts in plans and/or specifications noted on a daily basis.

7. Contractor's verification statement stating that each Daily Report is a complete, true and accurate account of that day’s construction activity.

B. The original and one copy of these records in report form shall be furnished to the Engineer (Construction Manager) daily and within 24 hours after the date covered by the report, except that reports need not be submitted for days on which no work is performed. As a minimum, one report shall be prepared and submitted for every seven (7) calendar days of no work and on the last day of a no work period. All calendar days shall be accounted for throughout the life of the contract. The first report following a day of no work shall be for that day

only. Reports shall be signed and dated by the Contractor QC Manager. The report from the Contractor QC Manager shall include copies of reports prepared by all subordinate quality control personnel.

20.04.10. Records of Construction Inspection

A. The Contractor shall maintain complete inspection and testing records and make them available to the Engineer (Construction Manager) in both hard copy and electronic form, as requested.

20.04.11. Notification of Non-compliance

A. Either the Contractor QC Staff or the Engineer (Construction Manager) may issue a Non-Compliance Notice (NCN) to the Contractor for any apparent non-conformance in the work or portion thereof that has not been performed in accordance with the Contract Documents. Such Notice, when delivered to the Contractor at the work site, shall be deemed sufficient for the purpose of notification.

B. The Contractor shall take immediate corrective action after receipt of such Notice. The Contractor shall provide a written Response to Non-Compliance within five (5) working days after receipt of the Notice. The Contractor's response shall detail either (a) why they believe that the work was performed in accordance with the Contract Documents or (b) what corrective action they intend to take, at their sole expense, to correct the non-conforming work initiated as a Corrective Action Report (CAR).

C. If the Contractor disputes issuance of the Notice, the Engineer (Construction Manager) will respond within five (5) working days after receipt of dispute by either (a) withdrawing the Non-Compliance Notice or (b) directing the Contractor to correct the work. If the Engineer (Construction Manager) directs the Contractor to correct the work, the Contractor shall do so within five (5) working days after receipt of such direction from the Engineer (Construction Manager) , or such other time as may be agreed to with the Engineer (Construction Manager) .

D. Payment shall not be made for any portion of the work which is the subject of a Non-Compliance Notice until the Non-Conforming condition has been corrected.

E. If the Contractor fails or refuses to comply promptly, the Engineer (Construction Manager) may issue an order stopping that portion of the work related directly to the NCN as well as work which may be consequentially affected by the NCN until satisfactory corrective action has been taken. No extension of Contract time will be granted as a consequence of such a stop order.

20.04.12. Monthly CAR/NCN Status Log

A. The Contractor shall submit with its monthly application for payment, a complete log of all NCN's and CARs issued to date indicating the status of resolution, corrections undertaken, and the date of close out of the NCN/CAR. This log shall be signed by the Contractor's QC Manager.

20.04.13. Payment

A. Full compensation for doing all Work necessary to provide Contractor's internal quality control shall be included in the lump sum price Bid for Bid Item 3, Contractor's Internal Quality Control.

SECTION 21. PAYMENT PROCEDURES

21.01. Bid Items

21.01.01. General Requirements

A. Refer to Bid Documents Bid Form No. 1 Bid items for the listing of Bid items.

B. Unless otherwise indicated, all Bid Items include labor, material, equipment, and incidentals in accordance with the Drawings and Specifications to complete the Work.

C. No separate payment will be made for any Work included in the Drawings and/or Specifications but not specifically set forth in the listing of Bid items. All costs shall be included in a Bid item.

D. Where there is an overlap in the Work paid for under different Bid items, the Work will be paid for only once under the appropriate Bid item(s), as determined by the Engineer (Construction Manager).

E. Payment will not be made for any Work done beyond the lines and grades shown on the Drawings or established by the Engineer (Construction Manager) , or any extra work done without written authority. Such work will be considered as unauthorized. Acceptance of such Work by the Engineer (Construction Manager) will not constitute agreement to pay beyond the lines and grades shown on the Drawings or established by the Engineer (Construction Manager), or any extra work done without written authority.

21.01.02. Scope of Payment

A. The work has been broken down into several lump sum and unit price items for convenience in measuring progress for payment.

B. It is recognized that due to the “interconnected nature” of construction, specific separation of work into bid items is not always possible; generally only the major involved items are specified herein. However, all of the work under the contract for a complete project is included in these items, and no claims for extra work will be allowed for any item shown on the plans or required by the Specifications.

C. The Contractor shall accept the compensation provided in the Contract as full payment for furnishing all labortools, equipment, and incidentals necessary for performing all work contemplated and embraced under the Contract; also for loss or damage arising from the nature of the work, or from the action of the elements, or from any unforeseen difficulties which may be encountered during the prosecution of the work, until the work is accepted by the District; and for all risks of every description connected with the prosecution of the work, also for all expense incurred in consequence of the suspension or discontinuance of the work as herein specified; and for completing the work according to the Contract

Documents. Neither the payment of any estimate nor of any retained percentage shall relieve the Contractor of any obligation to make good any defective work or material.

D. No compensation will be made in any case for loss of anticipated profits.

E. Except as specifically provided otherwise, no separate payment will be made for any of the requirements of the Standard Provisions, the Special Provisions, or for any of the work specified in the Drawings and Specifications. The cost thereof will be considered as included in the prices paid for the various contract items included in the BID SCHEDULE.

F. Lump Sum Bid Prices - Work under Contract lump sum prices listed in the Bid Form No. 1 will be paid based on prorate completion of that Work.

G. Unit Bid Prices – Work under Contract unit bid prices listed in the Bid Form No. 1 will be paid based on completion of units of Work.

21.01.03. Payment for Equipment Delivered to the Job Site

A. At the request of the Contractor, included in the monthly progress payment shall be 90% of the cost of equipment delivered to the job site but not installed. The cost of the equipment shall be verified by a copy of the invoice from the supplier to the Contractor. The invoice must be documented as “Paid in Full.”

21.01.02. Description of Bid Items

A. Bid Item No. 1 – Mobilization and Demobilization

1. This Bid item shall include the preconstruction meeting, all preparatory Work, and appurtenant preconstruction operations, including, but not limited to, those necessary for the movement of personnel, equipment, supplies, and incidentals to the Project site; building and removing any temporary construction areas; installing and removing temporary facilities necessary for Work on the Project; other Work and operations that must be performed or costs incurred prior to beginning Work on the various Contract items on the Project site; and other Work as specified in these Specifications.

2. Demobilization shall include removal of all temporary facilities and services and restoration of the project sites.

3. Payment for this item shall be made on a lump sum basis. Seventy-five (75) percent of the lump-sum price will be allowed for mobilization, and twenty-five (25) percent will be allowed for demobilization.

B. Bid Item No. 2 – Engineer’s Construction Office

1. Payment for this bid item shall be for providing Engineer’s Construction Office as required by Section 14.

2. Payment will be made on a unit price basis for each month that the trailer is being used by the Engineer.

3. Partial months will be paid for on a prorata basis.

C. Bid Item No. 3 – Contractor's Internal Quality Control

1. Payment for this bid item shall be for providing Contractor's internal quality control program as required by Section 20.

2. Payment will be made on a unit price basis for each month that the Contractor is actively performing construction Work on the project site and completes the activities required by the Standard Provisions and Special Provisions.

3. Payment will end when the Contractor submits the Project Completion Certification to the District, in accordance with Standard Provisions Article 11.01.05.

4. Partial months will be paid for on a prorata basis.

D. Bid Item No. 4 – Submittal of Schedule of Work

1. Payment for this bid item will for submittal of the Contractor's baseline project schedule.

2. Payment will be made on a lump sum basis following review and approval of the baseline project schedule.

E. Bid Item No. 5 – Adjustment to Schedule, Schedule Updates and Recovery Schedule

1. Payment for this bid item will be for monthly updates to the Contractor's schedule, including recovery schedules.

2. Payment will be made on a unit price basis for each month that the Contractor is actively performing construction Work on the project site.

F. Bid Item No. 6 – Operations and Maintenance Documents

1. Payment for this bid item will be for providing Operations and Maintenance Documents required by the Standard Provisions, Special Provisions and Technical Specifications.

2. Payment will be made on a prorata basis based on receipt, review and approval by the Engineer of required documents.

3. A complete list of Operation and Maintenance Documents shall be submitted to and approved by the Engineer for review prior any partial payments.

G. Bid Item No. 7 – Compliance with Environmental Requirements

1. Payment for this bid item will be for complying with project environmental requirements as required in Section 19.

2. Payment will be made on a lump sum basis on a prorata basis for each month that the Contractor complies with all requirements.

3. Deductions may be made by the Engineer for non-compliance.

H. Bid Item No. 8 - Demolition

1. Payment for this bid item will be for demolition work called for in the Drawings and Technical Specifications

2. Payment will be on a lump sum basis.

3. Partial payments will be made based on the contractor's schedule of values.

I. Bid Item No. 9 - Gravity Thickeners 1 and 2 Modifications

1. Payment of the contract price shall constitute full compensation for providing all labor, equipment and those materials, required to complete upgrades to Gravity Thickeners 1 and 2, including modifications to the existing thickener influent and effluent piping, replacing centrate return piping, installation of access hatches, replacing rake arms, adding sample sinks and adding/replacing instrumentation.

2. Payment will be on a lump sum basis.

3. Partial payments will be made based on the contractor's schedule of values.

J. Bid Item No. 10 – Sludge Transfer System Modifications

1. Payment of the contract price shall constitute full compensation for providing all labor, equipment and those materials, required to complete upgrades to the Sludge System area, including piping changes, installation of a new sump pump and sample sink, installation of new instrumentation.

2. Payment will be on a lump sum basis.

3. Partial payments will be made based on the contractor's schedule of values.

K. Bid Item No. 11 – Sludge Storage Tank 1

1. Payment of the contract price shall constitute full compensation for providing all labor, equipment and those materials, required to construct a new sludge storage tank, including excavation, structural fill, structures, piping, mixers, electrical and controls, appurtenances, final grading and paving.

2. If the District does not accept Supplemental Bid Item No. 2, this item will include paving of the area where Sludge Storage Tank 2 is shown on the drawings.

3. Payment will be on a lump sum basis.

4. Partial payments will be made based on the contractor's schedule of values.

N. Bid Item No. 12 – Centrate Wetwell B

1. Payment of the contract price shall constitute full compensation for providing all labor, equipment and those materials, required to construct a new centrate wetwell, including excavation, wetwell structure, centrate return pumps, centrate wetwell pump discharge piping and valves, centrate piping and valve shade structure, electrical and controls, backfill, final grading and paving.

2. Payment will be on a lump sum basis.

3. Partial payments will be made based on the contractor's schedule of values.

O. Bid Item No. 13 – Centrifuge Feed Pump Station

1. Payment of the contract price shall constitute full compensation for providing all labor, equipment and those materials, required to construct a new centrifuge feed pump station, including excavation, containment structure, centrifuge feed pumps, pump suction and discharge piping and valves, shade structure, electrical and controls, backfill, final grading and paving.

2. Payment will be on a lump sum basis.

3. Partial payments will be made based on the contractor's schedule of values.

P. Bid Item No. 14 – Solids Loadout Structure Platforms

1. Payment of the contract price shall constitute full compensation for providing all labor, equipment and those materials, required to modify the existing loadout structure and construct a new loadout platform, including excavation, foundation, stairways, structural members, backfill, final grading and paving.

2. Payment will be on a lump sum basis.

3. Partial payments will be made based on the contractor's schedule of values.

Q. Bid Item No. 15 – Hiller Centrifuges and Related Services

1. Payment of the contract price shall constitute full compensation for providing all labor, equipment and those materials, for Hiller LLC to supply two centrifuges in accordance with the scope of supply and price quotation received by the District on February 24, 2021, and attached to the Technical Specification.

2. Payment will be on a lump sum basis.

3. Partial payments will be made based on the contractor's schedule of values.

R. Bid Item No. 16 – Centrifuge Shop Drawings

1. Payment for this bid item shall constitute full compensation for providing shop drawings and related fabrication and design submittals for the Hiller Centrifuges to be supplied under Bid Item No. 15.

2. Payment will be on a lump sum basis.

3. Partial payments will be made based on the contractor's schedule of values.

S. Bid Item No. 17 – Centrifuge System in Centrifuge Building B

1. Payment for this bid item shall constitute full compensation for providing all labor, equipment and those materials, required to install the Hiller Centrifuges to be supplied under Bid Item No. 15 in Centrifuge Building B, including foundations, access platforms, piping, electrical, instrumentation and controls.

2. Payment will be on a lump sum basis.

3. Partial payments will be made based on the contractor's schedule of values.

T. Bid Item No. 18 – Conveyor Systems

1. Payment of the contract price shall constitute full compensation for providing all labor, equipment and those materials, required to modify the existing loadout conveyors and construct a new conveyors, including structural, mechanical, electrical, instrumentation and controls.

2. Payment will be on a lump sum basis.

3. Partial payments will be made based on the contractor's schedule of values.

U. Bid Item No. 19 – Polymer Feed System

1. Payment of the contract price shall constitute full compensation for providing all labor, equipment and those materials, required to install a new polymer feed system in Centrifuge Building B, including new storage and batch tanks, mixers, polymer batch system, polymer transfer and sump pumps, polymer feed pumps, new containment walls, foundations and grating.

2. Payment will be on a lump sum basis.

3. Partial payments will be made based on the contractor's schedule of values.

V. Bid Item No. 20 – Centrifuge Building B Improvements

1. Payment of the contract price shall constitute full compensation for providing all labor, equipment and those materials, required to modify the existing belt press building (Centrifuge Building B) in accordance with the drawings and specifications, including architectural, structural, HVAC, plumbing and electrical work not included in other work called for in other bid items.

2. Payment will be on a lump sum basis.

3. Partial payments will be made based on the contractor's schedule of values.

W. Bid item No. 21 – Centrifuge Building A Improvements

1. Payment of the contract price shall constitute full compensation for providing all labor, equipment and those materials, required to modify the existing centrifuge building (Centrifuge Building A) in accordance with the drawings and specifications, including HVAC, plumbing, process and electrical work not included in other work called for in other bid items.

2. Payment will be on a lump sum basis.

3. Partial payments will be made based on the contractor's schedule of values.

X. Bid Item No. 22 – Yard Piping

1. Payment of the contract price shall constitute full compensation for providing all labor, equipment and those materials, required to install yard piping work not included in other work called for in other bid items,

including excavation, bedding, backfill final grading, paving and restoration.

2. Payment will be on a lump sum basis.

3. Partial payments will be made based on the contractor's schedule of values.

Y. Bid Item No. 23 – Site Electrical Work Including Switchgear 3 Modifications

1. Payment of the contract price shall constitute full compensation for providing all labor, equipment and those materials, required to install yard electrical conduits, cables, handholes, junction boxes, and modification of Switchgear 3 not included in other work called for in other bid items, including excavation, bedding, backfill final grading, paving and restoration.

2. Payment will be on a lump sum basis.

3. Partial payments will be made based on the contractor's schedule of values.

Z. Bid Item No. 24 – Control System Programming and SCADA Integration

1. Payment of the contract price shall constitute full compensation for providing all labor, equipment and those materials, required to modify and install new control system and SCADA components, perform control system programming, integrate existing and new residuals management system equipment into a complete and operable system, including factory and system testing.

2. Payment will be on a lump sum basis.

3. Partial payments will be made based on the contractor's schedule of values.

AA. Bid Item No. 25 – Operational Readiness and Functional Testing

1. Payment of the contract price shall constitute full compensation for providing all labor, equipment and those materials, required to complete Operational Readiness and Functional Testing in accordance with Technical Specification Section 01 75 06.

2. Payment will be on a lump sum basis.

3. Partial payments will be made based on the contractor's schedule of values.

BB. Bid Item No. 26 – System Commissioning Testing

1. Payment of the contract price shall constitute full compensation for providing all labor, equipment and those materials, required to complete System Commissioning Testing in accordance with Technical Specification Section 01 75 06.

2. Payment will be on a lump sum basis.

3. Partial payments will be made based on the contractor's schedule of values.

CC. Bid Item No. 27 – Dispute Review Board and Professionally Facilitated Project Partnering

1. Payment for this bid item is described in Sections 3.13 and 3.15 of the Standard Provisions.

DD. Bid Item No. 28 – All Other Work and Shoring Required by the Residuals Remediation Project

1. Payment for this bid item shall constitute full compensation for all work not included in other bid items but required for a complete and operable system.

2. Payment will be on a lump sum basis.

3. Partial payments will be made based on the contractor's schedule of values.

EE. Supplemental Bid Item No. 1 – Replacement of Existing Centrifuge Feed Pumps

1. Payment of the contract price shall constitute full compensation for providing all labor, equipment and those materials, required to replace the existing centrifuge feed pumps in the sludge transfer area, as delineated in the drawings, including furnishing and installing new pumps, installing new seal water piping and equipment, installation of new seal water drains, electrical modifications and control system programming.

2. Payment will be on a lump sum basis.

3. Partial payments will be made based on the contractor's schedule of values.

FF. Supplemental Bid Item No. 2 – Sludge Storage Tank 2

1. Payment of the contract price shall constitute full compensation for providing all labor, equipment and those materials, required to construct a Sludge Storage Tank 2, including excavation, structural fill, structures, piping, mixers, electrical and controls, appurtenances, final grading and paving.

2. Note the paving requirements of Bid Item No. 11, in the event that this Supplemental Bid Item is not selected by the District.

3. Payment will be on a lump sum basis.

Partial payments will be made based on the contractor's schedule of values.

GG. Supplemental Bid Item No. 3 – Thickener Influent Valve Vaults

1. Payment of the contract price shall constitute full compensation for providing all labor, equipment and those materials, required to modify and relocate existing thickener influent piping, valves, flow meters and appurtenance; place them in below-grade vaults with hatches; restore and pave the disturbed area.

2. Payment will be on a lump sum basis.

3. Partial payments will be made based on the contractor's schedule of values.

21.02. Progress Payments and Schedule of Values

A. The Contractor shall submit a preliminary Schedule of Values for the major components of the Work at the Preconstruction Conference. The Schedule of Values will be used as a basis to make monthly progress payments to the Contractor.

B. The Contractor and Engineer (Construction Manager) shall meet and jointly review the preliminary Schedule of Values and make any adjustments in value allocations if, in the opinion of the Engineer (Construction Manager) , these are necessary to establish fair and reasonable allocation of values for the major WORK components. Front-end loading will not be permitted. The Engineer (Construction Manager) may require reallocation of major WORK components from items in the above listing if in the opinion of the Engineer (Construction Manager) such reallocation is necessary. This review and any necessary revisions shall be completed within 15 days from the date of Notice to Proceed.

C. The Contractor shall prepare and submit a detailed Schedule of Values to the Engineer (Construction Manager) within 30 days from the date of Notice to Proceed. The detailed Schedule of Values shall be based on the accepted preliminary Schedule of Values for major Work components. Because the ultimate requirement is to develop a detailed Schedule of Values sufficient to determine appropriate monthly progress payment amounts through cost loading of the scheduled activities, sufficient detailed breakdown shall be provided to meet this requirement. The Engineer (Construction Manager) shall be the sole judge of acceptable numbers, details and description of values established. If, in the opinion of the Engineer (Construction Manager) , a greater number of Schedule of Values items than proposed by the Contractor is necessary, the Contractor shall add the additional items so identified by the Engineer (Construction Manager) .

1. The minimum detail of breakdown of the major Work components is indicated below. Greater detail shall be provided as directed by the Engineer (Construction Manager) .

   a. Mobilization - no breakdown required.

   b. The electrical Work shall be broken down by structure and yard facilities. Structures electrical Work shall be broken down into conduit and raceway installation, cable and wire installation, electrical equipment installation, terminations and lighting. Yard facilities shall be broken down by duct bank designation and substations.

   c. Instrumentation and Control Work shall be broken down by structure.

   d. Yard piping Work shall be broken down into individual pipelines running from and to Contract termination points. Each pipeline shall be an individual pay item unless otherwise allowed by the Engineer (Construction Manager) .

   e. Mechanical Work shall be broken down within each structure to identify individual piping systems, equipment installation by equipment name and number, and equipment testing and checkout.

   f. Concrete structures shall be broken down into excavation, subgrade preparation, and appurtenant pre-foundation Work, concrete foundation construction, slabs on grade, walls/columns, suspended slabs, stairs, etc. (sufficient breakdown shall be provided to accommodate necessary Schedule detail), hydrostatic structure testing where required and backfill.

   g. Equipment testing and start-up shall be broken down for completion milestones for each.

   h. All other Work not specifically included in the above items shall be broken down as necessary for establishment of pay and schedule activity items.

2. Any adjustments deemed necessary to the value allocation or level of detail shall be made by the Contractor and a revised detailed Schedule of Values shall be submitted within 40 days from the date of Notice to Proceed.

3. Following acceptance of the detailed Schedule of Values, the Contractor shall incorporate the values into the cost-loading portion of the Schedule. The activities and logic shall have been developed concurrent with development of the detailed Schedule of Values; however, it shall be necessary to adjust the detailed Schedule of Values to correlate to individual Schedule activities. It is anticipated that instances will occur, due to the independent but simultaneous development of the Schedule of

Values and the Schedule activities, where interfacing these two documents will require changes to each document. Schedule activities may need to be added to accommodate the detail of the Schedule of Values. Schedule of Value items may need to be added to accommodate the detail of the Schedule activities. Where such instances arise, the CONTRACTOR shall propose changes to the Schedule of Values and to the Schedule activities to satisfy the Schedule cost loading requirements.

D. To assist in the correlation of the Schedule of Values and the Schedule, the Contractor shall provide a Cross Reference Listing which shall be furnished in two parts. The first part shall list each Scheduled Activity with the breakdown of the respective valued items making up the total cost of the activity. The second part shall list the valued item with the respective Scheduled Activity or Activities that make up the total cost indicated. In the case where a number of schedule items make up the total cost for a valued item (shown in the Schedule of Values) the total cost for each scheduled item should be indicated.

E. These listings shall be updated and submitted in conjunction with the monthly schedule adjustment/update submittals.

F. Approved change orders reflected in the Schedule shall be incorporated into the Schedule of Values as a single unit identified by the change order number.

G. Changes to the Schedule which add activities not included in the original schedule but included in the original Work (schedule omissions) shall have values assigned as approved by the Engineer (Construction Manager) . Other activity values shall be reduced to provide equal value adjustment increases for added activities as approved by the Engineer (Construction Manager) .

H. In the event that the Contractor and Engineer (Construction Manager) agree to make adjustments to the original Schedule of Values because of inequities discovered in the original accepted detailed Schedule of Values, increases and equal decreases to values for activities may be made.

21.03. Progress Payment Retention

A. The Board finds that this Project is substantially complex and establishes the Contract retention at ten (10) percent of the Contract Price.

21.04. SBE Requirements

A. No Requirements.

SECTION 22. CONTRACT CLOSEOUT

22.01. Project Completion and Acceptance

A. No Special Requirements; see Standard Provisions.

22.02. Guarantee and Guaranty Bond

A. No Special Requirements; see Standard Provisions.

22.03. Training

A. This Section includes requirements for training District staff on the equipment, products, and systems furnished under these Contract Documents, including Contractor video recording of training instruction.

22.03.01. General Requirements

A. The objective of training included under this Section shall be to convey the knowledge needed by District operations, maintenance, and engineering staff to safely operate, maintain, and repair the equipment and systems furnished under this Work. Focus training to the skills and job classifications of the staff attending the classes (e.g., water treatment plant operator, maintenance technician, and electrician). Provide supporting documentation to assist the instruction learning process and to serve as a source of information to District staff after training. Provide video of training sessions to be used to train District staff who could not attend the scheduled sessions.

B. Unless specifically noted otherwise, conduct all training in English language and in accordance with the following general requirements. Facilities and equipment shall be fully functional before training begins.

1. Scheduling of classes: Training shall be planned in accordance with the accepted Detailed Progress Schedules. The Engineer (Construction Manager) must approve and confirm class schedules. All classes shall be scheduled in Detailed Progress Schedules.

2. Schedule specific classes a minimum of 3 weeks in advance to allow District staffing arrangements to take place. Generally, not more than 2 classes per week shall be scheduled. Classes shall be provided during the time periods of 8 a.m. to 4 p.m. Monday through Thursday as requested by the District.

3. Class agenda: Prepare a class agenda and submit it to the Engineer (Construction Manager) at least four (4) weeks in advance of the date of the first corresponding class. The agenda shall include (i) a listing of subjects to be discussed, (ii) the training goal(s), (iii) the methods to be

used to achieve the training goal(s), (iv) time estimated for each subject, (v) a list of documentation to be used or provided to support training, (vi) a period for the instructor to question staff members to ensure that the training was successful, (vii) and the instructor's name. Agendas shall include an allocation of time for District staff to ask questions and discuss the subject matter. The District may request that particular subjects be emphasized and that the agenda be adjusted to accommodate these requests. Copies of the agenda shall be distributed to each student at the beginning of each training class.

4. Number of students: It is estimated that from 3 to 20 persons will attend each training class. The actual number of students will be determined by the District. The Engineer (Construction Manager) will provide an estimated headcount two (2) Days prior to the class if requested by the Contractor.

5. Training location: Unless otherwise noted, all training will be conducted at indoor, on-site training facilities. If necessary and appropriate as determined by the Engineer (Construction Manager), training will be conducted at off-site locations or at the actual installed location of the equipment, product, or system as approved by the Engineer (Construction Manager). Training facility will be provided by the District.

6. Length of training: Each class shall be planned to be completed within 4 hours and shall include one 20-minute break for each 4-hour training period. Requests for longer class periods must be approved by the Engineer (Construction Manager).

7. Instructor qualifications: Instructors shall be completely knowledgeable in the products and systems for which they are providing training and experienced in conducting classes. Sales representatives are not qualified instructors unless they possess the detailed operating and maintenance knowledge required for proper class instruction. If, in the opinion of the Engineer (Engineer of Record), the scheduled training was not provided by an appropriately knowledgeable person, such training shall be rescheduled and repeated with a suitable instructor at the Contractor's expense.

8. Training aids: Each instructor is encouraged to use audio/video devices, models, charts, etc. to increase the transfer of knowledge. The business conducting the training shall provide all such equipment (televisions, video cassette recorder/player, Projectors, screens, easels, etc.); models; charts; etc. for each class. It shall be the responsibility of the business conducting the training to confirm in advance that the classroom is appropriate for the types of audio/video equipment to be used.

9. Training at the actual equipment (hands-on) shall be a part of each class. This portion of the instruction shall include operation, preventative maintenance points, calibration (wherever applicable), troubleshooting, common repairs, and manufacturer-recommended servicing.

10. Classroom documentation: For training on equipment, systems, or products for which the Contractor is required to provide an O&M manual, a complete O&M manual shall have been submitted per Special Provisions Article 14.10.02. Submittal Schedule and shall be used during the classroom instruction. Supplemental documentation handouts shall be provided to support the instruction.

11. Contractor shall provide audio/video recording of each class with appropriate lighting to document the training. The video recording shall be 4K resolution and of mp4 format. Video recordings shall be made by a professional videographer or video production company approved by the Engineer (Construction Manager). Recording shall take place during all portions of the instruction, including at the actual equipment. Questions from students and their answers shall be recorded to the extent feasible. Each class shall be video recorded if more than one (1) class is taught. The District acknowledges that the manufacturer's written operation and maintenance documentation takes precedence over the classroom training (including viewing of the video) and will be consulted prior to and during maintenance and operations. The Contractor shall submit a separate electronic copy of each class recording within two (2) weeks of the completed training date. The electronic copy of each class shall be transmitted to the District in Contractor supplied usb drives or hard drives, which will become the property of the District. Each recording shall be affixed with a word-processed label stating at a minimum:

    a. the subject;

    b. date of class;

    c. company providing the training;

    d. project name and number;

    e. reference Specification Section; and

    f. a summary of class subjects.

12. Video recordings that are incomplete or that are not readily audible or clear shall require the class to be repeated with new video recording.

13. District video recordings, photographing, audio recording, and other documentation of training classes: In addition to video recordings being completed by the Contractor, the District reserves the right to videotape, photograph, audio record, and otherwise document any or all training classes provided under this Work. The business(es) conducting the training and the Contractor shall cooperate with the District in making such video recordings, photographs, or audio recordings, which shall remain the exclusive property of the District.

14. If the instructor cannot answer relevant product questions by students during the training, these questions shall be recorded by the instructor and a written response shall be submitted to the Engineer (Construction Manager) within three (3) weeks.

C. Additional training requirements for specific equipment and systems may also be specified in these Specifications.

D. Training list: Contractor shall submit a list of all equipment, systems, and processes that require training. For each item, identify (i) the type of training (maintenance or operations); (ii) duration of each class in consecutive Days; (iii) number of classes per Day; (iv) total number of classes; and (v) minimum number of instruction hours per class.

22.03.02. Submittals

A. Submit an overall schedule of all classes to the Engineer (Construction Manager) at least six (6) weeks in advance of the date of the first class.

B. Submit a list of all training required in accordance with Article 22.03.01. General Requirements, paragraph D. at least ten (10) weeks in advance of the date of the first class.

C. Submit class agendas to the Engineer (Construction Manager) in accordance with this Section.

22.04. Testing and Facility Start-Up

A. Testing and facility startup requirements are specified in Section 01 75 06 of the Technical Specifications.

22.05. Submission of Closeout Items

A. At completion of construction and prior to issuance of the Project Completion letter by the Engineer, the Contractor shall deliver to the Engineer the closeout Documents described in Standards Provisions Section 11 Contract Closeout.

22.06. Final Cleaning

A. Structures that are to be cleaned by a professional industrial janitorial service as specified in Standard Provisions Section 11 Contract Closeout include:

1. Centrifuge Building A

2. Centrifuge Building B

22.07. Payment

A. Unless noted otherwise, full compensation for Work involved in complying with all requirements under Special Provisions Section 22 Contract Closeout shall be considered incidental and included in the Contract Price(s) paid for the various items of Work involved; no additional time or payment shall be allowed.

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SECTION 01 33 17

STRUCTURAL DESIGN, SUPPORT AND ANCHORAGE

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall provide calculations and details for structural and non-structural components, supports, and anchorages as required by the Contract Documents and the 2019 CBC. The contractor shall furnish and install all such structural and non-structural components, supports, and anchorages in accordance with the calculations and details.

B. The Contractor shall provide calculations and details for structures and non-building structures, supports, and anchorages as required by the Contract Documents and the 2019 CBC. The contractor shall furnish and install all such structures and non-building structures, supports, and anchorages in accordance with the calculations and details.

C. Where a conflict exists between the requirements of the Contract Documents and the 2019 CBC, the more stringent requirement shall apply.

D. Design parameters used to determine Seismic and Wind design forces shall be as listed herein.

1.02 REFERENCES

A. CBC 2019 California Building Code

B. ASCE 7 American Society of Civil Engineers Standard 7-16 – Minimum Design Loads for Buildings and Other Structures.

C. ACI 318 Building Code Requirements for Structural Concrete (2014 edition)

D. TMS 402/602 Building Code Requirements and Specification for Masonry Structures (2016 edition)

E. ACI 350.3 Seismic Design of Liquid-Containing Concrete Structures and Commentary (2006 Edition)

1.03 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 7 of Standard Povisions – Submittal Management.

B. Calculations and Details

1. Calculatons and details are considered a Deferred Submittal as defined in the CBC.

2. Calculations and details shall be complete, accurate, and in accordance with the requirements of the CBC and ASCE 7, and shall be signed and sealed by a Professional Engineer registered in the State of California.

3. Calculations shall be clear and concise and show equipment and other non-structural component anchorage forces and the capacities of the anchorage elements proposed by the Contractor. The calculations shall substantiate a complete load path from the component or equipment being anchored into the supporting structure or foundation.

4. The calculations and details shall demonstrate a complete lateral and vertical load path, and shall clearly indicate all forces imposed on the supporting structure.

5. Calculations and details are required for all Non-Structural components, supports, anchorages, and attachments.

    a. Non-Structural components shall include all architectural, mechanical, and electrical components, equipment, piping, ductwork, and all other similar or related appurtenances necessary to produce the complete architectural, mechanical, and electrical systems.

6. When the Contract Documents require the CONTRACTOR to design structures or structural components, calculations and details for those structures and structural components, and their supports, anchorages, and attachments, are required.

    a. The Contractor shall provide engineering and design of the following:

        1) Excavation safety plans.

        2) Chemical storage tanks, including access platform between tanks and manways

        3) Access stairway, steel bridge and mixer platform at sludge mixing tanks

        4) Chemical feed system appurtenances.

        5) Anchorage of mechanical and electrical equipment.

        6) Sunscreens for control panels.

        7) Other structures or items as specified herein or as indicated on the Drawings.

7. When computer generated calculations and analyses are included as part (or as the whole) of the calculations, the calculations shall include, but not be limited to, the following: derivations of all input parameters; clear indication of the applicable load combinations and building code equations; diagrams of all members, geometry, loads, forces, reactions and deflections, for all components and connections; and output results demonstrating all stress, force, deflection and other Contract Document and building code requirements have been satisfied.

8. All calculations associated with anchorage into concrete or masonry shall be done using Strength Level forces, and shall be in accordance with the applicable provisions of ACI 318 and TMS 402/602, respectively.

9. Refer to Part 2 below for additional requirements.

1.04 SEISMIC DESIGN CRITERIA

A. Design Requirements

1. Design Parameters:

a. Risk Category: III.

b. Seismic Design Category: E.

c. Mapped MCE spectral acceleration at short period: S_S = 2.36

d. Mapped MCE spectral acceleration at 1-second period: S_1 = 0.85

e. Site Class: D.

f. Design spectral acceleration at short period: S_{DS} = 1.89

g. Design spectral acceleration at 1-second period: S_{D1} = 1.13

h. Long period transition period: T_L = 12 seconds

i. Response modification coefficient, R: In accordance with ASCE 7, Tables 12.2-1, 12.14-1, 15.4-1 and 15.4-2.

j. Seismic Importance Factor, I: 1.25

k. Component amplification factor, a_p: In accordance with ASCE 7, Tables 13.5-1 and 13.6-1.

l. Component response modification factor, R_p: In accordance with ASCE 7, Tables 13.5-1 and 13.6-1.

m. Component importance factor, I_p:

1) I_p = 1.00, unless noted otherwise herein.

2) I_p = 1.50 if any of the following conditions apply:

a) The component is required to function for life-safety purposes after an earthquake, including fire sprinkler systems.

b) The component contains hazardous materials.

2. The following components are exempted from the seismic design requirements:

a. Exemptions shall be as indicated in ASCE 7 Chapter 13.

1.05 WIND DESIGN CRITERIA

A. Design Requirements

1. Design Parameters:

a. Risk Category: III

b. Basic 3-second Wind Gust Speed: 98 miles per hour.

c. Exposure Category: C.

d. Topographic Factor, K_{zt}: 1.0.

PART 2 -- PRODUCTS

2.01 GENERAL

A. Non-Structural Component Supports and Anchors

1. Unless otherwise indicated, non-structural component supports, anchors, and restrainers shall be adequately designed for all applicable static, dynamic, operational, seismic and wind loads.

a. Wall-mounted equipment weighing more than 250 pounds or which is within 18-inches of the floor shall be provided with fabricated steel supports. Pedestals shall be of welded steel or engineered framing support systems. If the supported equipment is a panel or cabinet or is enclosed with removable sides, the pedestal shall match the supported equipment in appearance and dimensions.

b. All equipment and all other non-structural components shall be supported and anchored in place by methods that satisfy the building code and the Contract Documents.

c. All equipment and all other non-structural components shall be supported and anchored in place by methods that satisfy the manufacturer's applicable seismic certification requirements.

2. Component attachments shall be bolted, welded, or otherwise positively fastened without consideration of frictional resistance produced by the effects of gravity.

B. Non-Building Structures

1. Non-Building Structures shall be designed in accordance with ASCE 7 Chapter 15.

2. Non-Building Structures, foundations, supports, anchors, and restrainers shall be adequately designed for all applicable static, dynamic, operational, seismic and wind loads.

C. Anchors – General

1. Anchor bolts shall be in accordance with Section 05 05 19 and 04 05 19.29.

2. Grouts for anchor bolts shall be in accordance with Section 03 60 00.

3. The Contractor shall determine the size, type, capacity, location, and other placement requirements of anchorage elements. Anchoring methods and leveling criteria in the manufacturer's literature shall be followed. Submit methods and criteria with the calculations and details.

4. Anchor bolt calculations shall clearly show that the capacity of the anchor and the capacity of the concrete that the anchor is embedded in are adequate to resist all applicable load combinations, including seismic and wind loads.

   a. The design of anchors resisting seismic forces shall satisfy the ductility requirements stated in the CBC, ASCE 7, ACI 318, and TMS 402/602.

5. Reduction factors associated with edge distance, embed length, grout and base plate thickness, and bolt spacing shall all be considered and based on the actual dimensions of the concrete or masonry that resists the anchorage forces.

6. Where anchorage is required into or through equipment pads, the following requirements shall apply unless otherwise approved by the Engineer of Record:

   a. For tensile forces, the embed length and associated concrete failure zone shall be provided entirely within the structural slab. No portion of the equipment pad may be considered as effective in resisting tensile forces.

   b. For shear forces, the edge distance and associated concrete failure zone shall be provided entirely within the equipment pad. No portion of the structural slab may be considered as effective in resisting shear forces.

7. Anchor bolt details shall include required bolt diameter, embed, spacing, and edge distances.

8. Where additional reinforcement is required to satisfy anchorage requirements, such reinforcement shall be included in the anchorage details, and shall be furnished and installed by the Contractor.

D. Mechanical and Electrical Equipment Foundations

1. Equipment foundations are indicated on Drawings. The Contractor, through the equipment manufacturer, shall verify the size and weight of the equipment foundation to ensure compatibility with equipment.

2. Equipment foundation dimensions shall be coordinated with the equipment base geometry and the edge distance and embed requirements of the equipment anchorage calculations.

E. Mechanical and Electrical Equipment Equipment (Housekeeping) Pads

1. General

a. Equipment, tanks, control cabinets, enclosures, and related equipment shall be mounted on concrete equipment pads, unless otherwise indicated. The top surface of the equipment pads shall be level, unless otherwise indicated, or otherwise required by the equipment manufacturer.

b. Equipment pads shall be sized to accommodate the bearing and anchorage requirements of the equipment, subject to the constraints listed below.

c. Final geometry of the equipment pads shall not result in a condition that violates applicable building code provisions, including but not limited to the provisions of the National Electric Code.

2. Mechanical Equipment Pads

a. Mechanical equipment pad heights shall be coordinated with process equipment and piping elevation requirements. Where no such elevation constraints exist, the equipment pad height shall be as shown on the drawings, or as indicated below when no specific height is provided.

1) Equipment pads for mechanical equipment shall be 3.5 inches tall (maximum) at the front of the equipment.

b. Mechanical equipment pads shall extend not more than 2 inches beyond the front, back, and sides of the equipment, except as indicated below, unless otherwise shown on the drawings.

1) Where necessary to meet seismic or wind anchorage requirements, the pads may be extended beyond the 2 inch limit indicated above. The pads shall extend not more than 6 inches beyond the front, back, and sides of the equipment.

3. Electrical Equipment Pads

a. Electrical equipment pads shall be 3.5 inches tall (maximum) at the front of the equipment.

b. Electrical equipment pads shall extend not more than 2 inches beyond the front, back, and sides of the equipment, except as indicated below, unless otherwise shown on the drawings.

1) Where necessary to meet seismic anchorage requirements, the pads may be extended beyond the 2 inch limit indicated above. The pads shall extend not more than 6 inches beyond the front, back, and sides of the equipment.

PART 3 -- EXECUTION (NOT USED)

END OF SECTION

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SECTION 01 74 30

PRESSURE PIPE TESTING AND DISINFECTION

PART 1 - GENERAL

1.01 THE SUMMARY

A. The CONTRACTOR shall test and disinfect potable water pipelines and appurtenant piping, in accordance with the Contract Documents.

B. The CONTRACTOR shall be responsible for obtaining permits for discharging excess testing and disinfection water and dechlorination of such water if required to satisfy permit limits.

1.02 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Special Provisions Section 20.

B. Furnish:

1. A testing plan and schedule, including method for water conveyance, control, disposal, and disinfection shall be submitted in writing for approval.

2. Name of certified bacteriological testing laboratory.

3. Resume of experienced technician, if liquid chlorine is proposed.

PART 2 - PRODUCTS

2.01 MATERIAL REQUIREMENTS

A. All test equipment, chemicals for chlorination, temporary valves, bulkheads, and other water control equipment, and choice of disinfectant shall be as determined by the CONTRACTOR. No materials shall be used which would be injurious to the WORK for future conveyance of potable water.

B. Chlorine for disinfection may be in the form of liquid chlorine, sodium hypochlorite solution, or calcium hypochlorite granules or tablets.

1. Liquid chlorine shall be in accordance with the requirements of ANSI/AWWA B301 - Liquid Chlorine, and shall be used only when each of the following conditions are satisfied:

a. Appropriate gas flow chlorinators and ejectors are used.

b. An experienced technician directly supervises.

c. Appropriate safety practices are observed.

2. Sodium and calcium hypochlorite shall be in accordance with ANSI/AWWA B300 - Hypochlorites.

C. Dechlorination agents may be sodium bisulfate, sodium sulfite, or sodium thiosulfate.

PART 3 - EXECUTION

3.01 GENERAL

A. Water for testing and disinfecting water pipelines will be furnished by the OWNER; however, the CONTRACTOR shall convey the water from the OWNER-designated source to the points of use.

B. All pressure pipelines shall be tested; those for potable water shall be disinfected. All chlorinating and testing operations shall be performed in the presence of the CONSTRUCTION MANAGER.

C. Disposal of flushing water and water containing chlorine shall be by methods acceptable to the CONSTRUCTION MANAGER.

D. Disinfection operations shall be scheduled as late as possible during the Contract Time to maximize the degree of sterility of the facilities at the time the WORK is accepted by the OWNER. Bacteriological testing shall be performed by a certified testing laboratory accepted by the OWNER. Results of the bacteriological testing shall be satisfactory with the State Department of Health or other appropriate regulatory agency.

3.02 PIPELINE CLEANING

A. The CONTRACTOR shall clean the system thoroughly to remove sand, grit, gravel, stones, fluids, construction waste, and all material which would not be found in a properly cleaned pipeline. Cleaning shall obtain a smooth interior pipe surface free from any material or fluid not used in cleaning.

B. Provision for disposal of water and materials shall be the CONTRACTOR's responsibility.

3.03 HYDROSTATIC TESTING OF PIPELINES

A. Pipeline 30-inches diameter and larger shall be visually inspected that all debris has been removed prior to flushing.

B. Prior to hydrostatic testing, pipelines shall be flushed or blown out as appropriate. The CONTRACTOR shall test pipelines in sections. Sections to be tested shall be defined by isolation valves in the pipeline. Where such valves are not present, the CONTRACTOR shall install temporary bulkheads or plugs for the purpose of testing. Sections that do not have isolation valves shall be tested in approximate one-mile segments. Sections that have a zero leakage allowance may be tested as a unit. No

section of the pipeline shall be tested until field-placed concrete or mortar has attained an age of 14 Days. The test shall be made by closing valves when available or by placing bulkheads and filling the line slowly with water. The CONTRACTOR shall be responsible for ascertaining that test bulkheads are suitably restrained to resist the thrust of the test pressure without damage to or movement of the adjacent pipe. Unharnessed sleeve-type couplings, expansion joints, or other sliding joints shall be restrained or suitably anchored prior to the test to avoid movement and damage to piping and equipment. Remove or protect any pipeline-mounted devices that may be damaged by the test pressure. The CONTRACTOR shall provide sufficient temporary tappings in the pipelines to allow for trapped air to exit. After completion of the tests, such taps shall be permanently plugged. Care shall be taken that air relief valves are open during filling.

C. The pipeline shall be filled at a rate which will not cause any surges or exceed the rate at which the air can be released through the release valves at a reasonable velocity. The air within the pipeline shall be allowed to escape completely. The differential pressure across the orifices in the air release valves shall not be allowed to exceed 5 psi at any time during filling. After the pipeline or section thereof has been filled, it shall be allowed to stand under a slight pressure for at least 24 hours to allow the concrete or mortar lining, as applicable, to absorb water and to allow the escape of air from air pockets. During this period, bulkheads, valves, and connections shall be examined for leaks. If leaks are found, corrective measures satisfactory to the CONSTRUCTION MANAGER shall be taken.

D. The hydrostatic test shall consist of holding the indicated test pressure on the pipeline segment for a period of 4 hours. The test pressure for yard piping shall be as indicated on the Piping Schedule measured at the lowest point of the pipeline section being tested and shall be for 2 hours minimum. No pressure test will be required for a reservoir overflow line. Visible leaks that appear during testing shall be repaired in a manner acceptable to the CONSTRUCTION MANAGER. Add water to restore the test pressure if the pressure decreases 5 psi below test pressure during the test period.

E. The maximum leakage for yard piping shall be as indicated on the Piping Schedule. Pipe with welded joints shall have no leakage. Exposed piping shall show no visible leaks and no pressure loss during the test. In the case of pipelines that fail to pass the leakage test, the CONTRACTOR shall determine the cause of the leakage, shall take corrective measures necessary to repair the leaks, and shall again test the pipeline, repeating as necessary until the pipeline passes.

3.04 DISINFECTING PIPELINES

A. General: Potable water pipelines except those appurtenant to hydraulic structures shall be disinfected in accordance with the requirements of ANSI/AWWA C651 - Disinfecting Water Mains, using the Continuous-Feed Method as modified herein.

B. Chlorination: A chlorine-water mixture shall be uniformly introduced into the pipeline by means of a solution-feed chlorinating device. The chlorine solution shall be introduced at one end of the pipeline through a tap in such a manner that as the pipeline is filled with water, the dosage applied to the water entering the pipe shall be approximately 50

mg/L. Care shall be taken to prevent the strong chlorine solution in the line being disinfected from flowing back into the line supplying the water.

C. Retention Period: Chlorinated water shall be retained in the pipeline for at least 24 hours. After the chlorine-treated water has been retained for the required time, the free chlorine residual at the pipeline extremities and at other representative points shall be at least 25 mg/L. If testing does not demonstrate a residual of 25 mg/L or greater, the disinfection procedure above shall be repeated.

D. Chlorinating Valves: During the process of chlorinating the pipelines, valves and other appurtenances shall be operated from closed to full open to closed while the pipeline is filled with the heavily-chlorinated water.

E. Sampling Ports: The CONTRACTOR shall provide sampling ports along the pipeline as defined on AWWA C651. Taps may be made at manways and air valves to help facilitate the spacing requirement.

F. Final Flushing: After the applicable retention period, the heavily chlorinated water shall be flushed from the pipeline until chlorine measurements show that the concentration in the water leaving the pipeline is no higher than that generally prevailing in the system or is acceptable for domestic use. Any release of chlorinated water shall comply with federal, state, and local regulation and the permits for the project. Chlorine in excessive amounts shall be treated (dechlorinated) before discharge.

G. Bacteriological Testing: After final flushing and before the pipeline is placed in service, a sample, or samples shall be collected from the end of the line, and shall be tested for bacteriological quality in accordance with the requirements of the State Department of Health or other appropriate regulatory agency. For this purpose the pipe shall be re-filled with fresh potable water and left for a period of 24 hours before any sample is collected. If testing does not demonstrate a free chlorine residual after the 24-hour period, the disinfection procedure above shall be repeated. If the initial disinfection treatment fails to produce satisfactory bacteriological test results, the disinfection procedure shall be repeated until acceptable results are obtained.

3.05 CONNECTIONS TO EXISTING SYSTEM

A. Where connections are to be made to an existing potable water system, the interior surfaces of all pipe and fittings used in making the connections shall be swabbed or sprayed with a one percent hypochlorite solution before installation. Thorough flushing shall be started as soon as the connection is completed and shall be continued until discolored water is eliminated.

END OF SECTION

SECTION 01 75 06

TESTING AND FACILITY START-UP

PART 1 -- GENERAL

1.01 SUMMARY

A. This Section includes requirements for materials, equipment, instrumentation, structure, and process system testing and start-up.

1.02 RELATED SECTIONS

Section 26 01 26 - Electrical Tests

Section 40 05 00 - Piping, General

Section 40 91 00 - Process Control and Instrumentation

Section 40 95 10 - PLC Control Systems Hardware and Software

Section 43 20 00 - Pumps, General

Section 46 01 00 - Equipment General Provisions

1.03 TESTING AND START-UP OVERVIEW

A. Certain portions of the Work will be completed at scheduled interim dates before substantial completion of the Project. Consequently, testing and start-up activities shall take place throughout much of the duration of the Work.

B. See other provisions in the Standard Provisions, Special Provisions and Technical Specifications for detailed testing requirements that shall be completed in the framework of the testing and start-up overview described herein.

C. As a minimum, the CONTRACTOR will test and start up the following equipment and systems independently:

1. Gravity Thickeners

    a. New access hatch leakage

    b. New rake arms

    c. New mechanism drive motor pressure indicators/transmitters

    d. New fluid level and sludge level indicators/transmitters

    e. Relocated inlet MOVs

f. Local manual control

g. Remote manual control

h. Remote auto control

2. Flow indicators/transmitters

3. Sludge Transfer Pump Area

4. New transfer pumps

a. Local manual control

b. Remote manual control

c. Remote auto control – all modes

d. Transfer pump seal water

5. Sludge density meters

6. Containment area sump pump

7. Sludge Storage Tanks

a. Tank leakage

b. Tank mixers

1) Local manual control

2) Remote manual control

c. Inlet and outlet valve MOVs

d. Level switches and level indicators/transmitters

8. Centrate Wetwell B

a. Centrate return pumps

1) Local manual control

2) Remote manual control

3) Remote auto control

4) Pressure indicator/pressure switch

b. Level switches and level indicators/transmitters

c. Centrate return flow indicator/transmitter

d. Centrate return pump discharge MOVs

9. Centrifuge Feed Pump Area

a. Sludge density meter

b. Centrifuge feed pumps

c. Local manual control

d. Remote manual control

e. Remote auto control in combination with centrifuge operation

f. High temperature switches

g. Pressure indicators/pressure switches

h. Flow indicators/transmitters

i. Pump seal water

10. Existing Centrifuges

a. New flushing water flow indicator/transmitter/controllers

11. New Centrifuges

a. Centrifuges

1) Bowl drive local manual control

2) Back drive local manual control

3) Remote manual control

4) Remote auto control in combination with centrifuge feed pumps, conveyors and polymer feed systems

5) Hydraulic system

6) Flushing water MOVs and flow indicator/transmitter/controllers

12. Conveyors

a. New loadout conveyors

1) Local manual control

2) Remote manual control

b. Relocated existing transfer conveyors

1) Local manual control

2) Remote manual control

3) Remote auto control

c. New discharge, vertical and transfer conveyors

1) Local manual control

2) Remote manual control

3) Remote auto control in combination with centrifuge operation

d. Conveyor MOVs

1) Local manual control

2) Remote manual control

13. Polymer Feed System

a. Bulk storage tank

1) Level indicator/transmitter

2) Mixer motor

b. Polymer Blending Units

1) Local manual control

2) Remote manual control

3) Remote auto control of batching operation

c. Polymer batch tanks

1) Level indicator/transmitters

2) Mixer motors

3) Inlet and feed pump suction pipe solenoid valves

d. Polymer feed pumps

1) Local manual control

2) Remote manual control

3) Remote auto control in combination with centrifuge and thickener inlet operation

4) High pressure switches

5) Flow indicators/transmitters

6) Dilution water solenoid valves

14. Centrifuge Building B HVAC System

a. Manual control

b. Auto control

15. Electrical Systems

a. See Division 26 technical specifications

16. Instrumentation and Control Systems

a. See Division 40 technical specifications

D. Following testing and start-up of the processes, systems and facilities listed above, the CONTRACTOR shall conduct a 30-day System Commissioning Test of the entire Residuals Management System.

E. The general sequence of testing and start-up will proceed as follows. Variations to this general sequence may be authorized by the CONSTRUCTION MANAGER where necessary to meet constraints described in these Contract Documents and permits from authorities having jurisdiction.

1. Submittals. All submittals relevant to installation, equipment, piping, anchorage calculations, instrumentation, material, and testing plans have been submitted to the CONSTRUCTION MANAGER and have received favorable review status.

2. General construction testing. For example: soils compaction and moisture content, welding, concrete properties, coating application, carrier piping pressure, dielectric flange isolation and double containment piping pressure.

3. Special construction testing. For example: HVAC balancing, pump vibration, pump flow and head measurements, fire sprinkler system testing and equipment noise testing.

4. Water containing structure water tightness testing. For example: sludge storage tanks, containment areas and gravity thickeners.

5. Factory testing. Where required prior to the shipment of equipment to the site, complete factory testing of equipment for proper performance at point of

manufacture or assembly. Such testing may be both unwitnessed and witnessed by the ENGINEER OF RECORD and/or by the CONSTRUCTION MANAGER as specified and at their discretion. When Factory testing is specified:

a. Perform testing as specified in the equipment Technical Specifications.

b. Demonstrate equipment meets specified performance requirements.

c. Provide certified copies of test results.

d. Ship equipment only after certified copies have received written acceptance from the District. Written acceptance does not constitute final acceptance of the installed equipment.

e. Include costs associated with witnessing performance tests in the bid price.

6. O&M manuals. Draft O&M manuals for equipment shall be submitted and shall receive NET or MCN review status.

7. Electrical testing. Testing, calibration, and setting of electrical conductors, equipment, protective devices, grounding, and other components as specified in the Technical Specifications prior to equipment start-up. This also includes bumping all motors to verify the direction of rotation.

8. Mechanical equipment and valve testing. Individual inspection and testing to shall be done to ensure and demonstrate that equipment and valves operate properly and reliably. Equipment that is capable of automatic or remote operation shall be tested first in manual mode. Manufacturer's representatives shall certify in writing that all equipment and valves are properly installed before first operation and shall conduct/oversee the initial operation and testing. Limit switches shall be set and adjusted on all valves so equipped. Set points on all pressure-regulating, pressure-relief, vacuum-relief, and other valves with set points shall be confirmed and reset as directed by the CONSTRUCTION MANAGER.

9. Training. Train District staff as specified for equipment and facility operation and maintenance before each associated system is placed into service.

10. Instrumentation wiring ring out. Test each conductor, fiber-optic cable, and other wiring components for proper installation, termination, and identification.

11. Calibration and adjustment of instrumentation. Test, calibrate, and complete reports for each field instrument.

12. Loop tuning. Complete the tuning of all control loops.

13. Control system configuration and testing. Complete the control system configuration and testing for each area of Work before start-up. Remaining configuration work must be completed to the point that unscheduled disruptions to systems placed into service do not occur.

14. Operational readiness test (ORT). Complete the operational readiness test for the process in question as specified. Correct deficiencies noted in the ORT; retest until all deficiencies are corrected.

15. Regulatory agency approvals. Conduct inspections by and tests for regulatory agencies (fire marshals, Department of Environmental Health, BAAQMD, etc.) and receive approvals needed to operate each system. Provide written information required by regulatory agencies. This may also include the receipt of authorization by the State Department of Health Services to amend the treatment plant operating permit to allow the new/modified process.

16. Functional test (FT). Complete the FT for the process, system or facility in question as specified. Correct deficiencies noted in the FT; retest until all deficiencies are corrected.

17. Confirm facility or plant readiness to accept new process systems. In some cases, chemicals may need to be purchased and loaded into new facilities. A comprehensive testing plan and meeting scheduled completion dates are vital to allowing the start-up of new and modified process systems.

18. Prior to system commissioning testing, the CONTRACTOR shall submit the Use Before Acceptance Guarantee in accordance with Article 11.02.03. Use Before Acceptance Guarantee. The Project guarantee period for the Work starts on the date of the Notice of Completion of Contract and Acceptance of Work.

19. System commissioning test (SCT). After satisfactory completion of the FT and acknowledgement of District readiness to operate the system, the system shall be placed into normal operation. This test shall be completed and shall be judged as defined in these Specifications. This test may last significantly longer than the number of Days specified if deficiencies are found and the test is restarted one (1) or more times.

20. Removal of replaced system. In some cases after the successful completion of the system commissioning test, a replaced system exists that is subsequently removed.

21. Construction complete. Construction is complete so that the facility is ready to be used for its intended purposes. Safety and operational signage is posted.

F. CONTRACTOR is required to maintain equipment through the duration of various stages of testing and start-up during periods between ORT, FT, and SCT.

G. CONTRACTOR is required to maintain appropriate staffing through duration of ORT, FT and SCT to maintain and repair equipment, troubleshoot issues, and provide cleanup due to spills caused by malfunctioning equipment.

1.04 WATER TIGHTNESS TESTING

A. A water tightness testing plan and schedule shall be submitted for approval. The plan shall include methods of water conveyance and water disposal.

B. Water tightness testing shall be performed prior to the application of damp proofing or waterproofing Material on exterior concrete surfaces or backfilling, and, for certain structures, prior to and after the application of the chemical resistant coating, Testing shall not be performed sooner than 7 days after forms are removed.

C. Each structure listed below shall be tested for water tightness.

1. Sludge/Storage Mixing Tank No. 1
2. Sludge/Storage Mixing Tank No. 2
3. Polymer Storage and Feed Containment Area
4. Gravity Thickeners (after modifications)

D. Each structure shall be filled to its maximum normal water surface elevation. For structures equipped with overflows, it shall be filled to the overflow weir elevation. The rate of filling shall not exceed 24 inches of depth per day.

E. After filling to the testing depth, an initial water level reading shall be made.

F. The duration of the test period, which begins after the initial reading is made, shall be as follows:

1. Sludge/Storage Mixing Tanks: 168 hours (7 days)
2. Containment Areas: 48 hours (2 days)
3. Gravity Thickeners 168 hours (7 days)

G. After filling, each structure shall be inspected by the CONTRACTOR and by the CONSTRUCTION MANAGER. Inspection shall include, but shall not be limited to, walls, floors, footings, sumps, piping penetrations, and under drains. The water level will be accurately measured over the test period to measure the drop in water level for comparison with allowable leakage. Evaporative losses and rainfall gains shall be measured and deducted/added to determine the net water leakage. The net water leakage for any 24-hour period shall not exceed the calculated value of 0.0003 times the structure nominal volume; nor shall damp spots on the exterior wall surfaces be permitted; nor shall there be measurable leakage at any wall/footing joint. Damp spots are defined as locations where moisture can be picked up by a dry hand. Where leakage rates are defined by regulatory agencies, testing shall meet those requirements.

H. If the structure fails to pass the test, the test may be repeated for up to 3 additional test periods. If, at the end of the 3 test periods, the structure still fails to pass the leakage test, the CONTRACTOR shall empty the structure as acceptable to the CONSTRUCTION MANAGER and shall examine the interior for evidence of any cracking or other conditions that might be causing the leakage. Cracks shall be repaired

in accordance with Section 03 01 30 – Concrete Repair and Rehabilitation. Any evidence of leakage shall be repaired.

I. Structures will not be accepted until the water tightness test is passed and all visible leakage repaired.

1.05 OPERATIONAL READINESS TESTING

A. Demonstrate proper rotation, alignment, speed, flow, pressure, vibration, sound level, adjustments, and calibration. Perform initial checks in the presence of the CONSTRUCTION MANAGER and with the assistance of the manufacturer's representative.

B. Demonstrate proper operation of each instrument loop function, including alarms, local and remote controls, instrumentation, and other equipment functions. Generate signals with test equipment to simulate operating conditions in each control mode.

1. Complete instrument calibration as required in Section 40 91 00, Article 3.04.

2. Complete loop testing as required in Section 40 91 00, Article 3.06.

3. Complete pre-commissioning testing as required in Section 40 91 00, Article 3.07.

4. Complete testing and installation as required in Section 40 91 00, Articles 3.08 A., 3.08 B., 30.8 C., and 3.08 D.

5. See also the requirements of Section 40 91 00, Article 3.08 E. 11. a.

C. Certificate of Proper Installation

1. At completion of operational readiness testing (ORT) and prior to functional testing (FT): CONTRACTOR shall furnish a written report prepared and signed by the manufacturer's authorized representative certifying that equipment:

   a. has been properly installed, adjusted, aligned, and lubricated

   b. is free of any stresses imposed by connecting piping or anchor bolts

   c. is suitable for satisfactory, full-time operation under full load conditions

   d. operates within the allowable limits for vibration

   e. has properly installed, calibrated, and functioning controls, protective devices, instrumentation, and control panels furnished as part of the equipment package

   f. has tested and properly functioning control logic for start-up, shutdown, sequencing, interlocks, and emergency shutdown

2. Written report shall document data recorded and include specific equipment by serial number.

3. Written report shall include the following statement: “The equipment has been inspected for proper installation and is certified to be suitable for satisfactory, full-time operation.”

4. CONTRACTOR shall furnish preliminary field written report prior to functional testing (FT) and shall submit comprehensive report in final record of testing.

D. Prior to commencing functional testing (FT) the CONTRACTOR shall provide a certificate of completion of ORT certifying that equipment and systems are ready for functional testing.

1.06 FUNCTIONAL TESTING

A. The system to be tested shall be brought into a mode of operation sufficient to perform the functional testing (FT) of mechanical and electrical equipment, and instrumentation and controls systems for proper operation to be completed by the CONTRACTOR within the FT period following the completion of the ORT.

1. If not completed during the ORT, demonstrate proper rotation, alignment, speed, flow, pressure, vibration, sound level, adjustments, and calibration. Perform initial checks in the presence of the CONSTRUCTION MANAGER and with the assistance of the manufacturer's representative.

2. If not completed during the ORT, demonstrate proper operation of each instrument loop function including alarms, local and remote controls, instrumentation, and other equipment functions. Generate signals with test equipment to simulate operating conditions in each control mode.

3. See also the requirements of Section 40 91 00, Article 3.08 E. 11. b.

B. The duration of the FT period shall be seven (7) working days. However, for systems that do not operate 24 hours per day (e.g., centrifuges and conveyors), all CONTRACTOR-supplied Equipment and systems shall operate for four 8-hour continuous periods on consecutive days without failure before this test will be considered successful.

C. The District will provide operations personnel, power, chemicals, and fuel for the duration of the FT with a minimum fourteen (14) days’ advance notice from the CONTRACTOR. However, the CONTRACTOR must provide chemicals required for structures, pipes, etc., that need to be cleaned or treated prior to tie-in or operation.

D. Prior to commencing system commissioning testing (SCT) the CONTRACTOR shall provide a certificate of completion of FT certifying that all equipment and systems are ready for commissioning.

1.07 SYSTEM COMMISSIONING TESTING

A. District staff will perform the system commissioning testing (SCT) for thirty (30) consecutive Days following satisfactory completion of the FT.

1. The District will monitor equipment or systems for performance within the normal modes of operation and parameters. The District will log and notify the CONTRACTOR of any abnormalities.

2. The District will monitor tanks, basins, containment areas, pipelines, conduits, and water and air systems for any leakage. The District will log and notify the CONTRACTOR of any leakage detected.

3. If any installed equipment fails to operate properly or experiences malfunction or failure during the testing period, the test may be stopped. The CONTRACTOR shall assist the District in determining the cause of the problem. If the cause of the problem is CONTRACTOR-supplied equipment, then the CONTRACTOR shall fix the problem at no additional cost to the District. If the problem has not been fixed by the CONTRACTOR within 24 hours, the CONSTRUCTION MANAGER will determine if the entire test must be repeated from the beginning or if the test period can resume from the point at which it was stopped. The test must be restarted if the problem has not been fixed within 72 hours.

B. The SCT shall include testing of all major process functions, including but not limited to:

1. One, two or three centrifuges running under all possible combinations.

2. Either or both truck loading conveyors operating.

3. Sludge transfer pump modes.

4. Sludge storage tank(s) filling, mixing, draining and transfer, as applicable.

5. Polymer batching, feed and batch tank transfer.

1.08 SUBMITTALS

A. Submittals shall be made as required in Article 20. In addition, the following specific information shall be provided:

1. Submit within 120 days of Notice to Proceed (NTP) a single master testing plan outlining all of the test elements of this project. It shall be divided into chapters including individual testing plans for each new or modified system or facility. Each chapter's testing plan shall summarize all planned work leading to the start-up and acceptance of each new system. As a minimum, it should include those items included in the testing plan outlined herein. Testing plans shall conform to all the work restrictions identified in Article 16. As a minimum, chapter testing plans shall be submitted those items listed in Article 1.03 C.

2. All test procedures and test plans to be submitted shall include the following when applicable:

a. Clearly indicate type and quantity of fluid and chemicals needed in order to conduct the test.

b. Indicate where the fluid and chemicals will be injected and discharged along with estimated intake and discharge rate and duration(s).

c. State any temporary or permanent configuration that the CONTRACTOR proposes to install in order to conduct the test.

d. Indicate the configuration of the equipment to be tested including that of other related equipment as appropriate.

e. Indicate what District operations and maintenance staff are required to assist with testing and start-up and what activities they are expected to perform.

B. Submit a Comprehensive Test Schedule a minimum of 120 days prior to the first functional test:

a. List all equipment testing by specification section number and name. Include the following for each equipment/system:

1) Specification section and paragraph number

2) Test type (i.e., operational readiness, functional, system commissioning)

3) Test procedure submittal dates

4) Testing and start-up dates

5) Test report submittal dates

2. After initial submittal, update and provide test schedules on a weekly basis at project progress meetings and/or test coordination meetings.

3. All communication systems and systems designed for control through PLC will require testing and coordination with the project Systems Integrator (“SI”). The CONTRACTOR shall make scheduling allowances for these tests and incorporate this information into the construction schedule.

4. The general critical path test sequence is as follows:

a. Operational Readiness Checks

b. Functional Testing

c. Pre-Start-up Test

d. 21-Day Training and Submittal of Test Documentation

e. 7-Day Start-up Test

f. Schedule Commissioning activities to finish no later than the 7-Day test

g. Submittal of Test & Commissioning Documentation

h. 14-Day Review Period

i. There may be other concurrent testing and commissioning activities which are not indicated above.

C. Submit the following a minimum of 90 calendar days prior to the first functional test:

1. An updated list of all field tests required for functional and performance testing of each equipment or system with reference to appropriate specification sections, and whether manufacturer representative's presence is required.

2. A draft of the Start-up Test Plan

3. Testing Coordinator's qualifications and past project experience including contact names, addresses, and current telephone numbers that can be used to verify the accuracy of the provided information.

4. Manufacturer's representatives' resumes demonstrating their qualifications and ability to perform the specified services.

D. Submit Test Procedures for Functional and Performance Tests a minimum of 45 calendar days prior to the first functional test that include:

1. All test procedures shall be comprehensive, neatly organized, type written, and numbered step-by-step.

2. Detailed test methods, including sample calculations and reference to standards as required or applicable.

3. Pre-test checklist to ensure readiness and any safety measures are in- place.

4. Details of all necessary adjustments, balancing, required equipment isolation or configuration, test equipment and instruments, calibration, and personnel needed.

5. Acceptance Criteria: For each test, specifically indicate what is considered an acceptable test result – reference Specification Sections and specified reference standards.

6. Data Forms: Include the test name, equipment (with tag numbers as applicable) or system name, specification section and paragraph number, test instrument tag numbers, test date, space for testing personnel names, test data names, and units, reference equations for all calculated values, and signature lines for manufacturer's representative, CONTRACTOR and CONSTRUCTION MANAGER's witness.

E. Submit the final Start-up Plan a minimum of 30 calendar days prior to the first functional test that includes:

1. Start-up Plan shall systematically describe the details of preparing for and starting each system at the facility. Both Plans shall also include detail procedures for the systematic shutdown of all systems at the facility.

2. The CONTRACTOR shall coordinate with the CONSTRUCTION MANAGER, as necessary to develop the Plans.

3. At a minimum, each Plan shall include the proposed chronological sequence of activities and detailed procedures for starting or shutting down facilities and systems. In addition, provide the following detailed information:

   a. A narrative of the strategy for the Start-up Plan and how it will achieve the performance and sufficient reliability of the system to be ready for the Start-up Test and thereafter.

   b. A step-by-step procedure for start-up that includes activities, durations, setpoints, chemical doses and indicators to either continue to the next step or terminate the operation.

   c. A daily test plan indicating, but not limited to, the objective, expected results, the equipment to be tested, resources needed, roles and responsibilities, data to be monitored, samples to be collected, etc.

   d. A list of new and existing facilities, equipment, and systems with applicable references to device name and tag number that must be in operation before the start-up test can begin.

   e. CAD and Revit BIM drawings, P&IDs, and schematics highlighting the facilities, systems, and equipment included in the testing.

   f. Diesel fuel and other expendables required for testing.

   g. Chemical solutions and other expendables for testing, including, but not limited to polymer.

F. Daily Test Reports

1. Submit daily test report describing equipment being tested, referenced test procedure, test methods, test strategies actually used or implemented during the test, and any problems and deficiencies found during testing. If there was troubleshooting done, the daily test report shall describe the troubleshooting methods and strategy.

2. At the end of each test day, CONTRACTOR shall download all pertinent data from graphic data recorder and attach to the daily test report.

G. Final Field Test Reports

1. Upon successful completion of testing for each equipment item or system, the CONTRACTOR shall submit complete typewritten test report including data forms.

2. Upon substantial completion, all factory, functional and performance test reports shall be inserted by the CONTRACTOR into the applicable O&M manuals.

H. Device Settings: Submit all final device settings for all field adjustable devices. These settings shall be incorporated into the final O&M manuals for each piece of equipment supplied.

I. Start-up Test Manual

1. When all start-up testing is complete, submit all test documents in bound form. This consolidated submittal is in addition to the individual submittal of test procedures and test results. Format requirement for this manual shall include section dividers by system or equipment. Note: Electrical equipment data shall be provided on approved NETA forms and Instrumentation and Control data shall be provided on ISA forms.

1.09 TESTING COORDINATOR RESPONSIBILITIES AND QUALIFICATIONS

A. The CONTRACTOR shall provide a test and commissioning expert hired from an independent consulting firm to develop, manage and administer the functional, performance, pre-start-up, and start-up test program for this project. This expert, the Testing Coordinator, shall not be directly employed by the CONTRACTOR or its subCONTRACTORs. The consulting firm may be an engineering or construction management consulting company. The Testing Coordinator's responsibilities shall include, but are not limited to, the following activities:

1. Overall responsibility and coordination for all field testing.

2. Located onsite while Operational Readiness Tests and Functional Tests are being conducted, unless otherwise approved by the CONSTRUCTION MANAGER.

3. Liaison between CONTRACTOR, subCONTRACTORs, vendors, instrumentation supplier, and the CONSTRUCTION MANAGER for all field testing and start-up activities.

4. The Testing Coordinator shall timely develop, compile, and review all test and start-up submittals for completeness and compliance with the Contract, before the CONTRACTOR submits them to the CONSTRUCTION MANAGER.

5. Develop a comprehensive schedule for all field testing and start-up activities and provide regular schedule updates.

6. Schedule and lead planning and technical meetings. Draft and distribute meeting minutes.

7. Oversee and administer all field testing activities, including either direct participation in the field testing, and/or oversight and monitoring of all field testing. It shall be the Testing Coordinator's responsibility to ensure that all field tests have been completed in accordance with approved testing procedures.

8. Conduct or oversee pre-test checks to ensure readiness for testing.

9. Verify all piping hydrostatic testing and applicable service cleaning, oxygen service cleaning, and disinfection activities have been completed prior to field testing connected equipment.

10. Safety: Identify and document safe work practice procedures (i.e., lockout/tagout procedures) and personnel protective equipment policies that will be followed during all field testing activities. At a minimum the CONTRACTOR must comply with Cal OSHA and the Owner's established safety guidelines. It shall be the Testing Coordinator's responsibility to ensure al safety procedures are followed at all times during testing.

11. Training: Prior to submittal to the CONSTRUCTION MANAGER, review and approve the content of all equipment training sessions to ensure that the training includes all applicable operation, maintenance, safety, and functional, performance, and start-up testing information.

B. Testing Coordinator's Minimum Statement of Qualifications:

1. The Testing Coordinator is required to be responsible and devoted solely to managing, coordinating, and supervising all work related to the planning, final testing, start-up and commissioning of the facilities as described in this section, and elsewhere in the Specification and will have:

a. Professional civil, mechanical or electrical engineer's license, currently registered in the State of California.

b. Minimum 10 years of experience in testing and commissioning of water or wastewater treatment systems and other related electrical, mechanical, and instrumentation and control systems.

c. Responsibility in test & start-up of similar systems on major projects with a construction cost of over $5 million, over 200 sheets of drawings, include at least one water or wastewater treatment plant greater than 20 mgd, and include chemical system, pumping, centrifuge, SCADA and electrical infrastructure.

1.10 MANUFACTURER'S SERVICES

A. A manufacturer's authorized representative shall perform all services when manufacturer's services are specified in the Technical Specifications. The authorized representative shall be factory trained and experienced in the technical applications, installation, operation and maintenance of the equipment, subsystem or system. Additional qualifications may be specified elsewhere.

B. Manufacturer's representative shall be subject to the acceptance of the CONSTRUCTION MANAGER. The CONTRACTOR shall submit the qualifications of the manufacturer's representative to the CONSTRUCTION MANAGER for review and approval. No substitute representatives will be allowed without prior written approval by the CONSTRUCTION MANAGER.

C. If the Technical Specifications provide for manufacturer's representatives or technicians to be present during installation, inspection or testing, but fail to expressly provide for their presence during Start-up Testing, then the CONTRACTOR shall re-allocate at least a day of the representative or technician's time to be present during Start-up Testing at no additional cost. Coordinate such reallocation with the CONSTRUCTION MANAGER.

1.11 EQUIPMENT AND MATERIALS REQUIRED FOR SYSTEM TESTING

A. It shall be the CONTRACTOR's responsibility to ensure that all required material and test and repair equipment are on hand during all testing.

B. All instruments used to measure equipment performance shall be calibrated. Certificates of calibration shall be current and shall be at the job site during testing and provided upon request or when specified. Copies of the calibration records shall be submitted to the CONSTRUCTION MANAGER for review and approval prior to the start of testing.

C. Except for treatment chemicals, CONTRACTOR is required to provide all expendables during testing, including but not limited to, diesel fuel, oil and filters (e.g., air, fuel, oil, etc.) required for testing.

D. Upon completion of testing, all expendables shall be replaced with new ones and primed ready for operation.

E. The Owner shall furnish power and treatment chemicals, unless indicated otherwise.

1.12 TESTING AND START-UP COORDINATION MEETINGS

A. Weekly meetings shall be scheduled and conducted by the Testing Coordinator to discuss overall test scheduling, procedures, strategy, and preparations for the forthcoming testing. The first meeting shall be conducted 60 calendar days prior to the first scheduled functional tests.

B. The weekly planning meetings shall continue until all field tests are completed and approved by the CONSTRUCTION MANAGER.

C. The CONTRACTOR's Testing Coordinator shall attend and chair all meetings, and the CONTRACTOR shall provide suitable representation from each subCONTRACTOR having testing responsibilities so that informed decisions can be made during the meetings.

1.13 MEASUREMENT AND PAYMENT

A. Work shall be considered incidental and compensation shall be included in the Contract prices paid for the various items of work and no additional time or compensation be allowed therefor.

Refer to Article 20.01 Schedule of Bid Items.

PART 2 -- PRODUCTS

NOT USED

PART 3 -- EXECUTION

NOT USED

END OF SECTION

SECTION 02 41 19

SELECTIVE DEMOLITION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Standard Provisions and Special Provisions apply to this Section.

B. Drawings and general provisions of the Contract, including Standard Provisions and Special Provisions apply to this Section.

1.02 SUMMARY

A. Section includes:

1. Demolition and removal of selected portions of building or structure.

2. Salvage of existing items to be reused or recycled.

1.03 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Salvage: Detach items from existing construction and deliver them to Owner ready for reuse.

C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.

D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.04 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

1.05 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at Project site.

1. Inspect and discuss condition of construction to be selectively demolished.

2. Review structural load limitations of existing structure.

3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.

4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.

5. Review areas where existing construction is to remain and requires protection.

1.06 INFORMATIONAL SUBMITTALS

A. Qualification Data: For refrigerant recovery technician.

B. Engineering Survey: Submit engineering survey of condition of building.

C. Proposed Protection Measures: Submit report, including drawings, that indicates the measures proposed for protecting individuals and property, for dust control and, for noise control. Indicate proposed locations and construction of barriers.

D. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.

2. Interruption of utility services. Indicate how long utility services will be interrupted.

3. Coordination for shutoff, capping, and continuation of utility services.

4. Use of elevator and stairs.

5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

E. Inventory: Submit a list of items to be removed and salvaged and deliver to Owner prior to start of demolition. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.

F. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces that might be misconstrued as damage caused by demolition operations. Submit before Work begins.

G. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

H. Warranties: Documentation indicated that existing warranties are still in effect after completion of selective demolition.

1.07 QUALITY ASSURANCE

A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

1.08 FIELD CONDITIONS

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. Hazardous materials will be removed by Owner before start of the Work.

2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

E. Storage or sale of removed items or materials on-site is not permitted.

F. Utility Service:

1. Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

2. Maintain fire-protection facilities in service during selective demolition operations.

1.09 WARRANTY

A. Existing Warranties: Remove, replace, patch and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties. Notify warrantor before proceeding. Existing warranties include the following:

B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

1.10 COORDINATION

A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

PART 2 PRODUCTS

2.01 PEFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Review Project record documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in record documents.

C. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.

1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

D. Steel Tendons: Locate tensioned steel tendons and include recommendations for de-tensioning.

E. Verify that hazardous materials have been remediated before proceeding with building demolition operations.

3.02 PREPARATION

A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.03 UTILITY SERVICES, MECHANICAL AND ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services and systems indicated to remain and protect them against damage during selective demolition operations.

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Arrange to shut off utilities with utility companies.

2. If services/systems are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated to be removed.

    a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
    c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
    d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
    e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
    f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
    g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.

3.04 PROTECTION

A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
4. Cover and protect furniture, furnishings, and equipment that have not been removed.
5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Standard Provisions Section "Temporary Facilities."

B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of selective demolition.

C. Remove temporary barricades and protections where hazards no longer exist.

3.05 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.

2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.

3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.

4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.

5. Maintain adequate ventilation when using cutting torches.

6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.

7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.

8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

9. Dispose of demolished items and materials promptly. Comply with requirements in Standard Provisions Section 10.

B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

C. Removed and Salvaged Items:

1. Clean salvaged items.

2. Pack or crate items after cleaning. Identify contents of containers.

3. Store items in a secure area until delivery to Owner.

4. Transport items to Owner's storage area designated by Owner.

5. Protect items from damage during transport and storage.

D. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.

2. Pack or crate items after cleaning and repairing. Identify contents of containers.

3. Protect items from damage during transport and storage.

4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and reinstalled in their original locations after selective demolition operations are complete. Cover existing carpet and floor bases to remain to protect during construction.

3.06 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch (19 mm) at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.

B. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.

C. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts. Remove whole CMUs where shown.

D. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.

3.07 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction and recycle or dispose of them according to Standard Provisions Section 10.

1. Do not allow demolished materials to accumulate on-site.

2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
4. Comply with requirements specified in Standard Provisions Section 10.

B. Burning: Do not burn demolished materials.

3.08 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION

SECTION 03 01 30

CONCRETE REPAIR AND REHABILITATION

PART 1 -- GENERAL

1.01 THE SUMMARY

A. Remove, repair, or rehabilitate new and existing concrete members and surfaces as indicated.

B. Provide all materials and equipment necessary to accomplish the WORK.

C. Repair damage to concrete and concrete surfaces which results from the removal of embedded items, from construction activities, or which existed previously in structures indicated to be repaired.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. References

1. ACI 201.1R-08 - Guide for Making a Condition Survey of Concrete in Service

2. ACI 546R-14 - Concrete Repair Guide

1.03 RELATED SECTIONS

A. Section 03 21 00 Reinforcement Steel

B. Section 03 31 00 Cast-in-Place Concrete

C. Section 03 32 00 Joints in Concrete

D. Section 03 60 00 Grouting

E. Section 05 05 19 Post-Installed Anchors in Concrete

1.04 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with the requirements of Section 7 of Standard Provisions – Submittal Management.

B. Shop Drawings

1. Submit Shop Drawings for strengthening required around new openings.

2. Submit detailed drawings showing proposed methods for supporting existing structures, equipment, and piping during demolition and repair activities.

C. Concrete Repair Products and Procedures

1. Submit a comprehensive plan for each repair method indicated within this Section, the plan shall include the following:

a. Manufacturer's literature containing instructions and recommendations on the mixing, handling, placement, curing, and appropriate uses for each product.

b. Curing products and procedures for each repair method for which curing is recommended by the manufacturer.

1.05 QUALIFICATIONS OF CONCRETE RESTORATION FIRMS

A. The concrete restoration WORK shall be performed by an experienced firm customarily engaged in performing similar repair work on cast-in-place concrete structures.

B. The restoration firm shall have completed at least 5 similar projects in the last 5 years.

C. The restoration firm shall be certified by the manufacturer of the repair materials.

1.06 QUALITY ASSURANCE

A. Field Tests of Cement Based Mortars and Grouts

1. The CONSTRUCTION MANAGER may take compression test specimens during construction from the first placement of each type of mortar or grout, and at intervals thereafter as selected by the CONSTRUCTION MANAGER in order to ensure continued compliance with the indicated requirements.

2. The CONTRACTOR shall assist the CONSTRUCTION MANAGER in obtaining specimens for testing.

3. The compression tests and fabrication of specimens for repair mortar and non-shrink grout will be performed as specified in ASTM C 109.

4. A set of 5 specimens will be made for testing at 7 days, 28 days, and additional time periods as appropriate.

5. Any material, already placed, which fails to meet the indicated performance requirements is subject to removal and replacement as part of the WORK.

6. The cost of laboratory tests on mortar and grout will be paid by the OWNER, but the CONTRACTOR shall be responsible for the cost of any additional tests and investigation on the WORK that does not meet the indicated requirements.

7. The CONTRACTOR shall supply all necessary materials for fabricating the test specimens.

B. Repair Concrete: Repair concrete shall be tested as required in Section 03 31 00 – Cast-in-Place Concrete.

C. Epoxy Grout: Epoxy grout shall be tested as required in Section 03 60 00 – Grouting.

D. Construction Tolerances: Construction tolerances shall comply with the requirements of Section 03 31 00 – Cast-in-Place Concrete, except as otherwise indicated.

PART 2 -- PRODUCTS

2.01 GENERAL

A. All products and materials in contact with potable water shall be certified as being in conformance with ANSI/NSF Standard 61 – Drinking Water System Components – Health Effects.

2.02 REPAIR MORTAR

A. Provide repair mortar as a pre-packaged, 2-component, polymer-modified, cementitious, non-sag mortar, specifically formulated for the repair of surface defects.

B. Provide the mortar with a penetrating corrosion inhibitor.

C. Repair mortar shall have the following properties:

Physical Property	Value	ASTM Standard
Compressive Strength (min.)		C-109
at 7 days	6000 psi	
at 28 days	7000 psi	
Bond Strength (min.)		C-882 (modified)
at 28 days	2200 psi	
Freeze/Thaw resistance (min.)		C-666
300 cycles	98 percent	

D. Provide a minimum repair thickness of 1/4 inch, unless otherwise indicated.

E. Repair Mortar shall be **SikaTop 123 Plus**, by **Sika Corporation**, or equal.

2.03 NON-SHRINK GROUT

A. Provide non-shrink grout conforming to the requirements of Section 03 60 00 – Grouting.

2.04 CONCRETE MATERIALS

A. Cement

1. Use Type II Portland cement unless otherwise indicated.

2. Where repairs are to be made on wall surfaces open to view and above normal water surface elevations, blend white Portland cement with the Type II cement as needed in order to match the color of the adjacent existing concrete surface.

B. Structural Repair Grout

1. Where required, provide structural repair grout meeting the requirements of Section 03 60 00 – Grouting.

2. Provide a minimum repair thickness of 3 inches.

C. Cement Grout

1. Provide cement grout that meets the requirements of Section 03 60 00 – Grouting.

2. Provide a minimum repair thickness of one inch.

D. Miscellaneous Materials**:** For concrete construction materials not covered specifically in this Section, conform to the requirements of Section 03 31 00 – Cast-in-Place Concrete.

2.05 AGGREGATE

A. Obtain the written permission of the manufacturer and CONSTRUCTION MANAGER before using aggregate to extend repair mortar and grout products.

B. If allowed and unless otherwise indicated, provide aggregate consisting of 3/8-inch clean, washed gravel or crushed stone as required in Section 03 31 00 – Cast-in-Place Concrete.

2.06 BONDING AGENT AND ANTI-CORROSION COATING

A. Provide a bonding agent that is a solvent-free, moisture-tolerant, epoxy-modified, cementitious product, specifically formulated as a bonding agent and anti-corrosion coating.

B. Bonding Agent shall be **Armatec 110 EpoCem**, by **Sika Corporation**, or equal.

2.07 EPOXY GROUT

A. Provide an epoxy grout conforming to the requirements of Section 03 60 00 – Grouting.

2.08 EPOXY RESIN

A. Use epoxy resin for structural crack repair.

B. For crack injection, provide a 2-component, moisture-tolerant, low-viscosity, high-strength epoxy resin adhesive that is specially formulated for that usage.

C. Provide a minimum bond strength of 2900 psi when tested per ASTM C 882 at 14 days, moist cured.

D. Epoxy Resin shall be **Sikadur 35, Hi-Mod LV**, by **Sika Corporation**, **KEMKO 068 LoVis IR**, by **ChemCo Systems, Inc.**, or equal.

2.09 PROTECTIVE COATING

A. Waterproofing

1. Provide a 2-component, polymer-modified, cementitious waterproofing and protective slurry mortar for concrete.

2. Apply the material in 2 coats, with a coverage of 40 sq ft/gal/coat.

3. Waterproofing shall be SikaTop Seal 107, by Sika Corporation, or equal.

B. Protective coating shall be as indicated in Section 09 96 00 – Protective Coating.

2.10 FORMWORK

A. Where needed, provide formwork that meets the requirements of Section 03 11 00 – Concrete Formwork.

2.11 REINFORCEMENT STEEL

A. Where required, provide reinforcing steel that meets the requirements of Section 03 21 00 – Reinforcement Steel.

2.12 POLYURETHANE SEALANT

A. Provide a 2-part polyurethane, gun-grade sealant.

B. Polyurethane Sealant shall be **Sikaflex – 2C**, by **Sika Corporation**, or equal.

2.13 POLYURETHANE CHEMICAL GROUT

A. Use polyurethane chemical grout for non-structural crack repair.

B. Polyurethane Chemical Grout shall be **SikaFix HH**, by **Sika Corporation**, **Flex LV PURe**, by **WR Grace/De Neef**, **Flex SLV PURe**, by **WR Grace/De Neef**, or equal.

2.14 EXPANSION JOINTS

A. Provide an expansion joint system for repair of the existing expansion joints, consisting of a Hypalon sealing strip and an epoxy adhesive in order to provide a watertight seal.

B. Expansion Joint System shall be **Sikadur Combiflex**, by **Sika Corporation**, or equal.

2.15 HYDROPHILIC WATERSTOP

A. Provide hydrophilic waterstop of the type which expands in the presence of water to form a watertight joint seal without damaging the concrete in which it is cast.

B. Provide hydrophilic waterstop that is bentonite-free and manufactured from chloroprene rubber and modified chloroprene rubber with hydrophilic properties.

C. Hydrophilic Waterstop shall be **Hydrotite RSS-040 P**, by **Greenstreak Group, Inc.**, KM **4mm String**, by **Adeka Ultra Seal**, or equal.

2.16 HIGH STRENGTH EPOXY GEL

A. High-Strength Epoxy Gel for crack surface sealing shall be **Denepox Rapidgel**, by **WR Grace/De Neef**, or equal.

2.17 STRUCTURAL EPOXY PASTE ADHESIVE

A. Structural Epoxy Paste Adhesive shall be **Sikadur 31 Hi_Mod Gel** by **Sika Corporation**, **Tyfo S** by **Aegion/Tyfo**, or equal.

PART 3 -- EXECUTION

3.01 GENERAL

A. Repairs

1. Repair techniques will be reviewed during the pre-construction meeting between the CONTRACTOR, ENGINEER OF RECORD, and CONSTRUCTION MANAGER.

2. The CONTRACTOR shall be familiar with the cause of deteriorated concrete and shall choose the right equipment, repair materials and techniques to be used for each repair.

3. Choose repair materials to match the adjacent concrete surface in color and texture.

4. Apply repair materials in strict accordance with the manufacturer's printed instructions, including temperature and moisture requirements throughout application and curing.

5. Protect adjacent portions of the structure, including all valves, pipes, mechanical equipment, and filter media from debris generated by repair activities.

6. For portions of the structure that are not identified to be repaired, maintain in their original condition.

B. Structural Stability

1. Use caution not to weaken the structural capacity of a beam, column, wall, slab, walkway, or other concrete member during concrete removal.

2. For severely deteriorated concrete members, consult with the CONSTRUCTION MANAGER before removing a major portion of any structural member.

3. Shoring may be required in order to support the structure and to protect workers.

C. Provide off-site disposal of debris generated as a result of repair procedures.

D. Provide concrete construction procedures not specifically addressed in this Section in accordance with the requirements of Section 03 31 00 – Cast-in-Place Concrete.

3.02 REPAIR SEQUENCING

A. Unless otherwise indicated, perform concrete repairs in the following sequence, with no activity in an area being started until previous activities in that area have been completed, including curing, cleanup, and the like:

1. removal of equipment, miscellaneous metals, and other surface features that would interfere with the repair;
2. removal of concrete sections which require complete replacement;
3. surface preparation hydroblasting over the entire area to be repaired;
4. embedded metal repair;
5. crack repair;
6. filter trough to wall connection repair;
7. spalled and delaminated concrete repair;
8. scaled concrete;
9. pop-out repair, and repair of other surface damage, deterioration, or defects;
10. patching of holes in concrete;
11. replacement of concrete sections which require complete replacement;
12. new construction;
13. application of protective coatings;
14. expansion joint repair; and,
15. installation of traffic topping.

B. For areas which require combinations of spalled and delaminated concrete repair, scaled concrete, and pop-out repair, perform these repairs at the same time.

C. Limit the size of the repair area in order to permit the repairs to be performed together, without sacrificing the quality of the individual repairs.

3.03 EMBEDDED METAL REPAIR

A. Unless otherwise indicated, repair anchor bolts and other embedded metal, except rebar, that are exposed at the concrete surface and are showing signs of corrosion, as follows:

1. Cut off or otherwise remove corroded metal fastened at the surface;

2. Burn back embedded metals to a depth of at least 1.5 inches beyond the surface of sound concrete;

3. Chip away unsound concrete around the embedded metal.

4. Apply epoxy grout to the repair area until level with the surface of the surrounding sound concrete.

B. Unless otherwise indicated, repair embedded rebar that is exposed at the concrete surface following the procedures outlined in the appropriate concrete repair subsection, below.

3.04 CRACK REPAIR

A. Structural Cracks

1. Structural Cracks are defined as follows:

a. All cracks where reinforcing steel is passing across the crack, including erratic cracks, and cracks at construction joints.

2. Repair structural cracks with epoxy resin.

B. Non Structural Cracks

1. Non Structural Cracks are defined as follows:

a. Cracks occurring at flexible joints, contraction joints or expansion joints.

2. Repair non-structural cracks with polyurethane chemical grout.

C. Efflorescence

1. Prior to the crack repair, clean efflorescence from the cracks and the surrounding area.

2. Clean the efflorescence by light hydro-blasting or scrubbing.

D. Pressure Injection: Pressure Injection to be performed prior to leak testing and roof membrane installation.

1. General

   a. The indicated repair materials have been selected to minimize the loss of material during the injection process. The areas selected for crack repair are to be identified by the Contractor, Engineer of Record or Construction Manager and be determined prior to leak tests and roof membrane installation. The injection of cracks may also be required as a result of the leak test.

   b. In order to avoid excessive loss of injected material at the lower exposed portions of the cracks, space the injection ports a distance no greater than the thickness of the wall being repaired.

2. Open through thickness structural cracks are to be repaired to deliver a water tight hydraulic structure passing the specified leakage test. All 3 foot long minimum or greater through thickness cracks greater than a minimum 15 mil thickness in the walls are to be injected unless they do not accept grout. All 2 foot long minimum through thickness cracks greater than 10 mil thickness in the foundation, water conduits, floor slabs and roof are to be injected unless they do not accept grout. Perform structural crack repairs by pressure injection in accordance with the manufacturer's directions, and in accordance with the following basic procedure:

   a. Remove unsound and foreign materials from the crack in a manner that does not trap debris in the crack and prevent the flow of repair materials.

   b. Remove any contamination by flushing with water or solvent, allowing adequate time for air-drying or blow out the solvent with compressed air. For potable water applications, any solvents must be fully flushed from the joint unless NSF/ANSI Standard 61 approved.

   c. Install the injection ports in accordance with the manufacturer's directions.

   d. Sealing

      1) Seal the surface in order to keep the pressure injecting materials from leaking out before it has set or gelled.

      2) Seal a surface by brushing an epoxy over the surface of the crack and allowing it to harden or use high injection pressures to cut-out the cracks in a 'V' shape, fill with an epoxy, and strike off flush with the surface.

      3) Surface patching or sealant shall be performed where needed to provide for complete penetration of the injected epoxy resin and to prevent wastage. Seal surface of crack with fast setting hydraulic cement or high strength epoxy gel. The surface along the cracks shall be cleaned and all wasted grout and surface seal material shall be completely removed from the concrete surface following completion of the repair work.

e. Inject the repair materials, with consideration of the following items:

1) Carefully select the pressure of the hydraulic pump or other device, because too much pressure can extend the existing cracks and cause more damage.

2) For vertical cracks, start by pumping material into the entry port at the lowest elevation until the material level reaches the entry port above, then cap the lower injection port and repeat the process at successively higher ports until the crack has been completely filled.

3) For horizontal cracks, start at one end of the crack and work to the other end, filling the crack until the pressure can be maintained.

4) For very fine cracks, start the injection of repair material at the widest end and proceed toward the thinner end, using low-viscosity repair material.

f. Cleanup

1) Remove the surface seal by grinding or other appropriate means.

2) Coat fittings and holes at injection ports with an epoxy patching compound.

3) If crack repairs are part of repair for surface defects, painting with epoxy is not necessary and surface preparation may be started after crack repairs have been completed.

3. Open through thickness non-structural cracks are to be repaired to deliver a water tight hydraulic structure passing the specified leakage test. Open through thickness cracks with lengths of at least 3 feet on each side of the wall and roof, at least 2 feet of length on the foundation or floor slab are to be injected unless they do not accept grout. All 3 foot long minimum or greater through thickness cracks greater than a minimum 15 mil thickness in the walls are to be injected unless they do not accept grout. All 2 foot long through thickness cracks greater than 10 mil thickness in the floors and roof are to be injected unless they do not accept grout. Perform non-structural crack repairs in accordance with the manufacturer's directions, and in accordance with the following basic procedure:

a. Remove unsound and foreign materials from the crack in a manner that does not trap debris in the crack and prevent the flow of repair materials.

b. Remove contamination by flushing with water or solvent, allowing adequate time for air-drying or blow out the solvent with compressed air. Any solvents must be fully flushed from the joint unless NSF/ANSI Standard 61 approved.

c. Install the injection ports in accordance with the manufacturer's directions.

d. Moisture

1) For non-structural cracks, moisture must be present for the chemical grout to react.

2) Prior to injecting the repair materials, inject the crack with a small amount of water in order to completely moisten the crack.

e. Inject the repair materials, with consideration of the following items:

1) Carefully select the pressure of the hydraulic pump or other device, because too much pressure can extend the existing cracks and cause more damage.

2) For vertical cracks, start by pumping material into the entry port at the lowest elevation until the material level reaches the entry port above, cap the lower injection port and repeat the process at successively higher ports until the crack has been completely filled, and then, starting again at the lowest port, re-inject into all ports in order to ensure that all voids are properly sealed off.

3) For horizontal cracks, start at one end of the crack and work to the other end, filling the crack until the pressure can be maintained.

4) For very fine cracks, start the injection of repair material at the widest end and proceed toward the thinner end.

f. Cleanup

1) Remove excess surface material by grinding or other appropriate means.

2) Coat fittings and holes at injection ports with an epoxy patching compound.

3) If crack repairs are part of repair for surface defects, painting with epoxy is not necessary and surface preparation may be started after crack repairs have been completed.

3.05 SPALLED AND DELAMINATED CONCRETE REPAIR

A. Repair spalls and delaminated concrete using repair mortar.

B. Surface Preparation

1. Remove all delaminated concrete and all unsound concrete beyond the spalled or delaminated area.

2. Boundaries

a. Determine the boundaries of the patch by sawcuts to a depth of at least 1/4 inch up to one inch deep.

b. Refer to the Structural Drawings for sawcut locations.

c. Where the sawcut locations are not shown on the Drawings, the boundaries shall be layouts designed to reduce boundary edge length.

d. Avoid excessive or complex edge conditions.

3. Sawcuts

a. Perform sawcuts perpendicular to the surface or slightly undercut.

b. Construct sawcuts in maximum 1/4-inch increments.

c. After each incremental cut, inspect the cut surface in order to ensure that the existing reinforcement has not been cut.

d. If at any depth the reinforcement becomes exposed, terminate the sawcut and notify the CONSTRUCTION MANAGER.

4. Chip away concrete within the repair area to a depth sufficient to expose sound concrete over the entire repair area, or to a minimum depth required by repair mortar, whichever is greater.

5. Base the selection of partial depth concrete removal equipment on the size of repair area, depth of concrete to be removed, and the location of the deteriorated concrete such as wall, slab-on-grade, underside or top of elevated slab.

6. Removal

a. The maximum allowable pneumatic chipping hammer shall be a 30-lb class hammer.

b. Hydroblast removal shall use a maximum pressure of 40,000 psi.

c. Sand blasting is not permitted.

d. Hydroblast concrete removal is recommended for large area of surface defects.

e. Remove water blasting debris daily in order to prevent it from setting up.

f. If a chipping hammer is used, ensure that the existing reinforcement is not damaged during the concrete removal operations.

g. Remove protrusions, such as mortar spatter or fins, by grinding or by striking with a hammer or other tool.

7. Reinforcement

    a. Remove concrete around reinforcement when the rebar is rusted, more than half the rebar perimeter is already exposed, the concrete bond around the rebar is broken, or if the concrete is unsound or honey-combed.

    b. Remove concrete in order to provide a clear space of minimum one inch on all sides of the reinforcement, such that the rebar can be cleaned and the repair material will completely surround the rebar.

    c. Clean exposed reinforcement by water blasting or wire brushing.

    d. After fully exposing and cleaning the reinforcement, check for steel deterioration, and if the cross-sectional area of the steel has been reduced by more than 10 percent, whether by deterioration, surface preparation, or a combination of both, provide additional reinforcement.

    e. Consult with the CONSTRUCTION MANAGER before adding or replacing rebar.

C. Repairing Surface Defects

1. Clean the concrete surface after removing unsound concrete, repairing cracks, and cleaning the reinforcement.

2. Ensure that the concrete surface and reinforcement are free of form-release agents, curing compounds, surface hardeners, oils, grease, food, chemicals, and other contaminants.

3. Remove dust, including new dust generated by surface preparation or scarifying.

4. Prior to application of the bonding agent, apply anti-corrosion coating to exposed rebar in accordance with the manufacturer's recommendations, allow the coating to dry, reapply the coating, and allow to dry again.

5. Prior to applying the repair mortar, apply bonding agent in accordance with the manufacturer's recommendations.

6. Repair Mortar

    a. Apply repair mortar in accordance with the manufacturer's recommendations.

    b. The thickness of each lift of repair mortar shall be in accordance with the manufacturer's recommendations, with the minimum thickness being not less than 1/4 inch.

7. Fully consolidate the repair mortar, working the material into the substrate to completely fill all pores and voids in the area to be filled.

8. Bring the repair surface into alignment with the adjacent existing surfaces in order to provide a uniform, even surface.

9. Match the repair surface to adjacent existing surfaces in texture by applying necessary coatings and surface treatments.

10. Float-finish the repaired surface using wood or sponge floats.

11. For repaired surfaces to receive a cementitious protective coating, brush-finish the surface in order to produce a roughened substrate for the coating.

12. Minimum and maximum ambient and surface temperatures shall be as recommended by repair material manufacturer.

D. Curing

1. Curing of repair mortar to receive waterproofing shall be as follows:

   a. Keep the mortar continuously wet by the application of water for a minimum period of at least 7 consecutive days, beginning immediately after the mortar has reached final set;

   b. Weight the curing blankets or otherwise held them in place in order to prevent being dislodged by wind or other causes, and to be substantially in contact with the concrete surface;

   c. Ensure that edges are continuously held in place; and,

   d. Keep the curing blankets and concrete continuously wet by the use of sprinklers or other means, both during and after normal working hours.

2. If the repair mortar is not to receive waterproofing, provide curing in accordance with the manufacturer's recommendations except that the minimum cure period shall be 7 days.

3. During cold weather, maintain the repair material temperature above 50 degrees F for at least 3 days after placement.

3.06 SCALED CONCRETE REPAIR

A. Repair scaling and pop-outs using repair mortar.

B. Surface Preparation

1. Prior to repair, prepare the surface in accordance with the repair mortar manufacturer's recommendations with the following minimum requirement.

2. Remove unsound concrete from surfaces by high-pressure water blasting, using a minimum pressure of 10,000 psi and maximum pressure of 40,000 psi.

3. Clean exposed reinforcement by water blasting or wire brushing.

C. Repairing Surface Defects

1. Clean the concrete surface after removing unsound concrete, repairing cracks, and cleaning reinforcement.

2. Ensure that the concrete surface and reinforcement are free of form-release agents, curing compounds, surface hardeners, oils, grease, food, chemicals, and other contaminants.

3. Remove dust, including new dust generated by surface preparation or scarifying.

4. Prior to application of the bonding agent, apply anti-corrosion coating to exposed rebar in accordance with the manufacturer's recommendations, allow the coating to dry, reapply the coating, and allow to dry again.

5. Prior to applying the repair mortar, apply bonding agent in accordance with the manufacturer's recommendations.

6. Apply repair mortar in accordance with the manufacturer's recommendations, using a minimum repair material thickness of 1/4 inch.

7. Fully consolidate the repair material, working the material into the substrate to completely fill all pores and voids in the area to be filled.

8. Bring the repair surface into alignment with the adjacent existing surfaces in order to provide a uniform, even surface.

9. Match the repair surface to adjacent existing surfaces in texture by applying necessary coatings and surface treatments.

10. Float-finish the repaired surface using wood or sponge floats.

D. Provide strip joint in newly placed mortar at the location of repaired cracks.

E. Curing

1. Curing of repair mortar to receive waterproofing shall be as follows:

   a. Keep the mortar continuously wet by the application of water for a minimum period of at least 7 consecutive days, beginning immediately after the mortar has reached final set;

   b. Weight the curing blankets or otherwise held them in place in order to prevent being dislodged by wind or other causes, and to be substantially in contact with the concrete surface;

   c. Ensure that edges are continuously held in place; and,

   d. Keep the curing blankets and concrete continuously wet by the use of sprinklers or other means, both during and after normal working hours.

2. If the repair mortar is not to receive waterproofing, provide curing in accordance with the manufacturer's recommendations except that the minimum cure period shall be 7 days.

3. During cold weather, maintain the repair material temperature above 50 degrees F for at least 3 days after placement.

3.07 POP-OUT REPAIR, AND REPAIR OF OTHER SURFACE DAMAGE, DETERIORATION, OR DEFECTS

A. Repair pop-outs and other surface damage, deterioration, and defects which are 1/4 inch deep or shallower, using the procedures described under "SCALED CONCRETE REPAIR," above.

B. Repair other pop-outs and surface damage, deterioration, and defects using the procedures described under "SPALLED AND DELAMINATED CONCRETE REPAIR," above.

3.08 REPLACEMENT OF CONCRETE SECTIONS WHICH REQUIRE COMPLETE REPLACEMENT

A. Refer to the Structural Drawings for locations where the level of concrete deterioration is such that complete removal and replacement of the deteriorated section is required.

B. At these locations, remove the deteriorated concrete in accordance with the details on the Structural Drawings and the requirements of this Section.

C. Limits

1. The limits of concrete removal shall be as indicated on the Structural Drawings.

2. If no limits of removal are indicated, determine the limits in accordance with the procedures described under "Boundaries – Spalled and Delaminated Concrete Repair."

D. Provide sawcuts in accordance with the procedures described under "Sawcuts – Spalled and Delaminated Concrete Repair."

E. After removal of the concrete, prepare the area and provide repair concrete in accordance with the details on the Structural Drawings and the requirements of this Section.

F. Unless otherwise indicated, match the finished cross-section of the repaired concrete to the cross-section of the adjacent undamaged concrete.

3.09 PATCHING OF HOLES IN CONCRETE

A. General

1. For the purposes of this Section, holes are defined as penetrations completely through the concrete member and with interior surfaces approximately perpendicular to the surface of the existing member.

2. Interior surface areas which are inclined and do not meet this criteria shall be chipped as needed to meet this requirement.

3. The perimeter of holes at the surface shall form a regular shape composed of curved or straight line segments.

4. Provide the minimum depth of placement for the material used; score the existing concrete by sawcutting, and chip as needed to meet this requirement.

5. Roughen the interior surface of holes less than 12 inches in diameter to a minimum of 0.125-inch amplitude and roughen larger holes to a minimum of 0.25-inch amplitude.

6. At holes, coat the existing surface to be repaired with a bonding agent.

B. Patching Small Holes: For holes which are less than 12 inches in their least dimension and extend completely through concrete members, fill with non-shrink grout.

C. Patching Large Holes

1. Fill holes which are larger than 12 inches in their least dimension with structural repair grout.

2. Provide large holes which are normally in contact with water or soil with hydrophilic waterstop placed in a groove.

3. Alternatively, bond the hydrophilic waterstop to the surface using an epoxy grout which completely fills all voids and irregularities beneath the waterstop material.

4. Install the waterstop in accordance with the requirements of Section 03 32 00 – Joints in Concrete.

5. Provide reinforcing steel in layers matching existing reinforcement location, size, spacing and cover requirements unless directed otherwise by the CONSTRUCTION MANAGER.

6. In locations where NSF/ANSI Standard 61 approval is required by the authority having jurisdiction, use one of the following procedures:

   a. Provide Product Data showing the proposed structural repair grout is NSF/ANSI Standard 61 approved.

   b. Complete the repair with structural repair grout. Coat all surfaces required to have NSF/ANSI Standard 61 approval completely with Structural Epoxy Paste Adhesive.

c. Place the structural repair grout to within 1 ½" of the finished surface of the repair. Complete the remainder of the repair with NSF/ANSI Standard 61 approved repair mortar.

3.10 PATCHING OF LINED HOLES

A. General

1. This WORK applies to those openings which have embedded material over all or a portion of their inside edge.

2. The requirements for repairing holes in concrete, as indicated above, apply as modified herein.

3. The CONSTRUCTION MANAGER will determine whether the embedded material is allowed to remain.

B. Where embedded material is allowed to remain, trim it back a minimum of 2 inches from the concrete surface.

C. Roughen or abrade the embedded material in order to promote good bonding to the repair material.

D. Remove substances that interfere with good bonding.

E. Completely remove embedded items that are not securely and permanently anchored into the concrete.

F. Completely remove embedded items which are larger than 12 inches in their least dimension, unless they are composed of a metal to which reinforcing steel can be welded; where reinforcement is required, weld it to the embedded metal.

G. The following requirements shall apply to concrete members which are in contact with water or soil:

1. Using epoxy grout, fill lined openings which are less than 4 inches in their least dimension;

2. Using an epoxy bonding agent, coat lined openings which are greater than 4 inches but less than 12 inches in their least dimension, prior to being filled with non-shrink grout.

3. Using an epoxy bonding agent, coat lined openings which are greater than 12 inches in their least dimension and provide a hydrophilic waterstop bonded to the interior of the opening with epoxy adhesive, prior to being filled with approved repair material.

3.11 APPLICATION OF PROTECTIVE COATINGS

A. Waterproofing

1. Apply waterproofing in accordance with the manufacturer's printed instructions.

2. Do not begin waterproofing WORK until repairs and new construction in the affected area have been completed and adequately cured.

B. Protective Coating shall be applied as indicated in Section 09 96 00.

3.12 EXPANSION JOINT REPAIR

A. Repair deteriorated expansion joints as follows:

1. Completely remove existing sealant;

2. Remove defective backer materials in the joint;

3. Sand-blast the joint and prepare the surface in accordance with the sealant manufacturer's instructions;

4. Prepare the wall surface on each side of the joint in accordance with the expansion joint manufacturer's instructions;

5. Ensure that the prepared surface is clean, sound, and bare concrete;

6. Place backer material in the joint;

7. Apply a primer recommended by the sealant manufacturer;

8. Fill the joint with polyurethane sealant;

9. Allow a minimum of 3 days curing prior to installing the expansion joint; and,

10. Install the expansion joint in accordance with the manufacturer's instructions.

END OF SECTION

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SECTION 03 21 00

REINFORCEMENT STEEL

PART 1 -- GENERAL

1.01 THE SUMMARY

A. Provide reinforcement steel and appurtenant WORK, complete and in place, in accordance with the Contract Documents.

1.02 RELATED SECTIONS

A. Section 03 31 00 Cast-in-Place Concrete

B. Section 03 32 00 Joints in Concrete

1.03 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with the requirements of Section 7 of Standard Provisions – Submittal Management.

B. Shop Drawings

1. Furnish shop bending diagrams, placing lists, and drawings of reinforcement steel prior to fabrication.

2. Diagrams

a. The shop bending diagrams shall show the actual lengths of bars to the nearest inch, measured to the intersection of the extensions (tangents for bars of circular cross section) of the outside surface.

b. Include bar placement diagrams that clearly indicate the dimensions of each bar splice.

3. Reinforcement

a. Details of the concrete reinforcement steel and concrete inserts shall be submitted at the earliest possible date after receipt by the CONTRACTOR of the Notice to Proceed.

b. Details of reinforcement steel for fabrication and erection shall conform to ACI 315R - Guide to Presenting Reinforcing Steel Design Details, and the indicated requirements.

c. Mill certificates, including reinforcing steel yield and tensile strength test data.

4. Mechanical Couplers

    a. Where mechanical couplers are required or permitted to be used to splice reinforcement steel, submit the following items:

        1) manufacturer's literature containing instructions and recommendations for installation for each type of coupler used;

        2) certified test reports that verify the load capacity of each type and size of coupler used; and

        3) Shop Drawings that show the location of each coupler with details of how they are to be installed in the formwork.

5. Welding

    a. If reinforcement steel is to be spliced by welding at any location, submit mill test reports containing the information necessary for determination of the carbon equivalent per AWS D1.4 - Structural Steel Welding Code - Reinforcing Steel.

    b. Submit a written welding procedure for each type of weld for each size of bar which is to be spliced by welding; merely a statement that AWS procedures will be followed is not acceptable.

    c. If reinforcement steel is spliced by welding at any location, submit certifications of procedure qualifications for each welding procedure and certification of welder qualifications, for each welding procedure and for each welder performing on the WORK.

1.04 QUALITY ASSURANCE

A. Materials Testing

1. If requested by the ENGINEER OF RECORD, furnish samples from each heat of reinforcement steel in a quantity adequate for testing.

2. Costs of initial tests will be paid by the OWNER.

3. Costs of additional tests if material fails initial tests shall be the CONTRACTOR’s responsibility.

B. Welding

1. Welder qualifications and procedure qualifications shall be as indicated in AWS D1.4.

2. If requested by the ENGINEER OF RECORD, furnish samples of each type of welded splice in a quantity and of dimensions adequate for testing.

3. At the discretion of the CONSTRUCTION MANAGER, radiographic testing of direct butt-welded splices will be performed.

4. Provide assistance necessary to facilitate testing.

5. Repair welds that fail to meet AWS D1.4.

6. The costs of testing will be paid by the OWNER, except that the costs of tests that show failure to meet requirements shall be the CONTRACTOR's responsibility.

PART 2 -- PRODUCTS

2.01 MATERIAL REQUIREMENTS

A. Materials that may remain or leave residues on or within the concrete shall be certified as compliant with NSF Standard 61- Drinking Water System Components.

2.02 REINFORCEMENT STEEL

A. Reinforcement steel for cast-in-place reinforced concrete construction shall conform to the following requirements:

1. Bar and Spiral Reinforcement

   a. Bar and spiral reinforcement shall conform to ASTM A 615 - Deformed and Plain Billet - Steel Bars, for Grade 60 reinforcement, unless otherwise indicated.

   b. Welded Reinforcement

      1) Bar and spiral reinforcement that is welded shall conform to ASTM A 706 - Low Alloy Steel Deformed and Plain Bars for Concrete Reinforcement, for Grade 60 reinforcement.

      2) The carbon equivalent in reinforcing that is welded shall not exceed 0.55 percent.

B. Accessories

1. Accessories shall include necessary chairs, slab bolsters, concrete blocks, tie wires, dips, supports, spacers, and other devices to position reinforcement during concrete placement.

2. Bar Supports

   a. Bar supports shall meet the requirements of the CRSI Manual of Standard Practice, including special requirements for supporting epoxy-coated reinforcing bars.

   b. Wire bar supports shall be CRSI Class 1 for maximum protection with a 1/8-inch minimum thickness of plastic coating that extends at least 1/2 inch from the concrete surface.

   c. Plastic shall be gray in color.

3. Concrete Blocks

   a. Concrete blocks (dobies) used to support and position reinforcement steel shall have the same or higher compressive strength as required for the concrete in which they are located.

   b. Wire ties shall be embedded in concrete block bar supports.

C. Epoxy coating for reinforcing and accessories, where indicated, shall conform to ASTM A 775 - Epoxy - Coated Reinforcing Steel Bars.

2.03 MECHANICAL COUPLERS

A. Mechanical couplers shall be provided where indicated and where approved by the ENGINEER OF RECORD.

B. The couplers shall develop a tensile strength and compressive strength that exceeds 125 percent of the specified yield strength of the reinforcement bars being spliced at each splice, and shall develop the specified tensile strength of the reinforcement bars being spliced at each splice.

C. Multi-Component Couplers

1. Where the type of coupler used is composed of more than one component, components required for a complete splice shall be provided.

2. This shall apply to mechanical splices, including those splices intended for future connections.

D. Connection

1. The reinforcement steel and coupler used shall be compatible for obtaining the required strength of the connection.

2. Straight threaded type couplers shall require the use of the next larger size reinforcing bar or shall be used with reinforcing bars with specially forged ends which provide upset threads which do not decrease the basic cross section of the bar.

E. Couplers shall be **Lenton Form Saver by Erico Products, Dowel Bar Splicer System by Dayton/Richmond,** or equal.

2.04 WELDED SPLICES

A. Welded splices shall be provided where indicated and where approved by the ENGINEER OF RECORD.

B. Welded splices of reinforcement steel shall develop a tensile strength that exceeds 125 percent of the specified yield strength of the reinforcement bars that are connected.

C. Materials as required to conform the welded splices to AWS D1.4 shall be provided.

2.05 EPOXY GROUT

A. Epoxy for grouting reinforcing bars shall be specifically formulated for such application, for the moisture condition, application temperature, and orientation of the hole to be filled.

B. Epoxy grout shall be in conformance with the requirements of Section 03 60 00 – Grouting.

PART 3 -- EXECUTION

3.01 GENERAL

A. Reinforcement steel, welded wire fabric, couplers, and other appurtenances shall be fabricated, and placed in accordance with the Building Code and the indicated supplementary requirements.

3.02 FABRICATION

A. General

1. Reinforcement steel shall be accurately formed to the dimensions and shapes indicated, and the fabricating details shall be prepared in accordance with ACI 315 **,** ACI 350 – Code Requirements for Environmental Engineering Concrete Structures, and ACI 318 - Building Code Requirements for Reinforced Concrete, except as modified by the Drawings.

2. Bars shall be bent cold.

3. Bars shall be bent in accordance with the requirements of ACI 318 and ACI 350.

4. Fabricate reinforcement bars for structures in accordance with accepted bending diagrams, placing lists, and placing drawings.

B. Fabricating Tolerances

1. Bars used for concrete reinforcement shall conform to the following fabricating tolerances:

   a. Sheared Length: plus and minus one inch

   b. Depth of Truss Bars: plus zero, minus 1/2 inch

   c. Stirrups, Ties and Spirals: plus and minus 1/2 inch

   d. Other Bends: plus and minus one inch

3.03 PLACEMENT

A. Reinforcement steel shall be accurately positioned as indicated, and shall be supported and wired together to prevent displacement using annealed iron wire ties or suitable clips at intersections.

B. Reinforcement steel shall be supported by concrete, plastic or metal support spacers, or metal hangers that are sufficiently strong and rigid to prevent any displacement of the reinforcement steel.

C. Where concrete is to be placed on the ground, supporting concrete blocks (or dobies) shall be used in sufficient numbers to support the bars without settlement, but in no case shall such support be continuous.

D. Concrete blocks used to support reinforcement steel shall be tied to the steel with wire ties that are embedded in the blocks.

E. For concrete over formwork, provide concrete, metal, plastic, or other acceptable bar chairs and spacers.

F. Limitations on the use of bar support materials shall be as follows.

1. Concrete Dobies

   a. permitted at any location except where architectural finish is required

   b. required for slabs on grade and surfaces in contact with or above ozonated process water

2. Wire bar supports will be permitted only at slabs over dry areas, interior dry wall surfaces, and exterior wall surfaces.

3. Plastic bar supports will be permitted at every location except on-grade.

G. Tie wires shall be bent away from the forms in order to provide the required concrete coverage.

H. Bars additional to those indicated that may be found necessary or desirable by the CONTRACTOR for the purpose of securing reinforcement in position shall be provided by the CONTRACTOR at no additional expense to the OWNER.

I. Except where in conflict with the Building Code, unless otherwise indicated reinforcement placing tolerances shall be within the placement limits indicated in ACI 318.

J. Moving Bars

1. Bars may be moved as necessary to avoid interference with other reinforcement steel, conduits, or embedded items.

2. If bars are moved more than one bar diameter or enough to exceed the above tolerances, the resulting arrangement of bars shall be as reviewed and accepted by the ENGINEER OF RECORD.

K. Welded Wire Reinforcement

1. Welded wire reinforcement placed over horizontal forms shall be supported on slab bolsters.

2. Slab bolsters shall be spaced not more than 30-inch on centers, shall extend continuously across the entire width of the reinforcement mat, and shall support the reinforcement mat in the plane indicated.

3. Welded wire reinforcement placed over the ground shall be supported on wired concrete blocks (dobies) spaced not more than 3 feet on centers in any direction.

4. The construction practice of placing welded wire fabric on the ground and hooking into place in the freshly placed concrete shall not be used.

L. Storage and Handling

1. Epoxy-coated reinforcing bars shall be stored, transported, and placed in such a manner as to avoid chipping of the epoxy coating.

2. Non-abrasive slings made of nylon and similar materials shall be used.

3. Specially coated bar supports shall be used.

4. Chips or cracks in the epoxy coating shall be repaired with a compatible epoxy repair material prior to placing concrete.

M. Accessory Spacing

1. Accessories supporting reinforcing bars shall be spaced such that there is no deflection of the accessory from the weight of the supported bars.

2. When used to space the reinforcing bars from wall forms, the forms and bars shall be located such that there is no deflection of the accessory when the forms are tightened into position.

3.04 SPACING OF BARS

A. The clear distance between parallel bars (except in columns and between multiple layers of bars in beams) shall be not less than the nominal diameter of the bars, nor less than 1-1/3 times the maximum size of the coarse aggregate, nor less than one inch.

B. Where reinforcement in beams or girders is placed in 2 or more layers, the clear distance between layers shall be not less than one inch.

C. In columns, the clear distance between longitudinal bars shall be not less than 1-1/2 times the bar diameter, nor less than 1-1/2 times the maximum size of the coarse aggregate, nor less than 1-1/2 inches.

D. The clear distance between bars shall also apply to the distance between a contact splice and adjacent splices or bars.

3.05 SPLICING

A. General

1. Reinforcement bar splices shall only be used at indicated locations.

2. When it is necessary to splice reinforcement at points other than where indicated, the character of the splice shall be as reviewed and accepted by the ENGINEER OF RECORD.

3. Unless otherwise indicated, dowels shall match the size and spacing of the spliced bar.

B. Splices of Reinforcement

1. The length of lap for reinforcement bars, unless otherwise indicated, shall be in accordance with ACI 318 for a Class B splice.

2. Welded Wire Reinforcement

a. Laps of welded wire reinforcement shall be in accordance with ACI 318.

b. Adjoining sheets shall be securely tied together with No. 14 tie wire, one tie for each 2 running feet.

c. Wires shall be staggered and tied in such a manner that they cannot slip.

3. Splices in column spiral reinforcement, when necessary, shall be made by welding or by a lap of 1-1/2 turns.

C. Bending or Straightening

1. Reinforcement shall not be straightened or re-bent in a manner which will injure the material.

2. Bars shall be bent or straight as indicated.

3. Do not use bends different from the bends indicated.

4. Bars shall be bent cold, unless otherwise permitted by the ENGINEER OF RECORD.

5. No bars partially embedded in concrete shall be field-bent except as indicated or specifically permitted by the ENGINEER OF RECORD.

D. Couplers

1. Couplers that are located at a joint face shall be of a type that can be set either flush or recessed from the face as indicated.

2. The couplers shall be sealed during concrete placement to completely eliminate concrete or cement paste from entering.

3. Couplers intended for future connections shall be recessed a minimum of 1/2 inch from the concrete surface.

4. After the concrete is placed, the coupler shall be plugged with plastic plugs which have an O-ring seal and the recess filled with sealant to prevent any contact with water or other corrosive materials.

5. Threaded couplers shall be plugged .

E. Unless indicated otherwise, mechanical coupler spacing and capacity shall match the spacing and capacity of the reinforcing indicated for the adjacent section.

3.06 CLEANING AND PROTECTION

A. Reinforcement steel shall always be protected from conditions conducive to corrosion until concrete has been placed around it.

B. The surfaces of reinforcement steel and other metalwork to be in contact with concrete shall be thoroughly cleaned of dirt, grease, loose scale and rust, grout, mortar, and other foreign substances immediately before the concrete is placed.

C. Where there is delay in depositing concrete, the reinforcement shall be re-inspected and, if necessary, re-cleaned.

3.07 EMBEDMENT OF DRILLED REINFORCING STEEL DOWELS

A. Hole Preparation

1. The hole diameter shall be as recommended by the adhesive manufacturer but shall be no larger than 1/4 inch greater than the diameter of the outer surface of the reinforcing bar deformations.

2. The depth of the hole shall be as recommended by the adhesive manufacturer to fully develop the bar but shall not be less than 12 bar diameters, unless indicated otherwise.

3. The hole shall be drilled by methods that do not interfere with the proper bonding of adhesive.

4. Existing reinforcing steel in the vicinity of proposed holes shall be located prior to drilling, and the location of holes shall be adjusted to avoid drilling through or nicking

any existing reinforcing bars. Final hole locations shall be as reviewed and accepted by the ENGINEER OF RECORD.

5. The hole shall be blown clean with clean, dry compressed air to remove dust and loose particles.

B. Embedment

1. Adhesive shall be injected into the hole through a tube placed to the bottom of the hole.

2. The tube shall be withdrawn as adhesive is placed but kept immersed to prevent formation of air pockets.

3. The hole shall be filled to a depth that insures excess material will be expelled from the hole during dowel placement.

4. Dowels shall be twisted during insertion into the partially filled hole so as to guarantee full wetting of the bar surface with adhesive.

5. The bar shall be inserted slowly enough to avoid developing air pockets.

END OF SECTION

SECTION 03 31 00

CAST-IN-PLACE CONCRETE

PART 1 -- GENERAL

1.01 THE SUMMARY

A. Provide cast-in-place concrete, as indicated in accordance with the Contract Documents.

B. The following types of concrete are covered in this Section:

1. Structural Concrete

a. Regular Mix: Use for roof, floor slabs, columns, walls, pavements, and other concrete items not indicated otherwise in the Contract Documents.

b. Thick Section Mix: For 12-inch and thicker walls, slabs on grade, pavements, and footings. This type of concrete may be used at the indicated locations at the CONTRACTOR's option if the ENGINEER OF RECORD agrees.

c. Congested Section Mix: Use where indicated or at the CONTRACTOR's option if approved by the ENGINEER OF RECORD.

d. Pea Gravel Mix: Required at the bottom 6 inches of walls with waterstops.

e. Sitework Concrete: Concrete to be used for curbs, gutters, catch basins, sidewalks, fence and guard post embedment, underground duct bank encasement, and other concrete appurtenant to electrical facilities, unless otherwise indicated.

f. Lean Concrete

1) Concrete to be used for thrust blocks, pipe trench cut-off blocks, and cradles that are indicated as unreinforced

2) Lean concrete shall be used as protective cover for dowels intended for future connections.

C. The term "hydraulic structure" shall mean environmental engineering concrete structures for the containment, treatment, or transmission of water, wastewater, sludge, slurry, other fluids, or gases.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. References

ACI 318-14	Buidling Code Requirements for Structural Concrete and Commentary
ACI 117-14	Standard Tolerance for Concrete Construction and Materials.

ACI 350-06	Code Requirements for Environmental Engineering Concrete Structures
ACI 350.3-06	Seismic Design of Liquid-Containing Concrete Structures and Commentary

NSF 61 – NSF/ANSI 61-2016 Drinking Water System Components – Health Effects

1.03 RELATED SECTIONS

Section 03 01 30	Concrete Repair and Rehabilitation
Section 03 21 00	Reinforcement Steel
Section 03 32 00	Joints in Concrete
Section 03 60 00	Grouting
Section 05 05 19	Post-Installed Anchors in Concrete

1.04 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 7 of Standard Provisions – Submittal Management.

B. Mix Designs

1. Prior to beginning the WORK and within 14 Days of the Notice to Proceed, submit preliminary concrete mix designs which shall show the proportions and gradations of materials proposed for each class and type of concrete.

2. Mix designs shall be checked through trial batch and laboratory testing by an independent testing laboratory acceptable to the ENGINEER OF RECORD.

3. Costs related to trial batch and related laboratory testing shall be CONTRACTOR's responsibility as part of the WORK.

4. Since laboratory trial batches require 35 calendar days to complete, the CONTRACTOR shall test a minimum of 2 mix designs for each class of concrete.

C. Delivery Tickets

1. Where ready-mix concrete is used, the CONTRACTOR shall furnish delivery tickets at the time of delivery of each load of concrete.

2. Each ticket shall show the state-certified equipment used for measuring and the total quantities, by weight, of cement, sand, each class of aggregate, admixtures, the amount of water in the aggregate added at the batching plant, and the amount allowed to be added at the Site for the specific design mix.

3. In addition, each ticket shall state the mix number, total yield in cubic yards, and the time of day, to the nearest minute, corresponding to the times when the batch was dispatched, when it left the plant, when it arrived at the Site, when unloading began, and when unloading was finished.

D. Test Data: Test data relating to the cement, aggregate, and admixtures shall be less than 6 months old.

E. Furnish the following submittals in accordance with ACI 301 – Structural Concrete:

1. mill tests for cement

2. admixture certification, including chloride ion content

3. aggregate gradation test results and certification

4. materials and methods for curing

1.05 CONCRETE CONFERENCE

A. The CONSTRUCTION MANAGER will chair a meeting to review the detailed requirements of the CONTRACTOR's proposed concrete design mixes and to determine the procedures for producing proper concrete construction no later than 14 Days after the Notice to Proceed.

B. Parties involved in the concrete WORK shall attend the conference, including the following at a minimum:

1. CONTRACTOR's representative

2. testing laboratory representative

3. concrete subcontractor

4. reinforcing steel subcontractor and detailer

5. concrete supplier

6. admixture manufacturer's representative

C. The conference shall be held at a time and place proposed by the CONTRACTOR and accepted by the ENGINEER OF RECORD.

D. The conference shall be held at least 5 Days after acceptance.

1.06 QUALITY ASSURANCE

A. General

1. Tests on component materials and for compressive strength and shrinkage of concrete shall be performed as indicated.

2. Tests for determining slump shall be in accordance with ASTM C 143 – Test Method for Slump of Hydraulic Cement Concrete.

3. Testing for aggregate shall include sand equivalence, reactivity, organic impurities, abrasion resistance, and soundness, according to ASTM C 33 – Concrete Aggregates.

4. The cost of trial batch laboratory tests on cement, aggregates, and concrete shall be the OWNER's responsibility.

5. The cost of laboratory tests on field-placed cement, aggregates, and concrete and the cost of Special Inspections required by Code will be the OWNER'S responsibility.

6. The CONTRACTOR shall be responsible for the cost of any tests and investigations of WORK that is determined to be Defective WORK.

7. The testing laboratory shall meet or exceed ASTM C 1077 – Practice for Laboratories Testing Concrete and Concrete Aggregates for use in Construction and Criteria for Laboratory Evaluation.

8. Concrete for testing shall be furnished by the CONTRACTOR, and the CONTRACTOR shall assist the CONSTRUCTION MANAGER in obtaining samples and disposal and cleanup of excess material.

B. Inspections

1. Continuous inspection by a special inspector approved by the local building department having jurisdiction and by the ENGINEER OF RECORD will be required where necessary to conform with Code requirements.

2. Costs of the special inspector shall be paid by the OWNER.

3. Inspection reports shall be submitted to the CONSTRUCTION MANAGER.

4. The special inspector shall observe the following for conformance to the Contract Documents:

   a. the preparation and taking of required test specimens; and,

   b. placement of concrete, except sitework concrete fully supported on earth.

C. Field Compression Tests

1. Compression test specimens shall be taken during construction from the first placement of each type of concrete and at intervals thereafter as selected by the CONSTRUCTION MANAGER to insure continued compliance with the Specifications.

2. Compression test specimens for concrete shall be made in accordance with Section 9.2 of ASTM C 31 – Practices for Making and Curing Concrete Test Specimens in the Field.

3. Specimens shall be 6-inches diameter by 12-inches tall cylinders.

4. Compression tests shall be performed in accordance with ASTM C 39 – Test Method for Compressive Strength of Cylindrical Concrete Specimens.

5. Each set of specimens shall include 5 cylinders.

   a. One test cylinder shall be tested at 7 Days, and 2 test cylinders tested at 28 Days.

   b. The remaining two cylinders shall be held to verify test results, if needed.

6. At the CONTRACTOR'S option, additional cylinders may be taken for testing at different ages. All costs associated with the additional cylinders and testing shall be paid by the CONTRACTOR.

D. Evaluation and Acceptance of Concrete

1. Evaluation and acceptance of the compressive strength of concrete shall be in accordance with ACI 318 – Building Code Requirements for Structural Concrete, ACI 301 – Specifications for Structural Concrete, and as indicated.

2. A statistical analysis of compression test results shall be performed according to ACI 214 – Recommended Practice for Evaluation of Strength Test Methods.

3. The standard deviation of the test results shall not exceed 640 psi, when ordered at equivalent water content as estimated by slump.

4. If any concrete fails to meet these requirements, immediate corrective action shall be taken to increase the compressive strength for subsequent batches of the type of concrete affected.

5. When the standard deviation of the test results exceeds 640 psi, the average strength for which the mix is designed shall be increased by an amount necessary to satisfy the statistical requirement that the probability of any test being more than 500 psi below or the average of any 3 consecutive tests being below the required compressive strength is 1 in 100.

6. The required average strength shall be calculated by Criterion No. 3 of ACI 214 using the actual standard deviation.

7. Concrete that fails to meet the ACI requirements and the indicated requirements is subject to removal and replacement.

E. Shrinkage Tests

1. Drying shrinkage tests shall be performed for the trial batches indicated in the Article below entitled "Trial Batch and Laboratory Tests," for the first placement of each class of structural concrete except pea gravel mix, and during placement to determine continued compliance.

2. Neither structural pea gravel nor structural C-R pea gravel mix need to be tested for shrinkage.

3. Drying shrinkage specimens shall be 4-inch by 4-inch by 11-inch prisms with an effective gauge length of 10-inches, and fabricated, cured, dried, and measured in accordance with ASTM C 157 – Test Method for Length Change of Hardened Hydraulic Cement Mortar and Concrete, modified as follows:

    a. Specimens shall be removed from molds at an age of 23 hours, plus or minus one hour, after trial batching, and shall be placed immediately in water at 70 degrees F, plus or minus 3 degrees F, for at least 30 minutes.

    b. Specimens shall be measured within 30 minutes thereafter to determine original length and then shall be submerged in saturated lime water at 73 degrees F, plus or minus 3 degrees F.

    c. Measurement to determine expansion expressed as a percentage of original length shall be made at age 7 Days.

    d. This length at age 7 Days shall be the base length for drying shrinkage calculations ("0" days drying age).

    e. Specimens then shall be stored immediately in a humidity control room maintained at 73 degrees F, plus or minus 3 degrees F, and 50 percent relative humidity, plus or minus 4 percent, for the remainder of the test.

    f. Measurements to determine shrinkage, expressed as percentage of base length, shall be performed and reported separately for 7, 14, 21, and 28 Days of drying after 7 Days of moist curing.

4. The drying shrinkage deformation of each specimen shall be computed as the difference between the base length (at "0" days drying age) and the length after drying at each test age.

5. The average drying shrinkage deformation of the specimens shall be computed to the nearest 0.0001 inch at each test age.

6. If the drying shrinkage of any specimen departs from the average of that test age by more than 0.0004 inch, the results obtained from that specimen shall be disregarded.

7. Results of the shrinkage test shall be reported to the nearest 0.001 percent of shrinkage.

8. Compression test specimens shall be taken in each case from the same concrete used for preparing drying shrinkage specimens.

9. These tests shall be considered a part of the normal compression tests for the project.

10. Allowable shrinkage limitations are indicated in PART 2 - PRODUCTS, below.

F. Aggregate Testing: Aggregate testing shall be performed for the trial batch in the Article below entitled “Trial Batch and Laboratory Tests” prior to construction and every 12 months during construction to determine continued compliance.

G. Construction Tolerances

1. The CONTRACTOR shall set and maintain concrete forms and perform finishing operations to ensure that the completed WORK is within tolerances.

2. Surface defects and irregularities are defined as finishes and are different from tolerances.

3. Tolerance is the permissible variation from lines, grades, or dimensions indicated on the Drawings.

4. Where tolerances are not indicated, permissible deviations shall be in accordance with ACI 117 – Standard Tolerance for Concrete Construction and Materials.

5. The following non-cumulative construction tolerances apply to finished walls, columns and slabs unless otherwise indicated:

ITEM	TOLERANCE
Variation of the constructed linear outline from the established position in plan.	in 10 feet: 1/4 inch in 20 feet or more: 1/2 inch
Variation from the level or from the grades indicated.	in 10 feet: 1/4 inch in 20 feet or more: 1/2 inch
Variation from plumb	in 10 feet: 1/4 inch in 20 feet or more: 1/2 inch
Variation in the thickness of slabs and walls.	minus 1/4 inch plus 1/2 inch
Variation in the locations and sizes of slabs and wall openings	plus or minus 1/4 inch

PART 2 -- PRODUCTS

2.01 CONCRETE MATERIALS

A. General

1. Concrete materials in contact with potable water shall be classified as acceptable for potable water use in accordance with NSF/ANSI Standard 61 as required by the

authority having jurisdiction. Not all products listed herein are for use in contact with potable water.

2. Cement for concrete that will contact potable water shall not be obtained from kilns that burn metal rich hazardous waste fuel.

3. Materials shall be delivered, stored, and handled so as to prevent damage by water or breakage.

4. Cement reclaimed from cleaning bags or leaking containers shall not be used.

5. Cement shall be used in the sequence of receipt of shipments.

B. Materials and storage of materials shall comply with ACI 301, as applicable.

C. Materials for concrete shall conform to the following requirements:

1. Cement

a. Cement shall be standard brand Portland cement conforming to ASTM C 150 – Portland Cement, for Type II or Type V**,** including Table 2 optional requirements.

b. A minimum of 85 percent of cement by weight shall pass a 325 screen.

c. A single brand of cement shall be used throughout the WORK, and prior to its use, the brand shall be accepted by the ENGINEER OF RECORD.

d. The cement shall be suitably protected from exposure to moisture until used.

e. Cement that has become lumpy shall not be used.

f. Sacked cement shall be stored in such a manner so as to permit access for inspection and sampling.

g. Certified mill test reports, including fineness, for each shipment of cement to be used shall be submitted to the CONSTRUCTION MANAGER, if requested, regarding compliance with the Specifications.

2. Water

a. Water for mixing and curing shall be potable, clean, and free from objectionable quantities of silty organic matter, alkali, salts, and other impurities.

b. The water shall be considered potable, for the purposes of this Section only, if it meets the requirements of the local governmental agencies.

c. Agricultural water with high total dissolved solids (greater than 1000 mg/L TDS) shall not be used.

3. Aggregates

   a. Aggregates shall be obtained from pits acceptable to the ENGINEER OF RECORD, shall be non-reactive, and shall conform to ASTM C 33 – Concrete Aggregates.

   b. The maximum size of coarse aggregate shall be as indicated, and the substitution of lightweight sand for fine aggregate will not be permitted.

   c. Coarse Aggregates

      1) Coarse aggregates shall consist of clean, hard, durable gravel, crushed gravel, crushed rock, or a combination thereof.

      2) The coarse aggregates shall be prepared and handled in 2 or more size groups for combined aggregates, with a maximum size greater than 3/4 inch.

      3) When the aggregates are proportioned for each batch of concrete, the 2 size groups shall be combined (also refer to the Article below entitled "Trial Batch and Laboratory Tests").

   d. Fine Aggregates

      1) Fine aggregates shall be natural sand or a combination of natural and manufactured sand that is hard and durable.

      2) When tested in accordance with ASTM D 2419 – Test Methods for Sand Equivalent Value of Soils and Fine Aggregate, the sand equivalency shall not be less than 75 percent for an average of 3 samples, nor less than 70 percent for an individual test.

      3) The gradation of fine aggregate shall conform to ASTM C 33 when tested in accordance with ASTM C 136 for the fineness modulus of the sand used, including the optional grading in Section 6.2.

      4) The fineness modulus of sand used shall not be greater than 3.1.

      5) When tested in accordance with ASTM C 33, the fine aggregate shall produce a color in the supernatant liquid no darker than the reference standard color solution.

   e. Combined Aggregates

      1) Combined aggregates shall be well graded from coarse to fine sizes and shall be uniformly graded between screen sizes to produce concrete that has optimum workability and consolidation characteristics.

      2) Where a trial batch is required for a mix design, the final combined aggregate gradations will be established during the trial batch process.

3) When tested in accordance with ASTM C 33, the coarse aggregate shall show a loss not exceeding 42 percent after 500 revolutions or 10.5 percent after 100 revolutions.

f. When tested in accordance with ASTM C 33, the ratio of silica released to reduction in alkalinity shall not exceed 1.0.

g. When tested in accordance with ASTM C 33, the loss resulting after 5 cycles of the soundness test shall not exceed 10 percent for fine aggregate and 12 percent for coarse aggregate when using sodium sulfate.

4. Ready-mixed concrete shall conform to the requirements of ASTM C 94 – Ready Mixed Concrete.

5. Admixtures

a. Admixtures shall be compatible and shall be furnished by a single manufacturer capable of providing qualified field service representation.

b. Admixtures shall be used in accordance with manufacturer's recommendations.

c. If the use of an admixture is producing an inferior end result, the CONTRACTOR shall discontinue use of the admixture.

d. Admixtures shall not contain thiocyanates nor more than 0.05 percent chloride ion, and shall be non-toxic after 30 days.

e. Air Content

1) An air-entraining agent meeting the requirements of ASTM C 260 – Air Entraining Admixtures for Concrete shall be used.

2) Concrete floors to receive a dry-shake floor hardener shall have an air content not to exceed 3 percent.

3) The OWNER reserves the right, at any time, to sample and test the air-entraining agent.

4) The air-entraining agent shall be added to the batch in a portion of the mixing water.

5) The solution shall be batched by means of a mechanical batcher capable of accurate measurement.

6) Air content shall be tested at the point of placement.

7) The air entraining agent shall be Micro-Air by Master Builders; Daravair by W.R. Grace; Sika AEA-15 by Sika Corporation; or equal

f. Set-Controlling and Water-Reducing Admixtures

1) Admixtures may be added at the CONTRACTOR's option, subject to the ENGINEER OF RECORD's approval, to control the set, effect water reduction, and increase workability.

2) The cost of adding an admixture shall be the CONTRACTOR's responsibility.

3) Concrete containing an admixture shall be first placed at a location determined by the CONSTRUCTION MANAGER.

4) Admixtures shall conform to ASTM C 494 – Chemical Admixtures for Concrete.

5) The required quantity of cement shall be used in the mix regardless of whether or not an admixture is used.

6) Concrete shall not contain more than one water-reducing admixture, unless it can be demonstrated that the proposed mix will meet the indicated drying shrinkage requirements.

7) The set-controlling admixture may be either with or without water-reducing properties.

8) Where the air temperature at the time of placement is expected to be consistently greater than 80 degrees F, a set-retarding admixture such as **Plastocrete 161MR by Sika Corporation, Pozzolith, Delvo by BASF, Daratard by GCP Applied Technologies,** or equal shall be used.

9) Where the air temperature at the time of placement is expected to be consistently less than 40 degrees F, a non-corrosive set accelerating admixture such as **Plastocrete 161FL by Sika Corporation, MasterSet FP 20 by BASF, Daraset by GCP Applied Technologies,** or equal shall be used.

10) Mid-Range Water Reducers

    a) General use water-reducing admixtures shall be mid-range and shall conform to ASTM C 494, Type A and F.

    b) Use **Daracem by GCP Applied Technologies, Polyheed by BASF, Sikament by Sika Corporation,** or equal.

    c) The quantity of admixture used and the method of mixing shall be in accordance with the manufacturer's instructions and recommendations.

11) High-Range Water Reducers

    a) High-range water reducers shall conform to ASTM C 494, Type F or G.

b) Use **ADVA by GCP Applied Technologies, ViscoCrete by Sika Corporation, Glenium by BASF,** or equal.

c) The high-range water reducer shall be added to the concrete after all other ingredients have been mixed and initial slump has been verified.

d) No more than 14 ounces of water reducer per sack of cement shall be used.

e) The water reducer shall be considered as part of the mixing water when calculating the water/cement ratio.

f) If the high-range water reducer is added to the concrete at the Site, it may be used in conjunction with the same water reducer added at the batch plant.

g) Concrete shall have a slump of 3 inches, plus or minus 1/2 inch, prior to adding the high-range water reducing admixture at the Site.

h) The high-range water reducing admixture shall be accurately measured and pressure injected into the mixer as a single dose by an experienced technician.

i) A standby system shall be provided and tested prior to each day's operation of the primary system.

j) Concrete shall be mixed at mixing speed for a minimum of 70 mixer revolutions or 5 minutes after the addition of the high-range water reducer, unless recommended otherwise by the manufacturer.

g. Other Admixtures

1) Flyash

a) Flyash shall not be used for concrete sections in hydraulic structures.

b) For other concrete, fly ash may be substituted for not more than 15 percent, by weight, of cement in structural concrete and not more than 30 percent, by weight, for sitework concrete, and not more than 50 percent, by weight, of cement in other concrete.

c) Fly ash shall conform to ASTM C618 and shall not have loss-on-ignition greater than 3 percent.

d) The water/cement ratio shall be calculated based on cement plus fly ash.

2) Ground Blast Furnace Slag Cement

a) Slag cement shall not be used for concrete sections in hydraulic structures.

b) Slag cement shall conform to ASTM C989 – Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars, Grade 100 or 120.

c) Blended cements shall conform to ASTM C595 – Blended Hydraulic Cements, Type 1S, or ASTM C1157 – Performance Specification for Hydraulic Cement.

d) Slag cement substitution, if used, shall be not less than 25, nor more than 50 percent by weight of cement.

e) Slag cement substitution shall not be used with fly ash substitution.

f) The water/cement ratio shall be calculated based on cement plus slag cement.

h. Corrosion Inhibitor

1) The corrosion inhibitor shall be DCIS by GCP Applied Technologies, or equal.

2) Mixing water shall be adjusted for the admixture in accordance with the manufacturer's recommendations.

2.02 CURING MATERIALS

A. General: Curing compounds shall be resin-based and shall be compliant with local VOC requirements, unless otherwise indicated herein.

B. Regular Curing Compound

1. Regular curing compound shall be white-pigmented and shall conform to ASTM C 309 - Liquid Membrane-Forming Compounds for Curing Concrete, Type 2, Class B.

2. Sodium silicate compounds will not be accepted.

3. The concrete curing compound shall be:

a. Kurez VOX White Pigmented by Euclid Chemicals Company;

b. L&M Cure R-2 by Laticrete;

c. 1200-White by W.R. Meadows;

d. Kure-N-Seal WB White Pigmented by Sonneborn/Degussa Building Systems;

e. or equal.

C. Dissipating Curing Compound

1. When the curing compound must be removed for finishes or grouting, compounds shall be of a dissipating type, conforming to ASTM C 309, Type 1 or 2, Class B.

2. The dissipating curing compound shall be:

    a. Korez DR VOX by Euclid Chemical Company;

    b. L&M Cure R-2 by Laticrete;

    c. 1100-Clear by W.R. Meadows;

    d. or equal.

D. Curing Compound for Applications Requiring NSF/ANSI Standard 61 Compliance

1. When the curing compound is required to conform to NSF/ANSI Standard 61, the curing compound shall be water-based and shall be compliant with all local VOC requirements; shall conform to ASTM C 309; and shall be certified to conform to the requirements of NSF/ANSI Standard 61.

2. The NSF/ANSI Standard 61 Certified curing compound shall be:

    a. E-Cure by SpecChem, LLC;

    b. Atlas Quantum-Cure NSF by Atlas Tech Products;

    c. or equal.

E. Concrete Curing Blanket

1. Polyethylene Sheets

    a. Polyethylene sheets for use as concrete curing blanket shall be white and shall have a nominal thickness of 6 mils.

    b. The loss of moisture when determined in accordance with ASTM C 156 – Test Method for Water Retention by Concrete Curing Materials, shall not exceed 0.055 grams per square centimeter of surface.

2. Polyethylene-Coated Waterproof Paper

    a. Polyethylene-coated waterproof paper sheeting for use as concrete curing blanket shall consist of white polyethylene sheeting free of visible defects, uniform in appearance, shall have a nominal thickness of 2-mils, and shall be permanently bonded to waterproof paper conforming to the requirements of Federal Specification UU-B-790A – Building Paper, Vegetable Fiber (Kraft, Waterproofed, Water Repellant and Fire Resistant).

b. The loss of moisture, when determined in accordance with ASTM C 156, shall not exceed 0.055 gram per square centimeter of surface.

3. Polyethylene-Coated Burlap

a. Polyethylene-coated burlap for use as concrete curing blanket shall be 4 mils thick, with white opaque polyethylene film impregnated or extruded into one side of the burlap.

b. The burlap shall weigh not less than 9 ounces per square yard.

c. The loss of moisture, when determined in accordance with ASTM C 156, shall not exceed 0.055 grams per square centimeter of surface.

F. Curing Mats

1. Curing mats for use in Curing Method 6, below, shall be heavy shag rugs or carpets or cotton mats quilted at 4 inches on center.

2. Curing mats shall weigh a minimum of 12 ounces per square yard when dry.

G. Evaporation Retardant

1. An evaporation retardant shall be used.

2. The evaporation retardant shall be:

a. MasterKure ER 50 by BASF/Master Builders;

b. Eucobar by Euclid Chemical Company;

c. L&M E-CON by Laticrete.;

d. or equal.

2.03 NON-WATERSTOP JOINT MATERIALS

A. Materials for non-waterstop joints in concrete shall conform to the following requirements:

1. The preformed joint filler shall be a non-extruding neoprene sponge or polyurethane type conforming to Section 03 32 00 – Joints in Concrete.

2. The elastomeric joint sealer shall conform to Section 07 92 00 – Joint Sealants

3. Mastic Joint Sealer

a. The mastic joint sealer shall be a material:

1) that does not contain evaporating solvents;

2) that will tenaciously adhere to concrete surfaces;

3) that will remain permanently resilient and pliable;

4) that will not be affected by the continuous presence of water;

5) that will not in any way contaminate potable water;

6) and that will effectively seal the joints against moisture infiltration even when the joints are subject to movement from expansion and contraction.

b. The sealer shall be composed of special asphalts or similar materials blended with lubricating and plasticizing agents to form a tough, durable mastic substance containing no volatile oils or lubricants.

c. The sealer shall be capable of meeting the indicated test requirements, if testing is required by the ENGINEER OF RECORD.

2.04 MISCELLANEOUS MATERIALS

A. Damproofing Agent

1. The damproofing agent shall be an asbestos-free, fibered asphalt emulsion intended for cold application to green concrete, both above- and below-grade.

2. Damproofing shall meet the requirements of ASTM D 1227 – Emulsified Asphalt Used as a Protective Coating for Roofing, Type II, Class I.

3. Dampproofing shall be:

a. Hydrocide 700 Series by Sonneborn/Degussa Building Systems;

b. Sealmastic by W. R. Meadows;

c. HE 789 by Henry Company;

d. or equal.

B. Bonding Agents

1. Bonding agents shall be epoxy adhesives.

2. Bonding agents for bonding freshly-mixed, plastic concrete to hardened concrete shall be:

a. Sikadur 32 Hi-Mod Epoxy Adhesive by Sika Corporation;

b. MasterEmaco ADH 326 by BASF/Master Builders;

c. BurkEpoxy MV by Edoco;

d. or equal.

3. Bonding agents for bonding hardened concrete or masonry to steel shall be:

a. Sikadur 31 Hi-Mod Gel by Sika Corporation;

b. BurkEpoxy NS by Edoco;

c. Concresive Paste (LPL) by MBT/Degussa Building Systems;

d. or equal.

C. Vapor Retarder

1. The vapor retarder shall be a plastic sheet meeting the Class A permeance and strength requirementsof ASTM E 1745 – Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs. The minimum thickness shall be 10 mils.

2. The vapor retarder shall be **Griffolyn Type-65 G** by **Reef Industries, Inc.**, or equal.

D. Colorant for duct bank concrete shall be an integral red oxide coloring pigment used in the proportion of 8 pounds per cubic yard of concrete.

2.05 CONCRETE DESIGN REQUIREMENTS

A. General

1. Concrete shall be composed of cement, admixtures, aggregates, and water of the qualities indicated.

2. The exact proportions in which these materials are to be used for different parts of the WORK shall be determined during the trial batches.

3. In general, the mix shall be designed to produce a concrete capable of being deposited to obtain maximum density and minimum shrinkage, and, where deposited in forms, to have good consolidation properties and maximum smoothness of surface.

4. The aggregate gradations shall be formulated to provide fresh concrete that will not promote rock pockets around reinforcing steel or embedded items.

5. The proportions shall be changed whenever necessary or desirable to meet the required results, and such changes shall be subject to review by the ENGINEER OF RECORD.

B. Fine Aggregate Composition

1. In mix designs for structural concrete, except for 1/2-inch and 3/8-inch maximum size aggregate, the percentage of fine aggregate in total aggregate by weight shall be as indicated in the following table:

FINE AGGREGATE	
Fineness Modulus	Percent (maximum)
2.7 or less	41
2.7 to 2.8	42
2.8 to 2.9	43
2.9 to 3.1	44

2. For other concrete, the maximum percentage of fine aggregate of total aggregate by weight shall not exceed 50 percent.

C. Duct Bank Concrete

1. Duct bank concrete shall contain an integral red-oxide coloring pigment.

2. The concrete shall be dyed red throughout.

3. Using a surface treatment to color duct banks will not be accepted.

D. Water/Cement Ratio

1. The indicated water/cement ratio is for a saturated-surface dry condition of aggregate.

2. Throughout every Day, the added batch water shall be adjusted for the total free water in the aggregates, which shall be determined as follows:

   a. The total moisture content of all aggregate shall be calculated by ASTM C 566 – Test Method for Total Moisture Content of Aggregate by Drying.

   b. Subtract the moisture absorbed by the coarse aggregate, calculated by ASTM C 127 – Standard Test Method for Density, Relative Density (Specific Gravity) and Absorption of Coarse Aggregate.

   c. Subtract the moisture absorbed by the fine aggregate, calculated by ASTM C 128 – Standard Test Method for Density, Relative Density (Specific Gravity) and Absorption of Fine Aggregate.

E. Concrete Property Tables

1. The maximum cement contents (determined from the maximum W/C Ratios and maximum Water Contents given in the Concrete Property Tables below) are intended to minimize drying shrinkage and heat of hydration of the concrete.

2. It is understood that the indicated maximum cement contents may require additional water reducing agent for the workability required by the CONTRACTOR'S methods, and may not result in the least costly concrete mix for the required concrete strength.

3. If the CONTRACTOR wishes to increase the maximum cement content for any mix, the CONTRACTOR must notify the CONSTRUCTION MANAGER in writing and submit the request within 30 days of the Notice to Proceed.

4. Increases in cement content shall be at the CONTRACTOR'S expense.

STRUCTURAL CONCRETE				
Type of WORK	Regular Mix (roof, floor slabs, walls, pavements, and other concrete items not categorized elsewhere)	Thick Section Mix (12-inch and thicker walls, slabs on grade, pavements, and footings)	Congested Section Mix (Use where indicated or at the CONTRACTOR's option and approved by the ENGINEER OF RECORD)	Pea Gravel Mix (concrete at the bottom 6 inches of waterstopped walls) At the CONTRACTOR's option, superplastic Regular Mix may be substituted for the first lift
Min 28 Day Compressive Strength, psi	4000	4000	5000	5000
Max Aggregate Size, in	1	1-1/2	1/2	3/8
Cement Content per cubic yard, lb, minimum	564	564	600	752
Water content per cubic yard, lb, maximum	254	254	240	301
Max W/C Ratio by weight	0.45	0.45	0.40	0.40
Total Air Content, percent	3 to 6	3 to 6	3 to 6	4.5 to 7.5
Slump	4 inches +/- 1 in with high-range water reducer: 7 inches +/- 2 in	4 inches +/- 1 in with high-range water reducer: 7 inches +/- 2 in	with high-range water reducer: 7 inches +/- 2 in	with high-range water reducer: 7 inches +/- 2 in

OTHER CONCRETE		
Type of WORK	Sitework Concrete (curbs, gutters, sidewalks, catch basins, fence embedments, encasements, and ductbanks)	Lean Concrete (thrust blocks, pipe trench cut-off blocks, and cradles)
Min 28 Day Compressive Strength, psi	3000	2000
Max Aggregate Size, in	1	1
Cement Content per cubic yard, lb, minimum	470	376
Water content per cubic yard, lb, maximum	254	270
Max W/C Ratio by weight	[0.50 normal] [0.45 frost or sulfates]	0.60
Total Air Content, percent	3 to 6	3 to 6
Slump	4 inches +/- 1 in ductbanks and encasements: 5 inches +/- 1 in	4 inches +/- 1 in

NOTE: The CONTRACTOR is cautioned that the limiting parameters above are not a mix design. Admixtures may be required to achieve workability required by the CONTRACTOR's construction methods and aggregates. The CONTRACTOR shall be responsible for providing concrete with the required workability and strength.

F. Adjustments to Mix Design

1. The CONTRACTOR may elect to decrease the water/cement ratio to achieve the strength and shrinkage requirements and/or add water reducers, as required to achieve workability.

2. The mixes shall be changed whenever such change is necessary or desirable to secure the required strength, density, workability, and surface finish, and the CONTRACTOR shall be entitled to no additional compensation because of such changes.

3. Any changes to the accepted concrete mix design shall be submitted to the ENGINEER OF RECORD for review and shall be tested again in accordance with the indicated requirements.

2.06 CONSISTENCY

A. The quantity of water in a batch of concrete shall be just sufficient, with a normal mixing period, to produce a concrete that can be worked properly into place without segregation and which can be compacted by vibratory methods to give the desired density, impermeability, and smoothness of surface.

B. The quantity of water shall be changed as necessary, with variations in the nature or moisture content of the aggregates, in order to maintain uniform production of a desired consistency.

C. The consistency of the concrete in successive batches shall be determined by slump tests in accordance with ASTM C 143 – Test Method for Slump of Hydraulic Cement Concrete.

D. The slumps shall be as indicated with the concrete properties.

2.07 TRIAL BATCH AND LABORATORY TESTS

A. The CONTRACTOR shall only use a mix design for construction that has first met the trial batch testing requirements.

B. Before placing any concrete, a testing laboratory selected by the CONSTRUCTION MANAGER shall prepare a trial batch of each class of structural concrete, based on the preliminary concrete mixes submitted by the CONTRACTOR.

C. Aggregate Proportions

1. During the trial batch the aggregate proportions may be adjusted by the testing laboratory using the two coarse aggregate size ranges to obtain the required properties.

2. If one size range produces an acceptable mix, a second size range need not be used.

3. Such adjustments will be considered refinements to the mix design and will not be the basis for extra compensation to the CONTRACTOR.

4. Concrete shall conform to the indicated requirements whether the aggregate proportions are from the CONTRACTOR's preliminary mix design or whether the proportions have been adjusted during the trial batch process.

5. The trial batch shall be prepared using the aggregates, cement, and admixture proposed for the project.

D. The trial batch materials shall be of a quantity such that the testing laboratory can obtain 3 drying shrinkage and 6 compression test specimens from each batch.

E. The determination of compressive strength shall be made by testing 6-inch diameter by 12-inch high cylinders, which have been made, cured, and tested in accordance with ASTM C 192 – Practice for Making and Curing Concrete Test Specimens in the Laboratory, and ASTM C 39.

F. The testing schedule shall be 3 compression test cylinders tested at 7 Days and 3 at 28 Days.

G. The average compressive strength for the 3 cylinders tested at 28 Days for any given trial batch shall be not less than the required average compressive strength indicated below:

Specified compressive strength f'c (psi)	Required average compressive strength f'cr (psi)
Less than 3000	f'c + 1000
3000 to 5000	f'c + 1200
Over 5000	1.1f'c + 700

H. A sieve analysis of the combined aggregate for each trial batch shall be performed according to the requirements of ASTM C 136 – Method for Sieve Analysis of Fine and Coarse Aggregates, and values shall be provided for percent passing each sieve.

2.08 SHRINKAGE LIMITATION

A. General

1. The CONTRACTOR shall only use a mix design for construction that has first met the trial batch shrinkage requirements.

2. Shrinkage limitations shall apply only to structural concrete.

B. Maximum Shrinkage

1. The maximum concrete shrinkage for specimens cast in the laboratory from the trial batch, as measured at 21-Day drying age or at 28-Day drying age, shall be 0.036 percent or 0.042 percent, respectively.

2. Standard deviation will not be considered.

3. The maximum concrete shrinkage for specimens cast in the field shall not exceed the trial batch maximum shrinkage requirement by more than 25 percent.

C. If the required shrinkage limitation is not met during construction, the CONTRACTOR shall take any or all of the following actions to reestablish compliance:

1. changing the source of aggregates, cement and/or admixtures;

2. reducing water/cement ratio;

3. washing of coarse and/or fine aggregate to reduce fines;

4. increasing the number of construction joints;

5. modifying the curing requirements; or

6. other actions to minimize shrinkage or the effects of shrinkage.

2.09 MEASUREMENT OF CEMENT AND AGGREGATE

A. The amount of cement and of each separate size of aggregate entering into each batch of concrete shall be determined by direct weighing equipment furnished by the CONTRACTOR and acceptable to the ENGINEER OF RECORD.

B. Weighing Tolerances

Material	Percent of Total Weight
Cement	1
Aggregates	3
Admixtures	3

2.10 MEASUREMENT OF WATER

A. The quantity of water entering the mixer shall be measured by a suitable water meter or other measuring device of a type acceptable to the ENGINEER OF RECORD and capable of measuring the water in variable amounts within a tolerance of one percent.

B. The water feed control mechanism shall be capable of being locked in position in order to constantly deliver the required amount of water to each batch of concrete.

C. A positive, quick-acting valve shall be used for a cut-off in the water line to the mixer, and the operating mechanism shall prevent leakage when the valve is closed.

2.11 READY-MIXED CONCRETE

A. General

1. At the CONTRACTOR'S option, ready-mixed concrete may be used if it meets the indicated requirements as to materials, batching, mixing, transporting and

placement, and is in accordance with ASTM C 94 and the following supplementary requirements.

2. Ready-mixed concrete shall be delivered to the WORK, and discharge shall be completed within one hour after the addition of the cement to the aggregates or before the drum has been revolved 250 revolutions, whichever occurs first.

3. The use of non-agitating equipment for transporting ready-mixed concrete will not be permitted.

4. Combination truck and trailer equipment for transporting ready-mixed concrete will not be permitted.

5. The quality and quantity of materials used in ready-mixed concrete and in batch aggregates shall be subject to continuous inspection at the batching plant by the ENGINEER OF RECORD.

B. Counters

1. Truck mixers shall be equipped with electrically-actuated counters by which the number of revolutions of the drum or blades may be readily verified.

2. The counter shall be of the resettable, recording type and shall be mounted in the driver's cab.

3. The counters shall be actuated at the time of starting the mixers at mixing speeds.

C. Mixing

1. Each batch of concrete shall be mixed in a truck mixer for not less than 70 revolutions of the drum or blades at the rate of rotation designated by the manufacturer of equipment.

2. Additional mixing, if any, shall be at the speed designated by the manufacturer of the equipment as agitating speed.

3. Materials, including the mixing water, shall be in the mixer drum before actuating the revolution counter for determining the number of revolutions of mixing.

D. Uniformity

1. Truck mixers and their operation shall be such that the concrete throughout the mixed batch as discharged is within acceptable limits of uniformity with respect to consistency, mix, and grading.

2. If slump tests taken at approximately the 1/4- and 3/4-point of the load during discharge result in slumps differing by more than one inch when the required slump is 3 inches or less, or if they differ by more than 2 inches when the required slump is more than 3 inches, the mixer shall not be used on the WORK unless the causative condition is corrected and satisfactory performance is verified by additional slump tests.

3. Mechanical details of the mixer, such as water measuring and discharge apparatus, condition of the blades, speed of rotation, general mechanical condition of the unit, and clearance of the drum, shall be checked before a further attempt to use the unit will be permitted.

E. Each batch of ready-mixed concrete delivered to the Site shall be accompanied by a delivery ticket that is furnished to the CONSTRUCTION MANAGER in accordance with the Paragraph in Part 1 of this Section entitled "Delivery Tickets."

PART 3 -- EXECUTION

3.01 PROPORTIONING AND MIXING

A. Proportioning of the mix shall conform to ACI 301.

B. Mixing shall conform to ACI 301.

C. Slumps shall be as indicated.

D. Re-tempering of concrete or mortar that has partially hardened will not be permitted.

3.02 PREPARATION OF SURFACES FOR CONCRETING

A. General

1. Earth surfaces shall be thoroughly wetted by sprinkling prior to the placing of any concrete, and these surfaces shall be kept moist by frequent sprinkling up to the time of placing concrete thereon.

2. The surface shall be free from standing water, mud, and debris at the time of placing concrete.

B. Joints in Concrete

1. Construction joints are defined as concrete surfaces upon which or against which concrete is to be placed, but placement of concrete has been stopped or interrupted and the CONSTRUCTION MANAGER has determined that the new concrete cannot be incorporated integrally with the concrete previously placed.

2. The surfaces of horizontal joints shall be given a compacted, roughened surface for good bonding.

3. Except where coated joint surfaces have been indicated, the joint surfaces shall be cleaned of laitance, loose or defective concrete, foreign material, and be roughened to a minimum 1/4-inch amplitude.

4. Cleaning and roughening shall be accomplished by hydroblasting or sandblasting (exposing aggregate) followed by thorough washing.

5. Pools of water shall be removed from the surface of construction joints before the new concrete is placed.

6. Pea gravel concrete mix

    a. After the surfaces have been prepared, each approximately horizontal construction joint (except at the top of walls) shall be covered with a 6-inch lift of a pea gravel mix.

    b. The pea gravel mix shall be placed and spread uniformly.

    c. Wall concrete shall follow immediately and shall be placed upon the fresh pea gravel mix.

C. Placement Interruptions

1. When placing of concrete is to be interrupted long enough for the concrete to take a set, the working face shall be given a shape by the use of forms or other means that will secure proper union with subsequent WORK.

2. Such construction joints shall be made only where acceptable to the ENGINEER OF RECORD.

D. Embedded Items

1. No concrete shall be placed until the formwork, the installation of parts to be embedded, the reinforcement steel, and the preparation of surfaces involved in the placing have been completed and accepted by the CONSTRUCTION MANAGER at least 4 hours before the placement of concrete.

2. Surfaces of forms and embedded items that have become encrusted with dried grout from previous usage shall be cleaned before the surrounding or adjacent concrete is placed.

3. Inserts or other embedded items shall conform to the indicated requirements.

4. Reinforcement, anchor bolts, sleeves, inserts, and similar items shall be set and secured in the forms at locations as indicated or shown by Shop Drawings, and shall be acceptable to the ENGINEER OF RECORD before any concrete is placed.

5. Accuracy of placement shall be the responsibility of the CONTRACTOR.

E. Casting New Concrete Against Old Concrete

1. Where concrete is to be cast against old concrete (defined as any concrete which is greater than 60 Days old), the surface of the old concrete shall be thoroughly cleaned and roughened by hydroblasting or sandblasting to expose aggregate.

2. The joint surface shall be coated with an epoxy bonding agent unless determined otherwise by the ENGINEER OF RECORD.

F. Water

1. No concrete shall be placed in any structure until water entering the space to be filled with concrete has been properly cut off or has been diverted by pipes or other means, and carried out of the forms, clear of the WORK.

2. No concrete shall be deposited underwater nor shall the CONTRACTOR allow still water to rise on any concrete until the concrete has attained its initial set.

3. Water shall not be permitted to flow over the surface of any concrete in such manner and at such velocity as will injure the surface finish of the concrete.

4. Pumping or other necessary dewatering operations for removing ground water, if required, shall be subject to review by the CONSTRUCTION MANAGER.

G. Corrosion Protection

1. Pipe, conduit, dowels, and other ferrous items required to be embedded in concrete construction shall be positioned and supported prior to placement of concrete such that there will be a minimum of 2 inches clearance between said items and any part of the concrete reinforcement.

2. Securing such items in position by wiring or welding them to the reinforcement will not be permitted.

H. Openings for pipes, inserts for pipe hangers and brackets, and anchors shall be provided, where practicable, during the placement of concrete.

I. Anchor bolts shall be accurately set and shall be maintained in position by templates while embedded in the concrete.

J. Cleaning: The surfaces of metalwork to be in contact with the concrete shall be thoroughly cleaned of dirt, grease, loose scale and rust, grout, mortar, and other foreign substances immediately before the concrete is placed.

3.03 HANDLING, TRANSPORTING, AND PLACING

A. General

1. The placement of concrete shall conform to the applicable portions of ACI 301 and the indicated requirements.

2. No aluminum materials shall be used in conveying any concrete.

B. Non-Conforming WORK or Materials

1. Concrete which during or before placing is found not to conform to the indicated requirements will be rejected and shall be immediately removed from the WORK.

2. Concrete that is not placed in accordance with these requirements or which is of inferior quality shall be removed and replaced.

C. Unauthorized Placement

1. No concrete shall be placed except in the presence of an authorized representative of the CONSTRUCTION MANAGER.

2. The CONTRACTOR shall notify the CONSTRUCTION MANAGER in writing at least 24 hours in advance of the placement of any concrete.

D. Casting New Concrete Against Old

1. An epoxy adhesive bonding agent shall be applied to the old surfaces according to the manufacturer's written recommendations.

2. This provision shall not apply to joints where waterstop has been provided.

3. Refer to Section 03 32 00 – Joints in Concrete, for other requirements.

E. Conveyor Belts and Chutes

1. Ends of chutes, hopper gates, and other points of concrete discharge throughout the CONTRACTOR's conveying, hoisting, and placement system shall be designed and arranged such that concrete passing from them will not fall separated into whatever receptacle immediately receives it.

2. Conveyor belts, if used, shall be of a type acceptable to the CONSTRUCTION MANAGER.

3. Chutes longer than 50 feet will not be permitted.

4. The minimum slopes of chutes shall be such that concrete of the indicated consistency will readily flow in them.

5. If a conveyor belt is used, it shall be wiped clean by a device operated in such a manner that none of the mortar adhering to the belt will be wasted.

6. Conveyor belts and chutes shall be covered.

F. Placement in Wall and Column Forms

1. Concrete shall not be dropped through reinforcement steel or into any deep form, nor shall concrete be placed in any form in such a manner as to leave accumulation of mortar on the form surfaces above the placed concrete.

2. In such cases, means such as hoppers and, if necessary, vertical ducts of canvas, rubber, or metal shall be used for placing concrete in the forms in a manner that it may reach the place of final deposit without separation.

3. In no case shall the free fall of concrete below the ends of ducts, chutes, or buggies exceed 4 feet in walls and 8 feet in columns.

4. Concrete shall be uniformly distributed during the process of deposition, and in no case after deposition shall any portion be displaced in the forms more than 6 feet in the horizontal direction.

5. Concrete in wall forms shall be deposited in uniform horizontal layers not deeper than 2 feet, and care shall be exercised to avoid inclined layers or inclined construction joints except where such are required for sloping members.

6. Each layer shall be placed while the previous layer is still soft.

7. The rate of placing concrete in wall forms shall not exceed 5 feet of vertical rise per hour.

8. Sufficient illumination shall be provided in the interior of forms such that the concrete at the places of deposit is visible from the deck or runway.

G. Placement in Slabs

1. Concrete placement in sloping slabs shall proceed uniformly from the bottom of the slab to the top for the full width of the placement.

2. As the WORK progresses, the concrete shall be vibrated and carefully worked around the slab reinforcement, and the surface of the slab shall be screeded in an up-slope direction.

H. Temperature of Concrete

1. The temperature of concrete when it is being placed shall be not more than 90 degrees F nor less than 50 degrees F.

2. For sections less than 12 inches thick, the temperature of concrete when placed shall be not less than 55 degrees F.

I. Hot or Cold Weather Procedures

1. If required by the ENGINEER OF RECORD, the CONTRACTOR shall submit detailed procedures for the production, transportation, placement, protection, curing, and temperature monitoring of concrete during hot or cold weather.

2. The submittal shall include procedures to be implemented upon abrupt changes in weather conditions or equipment failures.

3. The CONTRACTOR shall not be entitled to additional compensation for satisfying the hot weather placement or the cold weather placement requirements below.

J. Hot Weather Placement

1. If the temperature of the concrete is 85 degrees F or greater, the time between introducing the cement into the aggregates and discharge shall not exceed 45 minutes.

2. If the concrete is placed when the weather is such that the temperature of the concrete would exceed 90 degrees F, the CONTRACTOR shall employ effective means such as pre-cooling of aggregates, using ice as mixing water, or placing at night as necessary to maintain the temperature of the concrete below 90 degrees F as it is placed.

3. During the curing period, the maximum temperature decrease measured at the surface of the concrete shall not exceed 50 degrees F in 24 hours nor 5 degrees F in one hour.

K. Cold Weather Placement

1. The placement of concrete shall conform to ACI 306.1 – Cold Weather Concreting, and the following requirements:

a. Remove snow, ice, and frost from the surfaces, including reinforcement, against which concrete is to be placed.

b. Before beginning concrete placement, thaw the subgrade to a minimum depth of 6 inches.

c. Reinforcement and embedded items shall be warmed to above 32 degrees F prior to concrete placement.

d. Maintain the concrete temperature above 50 degrees F for at least 72 hours after placement.

e. Concrete ingredients shall not be heated more than necessary to prevent the temperature of the mixed concrete, as placed, from falling below the minimum temperature criterion.

3.04 PUMPING OF CONCRETE

A. General: If the pumped concrete does not produce satisfactory end results, the CONTRACTOR shall discontinue the pumping operation and proceed with the placing of concrete using conventional methods.

B. Pumping Equipment

1. The pumping equipment shall have 2 cylinders and shall be designed to operate with one cylinder in case the other one is not functioning.

2. In lieu of this requirement, the CONTRACTOR may have a standby pump on the Site during pumping.

3. The minimum diameter of the hose conduits shall be in accordance with ACI 304.2R – Placing Concrete by Pumping Methods.

4. Pumping equipment and hose conduits that are not functioning properly shall be replaced.

5. Aluminum conduits for conveying the concrete will not be permitted.

C. Field Control: Concrete samples for slump, air content, and test cylinders shall be taken at the placement end of the hose.

3.05 ORDER OF PLACING CONCRETE

A. General

1. The order of placing concrete in the WORK shall be acceptable to the ENGINEER OF RECORD.

2. In order to minimize the effects of shrinkage, the concrete shall be placed in units as bounded by construction joints at the indicated locations.

B. The placing of units shall be done by placing alternate units in a manner such that each unit placed shall have cured at least 5 Days for hydraulic structures and 2 Days for all other structures before the contiguous unit or units are placed, except that the corner sections of vertical walls shall not be placed until the two adjacent wall panels have cured at least 10 Days for hydraulic structures and 4 Days for all other structures.

C. Concrete Surfaces

1. The surface of the concrete shall be level whenever a run of concrete is stopped.

2. For a level, straight, intermediate joint on the exposed surface of walls, a wood strip at least 3/4-inch thick shall be tacked to the forms on these surfaces.

3. The concrete shall be carried approximately 1/2 inch above the underside of the strip.

4. The strip shall be removed one hour after the concrete is placed, and any irregularities in the edge formed by the strip shall be leveled with a trowel and laitance shall be removed.

3.06 TAMPING AND VIBRATING

A. As concrete is placed in the forms or in excavations, it shall be thoroughly settled and compacted throughout the entire depth of the layer which is being consolidated, into a dense and homogeneous mass, filling all corners and angles, thoroughly embedding the reinforcement, eliminating rock pockets, and bringing only a slight excess of water to the exposed surface of concrete.

B. Vibrators

1. Vibrators shall be Group 3 in accordance with ACI 309 – Consolidation of Concrete, high speed power vibrators (8000 to 12,000 rpm) of an immersion type in sufficient number and with at least one standby unit as required.

2. Group 2 vibrators may be used only at specific locations when accepted by the ENGINEER OF RECORD.

C. Waterstops

1. Care shall be exercised when placing concrete around waterstops.

2. The concrete shall be carefully worked by rodding and vibrating to make sure that air and rock pockets have been eliminated.

3. Where flat-strip type waterstops have been placed horizontally, the concrete shall be worked under the waterstops by hand, making sure that air and rock pockets have been eliminated.

4. Concrete that is surrounding the waterstops shall be given additional vibration over and above that used for adjacent concrete placement to ensure complete embedment of the waterstops in the concrete.

D. Concrete in Walls

1. Concrete in walls shall be internally vibrated and at the same time rammed, stirred, or worked with suitable appliances, tamping bars, shovels, or forked tools until it completely fills the forms or excavations and closes snugly against each surface.

2. Subsequent layers of concrete shall not be placed until the layers previously placed have been worked thoroughly.

3. Vibrators shall be provided in sufficient numbers, with standby units as required, to accomplish the required results within 15 minutes after concrete of the prescribed consistency has been placed in the forms.

4. The vibrating head shall not contact the surfaces of the forms.

5. Care shall be exercised not to vibrate concrete excessively or to work it in any manner that causes segregation of its constituents.

3.07 FINISHING CONCRETE SURFACES

A. General

1. Surface defects are defined as fins, bulges, ridges, offsets, honeycombing, roughness of any kind, and surface holes larger than **1/4** inch in diameter or deeper than **1/4** inch.

2. Concrete surfaces shall be free from surface defects and shall present a finished, smooth, continuous hard surface.

3. Allowable deviations from plumb or level and from the alignment, profiles, and dimensions are defined as tolerances and shall be as indicated.

4. These tolerances are to be distinguished from irregularities in finish as indicated.

5. Aluminum finishing tools shall not be used.

B. Formed Surfaces

1. Formed surfaces shall be treated to provide a “Smooth Form Finish”, which consists of finishing the surfaces as necessary to produce smooth, even surfaces of uniform texture and appearance, free of surface defects, depressions and other imperfections.

2. Tie holes and defective concrete shall be repaired.

3. Where architectural finish is required, treatment(s) shall be as indicated.

C. Unformed Surfaces

1. General

a. After proper and adequate vibration and tamping, unformed top surfaces of slabs, floors, walls, and curbs shall be brought to a uniform surface with suitable tools.

b. Immediately after the concrete has been screeded it shall be treated with a liquid evaporation retardant, and the retardant shall be used again after each operation as necessary to prevent drying shrinkage cracks.

2. The classes of finish for unformed concrete surfaces are defined as follows:

a. Finish U1

1) Sufficient leveling and screeding to produce an even, uniform surface with surface irregularities not to exceed 3/8 inch.

2) No further special finish is required.

b. Finish U2

1) After sufficient stiffening of the screeded concrete, surfaces shall be float finished with wood or metal floats or with a finishing machine using float blades.

2) Excessive floating of surfaces while the concrete is plastic and dusting of dry cement and sand on the concrete surface to absorb excess moisture will not be permitted.

3) Floating shall be the minimum necessary to produce a surface that is free from screed marks and is uniform in texture.

4) Surface irregularities shall not exceed 1/4 inch.

5) Joints and edges shall be tooled where indicated or as determined by the ENGINEER OF RECORD.

c. Finish U3

1) After the Finish U2 surface has hardened sufficiently to prevent excess of fine material from being drawn to the surface, steel troweling shall be performed with firm pressure such as will flatten the sandy texture of the floated surface and produce a dense, uniform surface free from blemishes, ripples, and trowel marks.

2) The finish shall be smooth and free of irregularities.

d. Finish U4

1) Trowel the Finish U3 surface to remove local depressions or high points.

2) In addition, the surface shall be given a light broom finish with brooming perpendicular to drainage unless otherwise indicated.

3) The resulting surface shall be sufficiently rough to provide a nonskid finish.

e. Unformed surfaces shall be finished according to the following schedule:

UNFORMED SURFACE FINISH SCHEDULE	
Area	Finish
grade slabs and foundations to be covered with concrete or fill material	U1
floors to be covered with grouted tile or topping grout	U2
water bearing slabs with slopes 10 percent and less	U3
water bearing slabs with slopes greater than 10 percent	U4
slabs not water bearing	U4
slabs to be covered with built-up roofing	U2
interior slabs and floors to receive architectural finish	U3
top surface of walls	U3

3.08 CURING AND DAMPPROOFING

A. General: Concrete shall be cured for not less than 7 Days after placement, in accordance with the methods indicated below for the different parts of the WORK.

Surface to be Cured or Dampproofed	Method
unstripped forms	1
construction joints between footings and walls, and between floor slab and columns	2
encasement and ductbank concrete and thrust blocks	3
concrete surfaces not specifically indicated in this Paragraph	4
floor slabs on grade in hydraulic structures	5
slabs not on grade	6
wall sections with forms removed	6

B. Method 1

1. Wooden forms shall be wetted immediately after concrete has been placed and shall be kept wet with water until removal.

2. If steel forms are used the exposed concrete surfaces shall be kept continuously wet until the forms are removed.

3. If forms are removed within 7 Days of placing the concrete, curing shall be continued in accordance with Method 6 below.

C. Method 2

1. The surface shall be covered with burlap mats which shall be kept wet with water for the duration of the curing period, until the concrete in the walls has been placed.

2. No curing compound shall be applied to surfaces cured under Method 2.

D. Method 3

1. The surface shall be covered with moist earth not less than 4 hours nor more than 24 hours after the concrete is placed.

2. Earthwork operations that may damage the concrete shall not begin until at least 7 Days after placement of the concrete.

E. Method 4

1. The surface shall be sprayed with a liquid curing compound.

2. The compound shall be applied in accordance with the manufacturer's printed instructions at a maximum coverage rate of 200 square feet per gallon and in such a manner as to cover the surface with a uniform film that will seal thoroughly.

3. Seal Protection

    a. Where the curing compound method is used, care shall be exercised to avoid damage to the seal during the 7-Day curing period.

    b. If the seal is damaged or broken before expiration of the curing period, the break shall be repaired immediately by the application of additional curing compound over the damaged portion.

4. Wherever curing compound has been applied by mistake to surfaces against which concrete subsequently is to be placed and to which it is to adhere, such compound shall be entirely removed by wet sandblasting just prior to the placing of new concrete.

5. Application Schedule

    a. The curing compound shall be applied as soon as the concrete has hardened enough to prevent marring on unformed surfaces and within 2 hours after removal of forms.

    b. Repairs to formed surfaces shall be made within the 2 hour period; provided, however, that any such repairs which cannot be made within the said 2 hour period shall be delayed until after the curing compound has been applied.

    c. When repairs are to be made to an area on which curing compound has been applied, the area involved shall first be wet-sandblasted to remove the curing compound.

6. At locations where concrete is placed adjacent to a panel which has been coated with curing compound, the panel shall have curing compound reapplied to an area within 6 feet of the joint and to any other location where the curing membrane has been disturbed.

7. Prior to final acceptance of the WORK, visible traces of curing compound shall be removed in such a manner that does not damage the surface finish.

F. Method 5

1. Until the concrete surface is covered with curing compound, the entire surface shall be kept damp by applying water using nozzles that atomize the flow such that the surface is not marred or washed.

2. The concrete shall be given a coat of curing compound in accordance with Method 4, above.

3. Not less than one hour nor more than 4 hours after the curing compound has been applied, the surface shall be wetted with water delivered through a fog nozzle, and concrete-curing blankets shall be placed on the slabs.

4. Curing Blankets

   a. The curing blankets shall be laid with the edges butted together and with the joints between strips sealed with 2-inch wide strips of sealing tape or with edges lapped not less than 3 inches, and fastened together with a waterproof cement to form a continuous watertight joint.

   b. The curing blankets shall be left in place during the 7-Day curing period and shall not be removed until after concrete for adjacent WORK has been placed.

   c. If the curing blankets become torn or otherwise ineffective, the CONTRACTOR shall replace damaged sections.

   d. During the first 3 Days of the curing period, no traffic of any nature and no depositing, temporary or otherwise, of any materials will be permitted on the curing blankets.

   e. During the remainder of the curing period, foot traffic and temporary depositing of materials that impose light pressure will be permitted only on top of plywood sheets 5/8-inch minimum thickness, laid over the curing blanket.

   f. The CONTRACTOR shall add water under the curing blanket as often as necessary to maintain damp concrete surfaces.

G. Method 6

1. Method 6 shall apply to both walls and slabs.

2. The concrete shall be kept continuously wet by the application of water for a minimum period of at least 7 Days, beginning immediately after the concrete has reached final set or the forms have been removed.

3. Until the concrete surface is covered with the curing mats, the entire surface shall be kept damp by applying water using nozzles that atomize the flow such that the surface is not marred or washed.

4. Curing Mats

   a. Heavy curing mats shall be used as a curing medium to retain the moisture during the curing period.

   b. The curing mats shall be weighted or otherwise held substantially in contact with the concrete surface to prevent dislodging by wind or other causes.

   c. Edges shall be continuously held in place.

5. The curing mats and concrete shall be kept continuously wet by the use of sprinklers or other means both during and after normal working hours.

6. Immediately after the application of water has terminated at the end of the curing period, the curing mats shall be removed, the entire concrete surface shall be wetted, and curing compound shall be immediately applied to the entire surface in accordance with Method 4, above.

7. The CONTRACTOR shall dispose of excess water from the curing operation in order to avoid damage to the WORK.

H. Dampproofing

1. The exterior surfaces of roof slabs to be buried and walls to be backfilled shall be dampproofed as follows.

2. Asphalt Emulsion

a. Immediately after the completion of curing, the surface shall be sprayed with a dampproofing agent consisting of an asphalt emulsion.

b. Application of the agent shall be in 2 coats.

c. The first coat shall be diluted to 1/2 strength by the addition of water, and shall be sprayed on so as to provide a maximum coverage rate of 100 square feet per gallon of dilute solution.

d. The second coat shall consist of an application of the undiluted material, and shall be sprayed on so as to provide a maximum coverage rate of 100 square feet per gallon.

3. Whitewash

a. As soon as the material has taken an initial set, the entire area thus coated shall be coated with whitewash.

b. Any formula for mixing the whitewash may be used if it produces a uniformly-coated white surface and remains until placing of the backfill.

c. If the whitewash fails to remain on the surface until the backfill is placed, the CONTRACTOR shall apply additional whitewash.

3.09 PROTECTION

A. The CONTRACTOR shall protect the concrete against damage until final acceptance.

B. Weather Protection

1. Fresh concrete shall be protected from damage due to rain, hail, sleet or snow.

2. The CONTRACTOR shall provide such protection while the concrete is still plastic and whenever precipitation is imminent or occurring.

3.10 CURING DURING COLD WEATHER

A. Water curing of concrete may be reduced to 6 Days during periods when the mean daily temperature in the vicinity of the Site is less than 40 degrees F, provided that during the prescribed period of water curing, when temperatures are such that concrete surfaces may freeze, water curing has been temporarily discontinued.

B. Compound-Cured Concrete

1. Concrete that is to be cured by an application of curing compound shall require no additional protection from freezing if the protection at 50 degrees F for 72 hours is obtained by means of approved insulation in contact with the forms or concrete surfaces.

2. Otherwise, the concrete shall be protected against freezing temperatures for 72 hours immediately following 72 hours protection at 50 degrees F.

C. Concrete cured by water shall be protected against freezing temperatures for 72 hours immediately following the 72 hours of protection at 50 degrees F.

D. Discontinuance of Protection

1. Discontinuance of protection against freezing temperatures shall be such that the drop in temperature of any portion of the concrete will be gradual and will not exceed 40 degrees F in 24 hours.

2. In the spring, when the mean daily temperature rises above 40 degrees F for more than 3 successive Days, the required 72-hour protection at a temperature not lower than 50 degrees F may be discontinued for as long as the mean daily temperature remains above 40 degrees F, provided that the concrete shall be protected against freezing temperatures for not less than 48 hours after placement.

E. Artificial Heat

1. Where artificial heat is employed, special care shall be taken to prevent the concrete from drying.

2. The use of unvented heaters will be permitted only when unformed surfaces of concrete adjacent to the heaters are protected for the first 24 hours from an excessive carbon dioxide atmosphere by application of curing compound, provided that the use of curing compound for such surfaces is otherwise permitted.

3.11 TREATMENT OF SURFACE DEFECTS

A. General

1. Surface defects are defined in Finishing Concrete Surfaces, above.

2. As soon as forms are removed, the exposed concrete surfaces shall be carefully examined and any irregularities shall be immediately rubbed or ground in order to

secure a smooth, uniform, and continuous surface satisfactory to the CONSTRUCTION MANAGER.

3. Plastering or coating of surfaces to be smoothed will not be permitted.

4. No repairs shall be made until after inspection by the CONSTRUCTION MANAGER.

5. In no case will extensive patching of honeycombed concrete be permitted.

6. Concrete containing minor voids, holes, honeycombing, or similar depression defects shall be repaired as indicated below.

7. Concrete containing extensive voids, holes, honeycombing, or similar depression defects shall be completely removed and replaced..

8. Repairs of surface defects shall be performed promptly.

B. Preparation

1. Defective surfaces to be repaired shall be cut back from trueline a minimum depth of 1/2-inch over the entire area.

2. Feathered edges will not be permitted.

3. Where chipping or cutting tools are not required in order to deepen the area properly, the surface shall be prepared for bonding by the removal of laitance and soft material, plus not less than 1/32-inch depth of the surface film from hard portions by means of an efficient sandblast.

4. After cutting and sandblasting, the surface shall be wetted sufficiently in advance of shooting with shotcrete or with cement mortar such that while the repair material is being applied the surfaces underneath will remain moist but not so wet as to overcome the suction upon which a good bond depends.

C. Materials

1. The material used for repair shall consist of a mixture of one sack of cement to 3 cubic feet of sand.

2. For exposed walls, the cement shall contain such a proportion of Atlas White Portland cement as is required to make the color of the patch match the color of the surrounding concrete.

D. Holes

1. Holes left by tie-rod cones shall be reamed with suitably toothed reamers in order to leave the surfaces of the holes clean and rough.

2. Holes then shall be repaired in an approved manner with dry-packed cement grout.

3. Holes left by form-tying devices having a rectangular cross section and other imperfections having a depth greater than their least surface dimension shall not be reamed but shall be repaired in an approved manner with dry-packed cement grout.

E. Repairs

1. Repairs shall be built up and shaped in such a manner that the completed WORK will conform to the indicated requirements, using approved methods which will not disturb the bond, cause sagging, or cause horizontal fractures.

2. The surfaces of repaired concrete shall receive the same kind and amount of curing treatment as required for the concrete in the repaired section.

F. Cracks: Prior to filling any structure with water, cracks shall be repaired in accordance with the requirements of Section 03 01 30 – Concrete Repair and Rehabilitation.

3.12 CONCRETE REPAIR AND REHABILITATION

A. All defects and repairs not covered under Treatment of Surface Defects shall be repaired per Section 03 01 30 - Concrete Repair and Rehabilitation.

3.13 CARE AND REPAIR OF CONCRETE

A. The CONTRACTOR shall protect concrete against injury or damage from excessive heat, lack of moisture, overstress, or any other cause until Final Acceptance.

B. Particular care shall be exercised in order to prevent the drying shrinkage damage of concrete and to avoid roughening or otherwise damaging the concrete surface.

C. Any concrete found to be damaged, or which may have been originally defective, or which becomes defective at any time prior to the final acceptance of the completed WORK, or which departs from the established line or grade, or which, for any other reason, does not conform to the requirements of the Contract Documents, shall be repaired or removed and replaced with acceptable materials to the satisfaction of the ENGINEER OF RECORD.

END OF SECTION

SECTION 03 32 00

JOINTS IN CONCRETE

PART 1 -- GENERAL

1.01 THE SUMMARY

A. The CONTRACTOR shall provide joints in concrete, complete and in place, in accordance with the Contract Documents.

B. Joints in concrete structures shall be the types defined below and will be permitted only where indicated, unless specifically accepted by the ENGINEER OF RECORD.

1.02 RELATED SECTIONS

A. Section 03 01 30 Concrete Repair and Rehabilitation

B. Section 03 21 00 Reinforcement Steel

C. Section 03 31 00 Cast-in-Place Concrete

D. Section 03 60 00 Grouting

1.03 TYPES OF JOINTS

A. Construction Joints

1. When fresh concrete is placed against a hardened concrete surface, the joint between the pours shall be defined as a construction joint.

2. Unless otherwise indicated, joints in water-bearing members shall be provided with a waterstop and/or sealant groove of the shape indicated.

B. Contraction Joints

1. Contraction joints are similar to construction joints except that the fresh concrete shall not bond to the hardened surface of the earlier pour.

2. The slab reinforcement shall be stopped 4-1/2 inches from the joint; which is provided with a sleeve-type dowel, in order to allow shrinkage of the concrete of the later pour.

3. Waterstop and/or sealant groove shall be provided where indicated.

C. Expansion Joints

1. In order to allow the concrete to expand freely, a space shall be provided between the 2 pours, and the joint shall be formed as indicated.

2. The space shall be obtained by placing a filler joint material against the earlier pour to act as a form for the later pour.

3. Unless otherwise indicated, expansion joints in water bearing members shall be provided with a center-bulb type waterstop.

4. Provide premolded expansion joint material with the edge at the indicated distance below or back from the finished concrete surface.

5. Provide a slightly tapered, dressed and oiled wooden strip secured to or placed at the edge of the expansion joint during concrete placement, and remove the strip later to form a space for the sealing material.

6. The space so formed shall be filled with a joint sealant material as indicated below. In order to keep the 2 wall or slab elements in line, the joint shall also be provided with a sleeve-type dowel as indicated.

D. Control Joints

1. The function of the control joint is to provide a weaker plane in the concrete where shrinkage cracks would likely occur.

2. Formed Groove

a. A groove, of the shape and dimensions indicated, shall be formed or saw-cut in the concrete and the groove shall then be filled with a joint sealant material.

b. The formed groove shall be placed in the first of the two sections cast at the control joint, in order to assure that the sealant bonds to the second section across the joint and not to the cement paste from the first pour.

1.04 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with the requirements of Section 7 of Standard Provisions – Submittal Management.

B. Shop Drawings

1. Furnish placement drawings showing the location and types of joints for each structure.

2. Test Reports

a. Furnish certified test reports from the sealant manufacturer on the actual batch of material supplied, demonstrating compliance with the indicated requirements.

b. Furnish the test reports before using the sealant on the Project.

3. Welding Certification

    a. Furnish copies of the waterstop welding certification by manufacturer or authorized agent of the manufacturer.

    b. Every person who is to be involved with waterstop installation shall be required to have individual certification on file with the CONSTRUCTION MANAGER, stating that the named individual is certified and trained to install waterstop in accordance with the manufacturer's recommendations and specifications.

4. Furnish manufacturer's information demonstrating compliance of the following with the indicated requirements:

    a. bearing pad

    b. neoprene sponge

    c. preformed joint filler

    d. backing rod

    e. waterstop

    f. slip dowels

    g. PVC tubing

C. Samples

1. Prior to production of the material required under this Section, submit qualification samples of waterstops which accurately represent the material being provided.

2. Such samples shall be extruded or molded sections of each size or shape to be installed.

3. The balance of the material to be used shall not be produced until after the ENGINEER OF RECORD has reviewed the qualification samples.

D. Certificates

1. Furnish written certification from the manufacturer, as an integral part of the shipping form, that the material shipped to the Site meets or exceeds the indicated physical property requirements.

2. Supplier certificates will not be accepted.

1.05 QUALITY ASSURANCE

A. Waterstop Inspection

1. Waterstop field joints shall be subject to inspection, and no such WORK shall be scheduled or started without having made prior arrangements with the CONSTRUCTION MANAGER for the required inspections.

2. Provide not less than 24 hours notice for the scheduling of such inspections.

3. Field joints in waterstops shall be subject to inspection for misalignment, bubbles, inadequate bond, porosity, cracks, offsets, and other defects that would reduce the potential resistance of the material to water pressure at any point.

4. Defective field joints shall be replaced with material that passes inspection, and faulty material shall be removed from the Site and destroyed.

B. The following waterstop defects represent a partial list of defects which shall be grounds for rejection:

1. offsets at joints greater than 1/16 inch or 15 percent of material thickness at any point, whichever is less

2. exterior cracking at the joint due to incomplete bond, which is deeper than 1/16 inch or 15 percent of material thickness at any point, whichever is less

3. any combination of offset or exterior cracking that will result in a net reduction in the cross-section of the waterstop in excess of 1/16 inch or 15 percent of material thickness at any point, whichever is less

4. misalignment of the joint which results in misalignment of the waterstop in excess of 1/2 inch in 10 feet

5. porosity in the welded joint as evidenced by visual inspection

6. bubbles or inadequate bonding which can be detected with a penknife test. (If, while prodding the entire joint with the point of a penknife, the knife breaks through the outer portion of the weld into a bubble, the joint shall be considered defective.)

7. visible signs of separation when the cooled splice is bent by hand at any sharp angle

8. evidence of burned material

C. Waterstop Samples

1. Prior to use of the waterstop material in the field, a sample of a prefabricated (shop made fitting) mitered cross and a tee constructed of each size or shape of material to be used shall be submitted.

2. Samples shall be prefabricated (shop made fitting) so that the material and workmanship represent the fittings to be provided.

3. In addition, field samples of prefabricated fittings (crosses, tees, and the like) will be selected at random by the CONSTRUCTION MANAGER for testing by a laboratory at the OWNER's expense.

4. When tested, the tensile strength across the joints shall be at least 1120 psi for PVC waterstops.

D. Construction Joint Sealant

1. The CONTRACTOR shall prepare adhesion and cohesion test specimens at intervals of 5 Days while sealants are being installed.

2. The sealant material shall show no signs of adhesive or cohesive failure when tested in accordance with the following procedure in laboratory and field tests:

a. Sealant specimen shall be prepared between 2 concrete blocks (1-inch by 2-inch by 3-inch).

b. Spacing between the blocks shall be one inch.

c. Coated spacers (2-inch by 1-1/2-inch by 1/2-inch) shall be used to set and hold sealant cross-sections of 1/2-inch by 2-inch with a width of one inch.

d. The sealant shall be cast and cured in accordance with the manufacturer's recommendations, except that the curing period shall be not less than 24 hours.

e. Following the curing period, the gap between the blocks shall be widened to 1-1/2 inches, and spacers shall be used to maintain this gap for 24 hours prior to inspection for failure.

1.06 SPECIAL CORRECTION OF DEFECTS REQUIREMENT

A. The CONTRACTOR shall furnish a 5-year written warranty of the entire sealant installation against faulty and/or incompatible materials and workmanship, together with a statement that the CONTRACTOR agrees to repair or replace, to the satisfaction of the OWNER, any defective areas which become evident within the 5-year period.

PART 2 -- PRODUCTS

2.01 GENERAL

A. Joint materials shall be listed as compliant with NSF Standard 61.

2.02 WATERSTOPS

A. PVC Waterstops

1. Waterstops shall be extruded from an elastomeric polyvinyl chloride compound containing the plasticizers, resins, stabilizers, and other materials necessary to meet the indicated requirements of this Section.

2. No reclaimed or scrap material shall be used.

3. The CONTRACTOR shall obtain from the waterstop manufacturer and shall furnish to the ENGINEER OF RECORD for review, current test reports and a written certification of the manufacturer that the material to be shipped to the Site meets the physical requirements as outlined in the U.S. Army Corps of Engineers Specification CRD-C572-PVC Waterstops, and those indicated.

4. Flatstrip and Center-Bulb Waterstops

   a. Flatstrip and center-bulb waterstops shall be manufactured such that at no place shall the thickness of waterstops, including the center bulb type, be less than 3/8 inch.

   b. The waterstop shall be provided with hog rings installed at 12 inches on centers along the waterstop.

   c. Shapes shall be as indicated, or as acceptable to the ENGINEER OF RECORD.

5. Multi-Rib Waterstops

   a. Multi-rib waterstops shall be as indicated or as acceptable to the ENGINEER OF RECORD.

   b. Prefabricated joint fittings shall be used at intersections of the ribbed-type waterstops.

6. Retrofit Waterstops

   a. Retrofit waterstops and batten bars shall be as indicated or as acceptable to the ENGINEER OF RECORD.

   b. The waterstop shall be supplied as a complete system including waterstop, SS batten bar, SS anchor bolts, and epoxy gel.

7. When tested in accordance with the indicated test standards, the waterstop material shall meet or exceed the following requirements:

Physical Property, Sheet Material	Value	ASTM Std

Tensile Strength-min, psi	2000	D 638, Type IV
Ultimate Elongation-min, percent	350	D 638, Type IV
Low Temp Brittleness, max degrees F	-35	D 746
Stiffness in Flexure, min, psi	600	D 747
Accelerated Extraction (CRD-C572		
Tensile Strength-min, psi	1500	D 638, Type IV
Ultimate Elongation, min, percent	300	D 638, Type IV
Effect of Alkalies (CRD-C572		
Change in Weight, percent	plus 0.25/minus 0.10	------
Change in Durometer, Shore A	plus and minus 5	D 2240
Finish Waterstop		
Tensile Strength-min, psi	1400	D 638, Type IV
Ultimate Elongation, min percent	280	D 638, Type IV

B. Preformed Hydrophilic Waterstop

1. Hydrophilic (bentonite-free) waterstops shall be Hydro-Flex Waterstop as manufactured by Henry Co., or Earthshield Type 20, as manufactured by JP Specialties, or equal.

2. The cross-sectional area of the waterstop shall not be less than 0.5 square inch.

3. Hydrophilic waterstop shall be the type that expands in the presence of water to form a watertight joint seal without damaging the concrete in which it is cast.

4. The waterstop shall be manufactured from butyl rubber with hydrophilic properties.

5. The waterstop shall have a delay coating to inhibit initial expansion due to moisture present in fresh concrete.

6. The minimum expansion ratio of modified chloroprene shall be not less than 2-to-1 volumetric change in distilled water at 70 degrees F (21 degrees C).

7. The bonding agent for hydrophilic waterstop shall be the manufacturer's recommended adhesive for wet, rough concrete.

C. When types of waterstops not listed above are indicated, they shall be subjected to the same requirements as those listed in this Section.

2.03 JOINT SEALANT FOR WATER-BEARING JOINTS

A. The joint sealant shall be a polyurethane polymer designed for bonding to concrete which is continuously submerged in water.

B. No material will be accepted which has an unsatisfactory history as to bond or durability when used in the joints of water-retaining structures.

C. Joint sealant material shall meet the following requirements (73 degrees F and 5 percent R.H.):

Work Life, minutes	45 - 180
Time to Reach 20 Shore A Hardness (at 77 degrees F, 200 gram quantity), max	24 hours
Ultimate Hardness (ASTM D 2240, Shore A)	20 - 45
Tensile Strength (ASTM D 412), min	175 psi
Ultimate Elongation (ASTM D 412), minimum	400 percent
Tear Resistance (Die C, ASTM D 624), pounds per inch of thickness, min	75
Color	Light Gray

D. Polyurethane sealants for waterstop joints in concrete shall conform to the following requirements:

1. Sealant shall be 2-part polyurethane with the physical properties of the cured sealant conforming to or exceeding the requirements of ASTM C 920 – Elastomeric Joint Sealant, or Federal Specification TT-S-0227 E(3) - Sealing Compound, Elastomeric Type, Multicomponent, for Caulking, Sealing, and Glazing Buildings and Other Structures, for 2-part material, as applicable.

2. For vertical joints and overhead horizontal joints, only "non-sag" compounds shall be used, conforming to the requirements of ASTM C 920, Class 25, Grade NS, or Federal Specification TT-S-0227 E(3), Type II, Class A.

3. For plane horizontal joints, use the self-leveling compounds meeting the requirements of ASTM C 920 Class 25, Grade P, or Federal Specification TT-S-0227 E(3), Type I.

4. For joints subject to either pedestrian or vehicular traffic, a compound providing non-tracking characteristics and having a Shore A hardness range of 35 to 45 shall be used.

5. Primer materials, if recommended by the sealant manufacturer, shall conform to the printed recommendations of the manufacturer.

E. Sealant Manufacturers

1. Sealants shall be PSI-270 as manufactured by Polymeric Systems Inc., Sikaflex 2C, as manufactured by Sika Corporation, Pelseal (with Viton) 2112/2012, or equal.

F. Sealants for non-waterstop joints in concrete shall be in conformance with the requirements of Section 07 92 00 – Joint Sealants.

2.04 JOINT MATERIALS

A. Bearing Pad

1. The bearing pad shall be neoprene conforming to ASTM D 2000 - Standard Classification System for Rubber Products in Automotive Applications, BC 420, 40 durometer hardness, unless otherwise indicated.

B. Neoprene Sponge

1. The sponge shall be neoprene, closed-cell, expanded, conforming to ASTM D 1056 - Flexible Cellular Materials - Sponge or Expanded Rubber, Type 2C5-E1.

C. Joint Filler

1. Joint filler for expansion joints in waterholding structures shall be neoprene conforming to ASTM D 1056, Type 2C5-E1.

2. Joint filler material in other locations shall be of the preformed non-extruding type, constructed of cellular neoprene sponge rubber or polyurethane of firm texture.

3. Bituminous fiber type will not be accepted.

4. Non-extruding and resilient-type preformed expansion joint fillers shall conform to the requirements and tests set forth in ASTM D 1752 - Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction, for Type I, except as otherwise indicated.

2.05 BACKING ROD

A. The backing rod shall be an extruded closed-cell, polyethylene foam rod.

B. The rod material shall be compatible with the joint sealant material, and shall have a tensile strength of not less than 40 psi and a compression deflection of approximately 25 percent at 8 psi.

C. The rod shall be 1/8 inch larger in diameter than the joint width except that a one-inch diameter rod shall be used for a 3/4-inch wide joint.

2.06 SLIP DOWELS

A. Slip dowels in joints shall be smooth epoxy-coated bars conforming to ASTM A 775 - Epoxy Coated Reinforcing Steel Bars.

2.07 PVC TUBING

A. PVC tubing in joints shall be SDR 13.5, conforming to ASTM D 2241 - Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).

PART 3 -- EXECUTION

3.01 GENERAL

A. Waterstops shall be embedded in the concrete across joints as indicated.

B. Waterstops shall be fully continuous for the extent of the joint.

C. Splices necessary to provide such continuity shall conform to the printed instructions of the waterstop manufacturer.

D. The CONTRACTOR shall take suitable precautions and provide means to support and protect the waterstops during the progress of the WORK, and shall repair or replace any waterstops damaged during progress of the WORK at no additional cost to the OWNER.

E. Waterstops shall be stored so as to permit free circulation of air around the waterstop material.

F. When any waterstop is installed in the concrete on one side of a joint while the other portion of the waterstop remains exposed to the atmosphere for more than 2 Days, suitable precautions shall be taken to shade and protect the exposed waterstop from direct rays of the sun during the entire exposure time until the exposed portion of waterstop is embedded in concrete.

3.02 SPLICES IN PVC WATERSTOPS

A. Splices in PVC waterstops shall be performed by heat sealing the adjacent waterstop sections in accordance with the manufacturer's printed recommendations.

B. It is essential that:

1. The material shall not be damaged by heat sealing.

2. The splices shall have a tensile strength of not less than 80 percent of the unspliced material.

3. The continuity of the waterstop ribs and of its tubular center axis shall be maintained.

4. No edge welding will be accepted.

C. Butt joints of the ends of 2 identical waterstop sections may be made while the material is in the forms.

D. Other Joints

1. Joints with waterstops involving more than 2 ends to be jointed together, and joints that involve an angle cut, alignment change, or the joining of 2 dissimilar waterstop sections, shall be prefabricated prior to placement in the forms, allowing not less than 24-inch long strips of waterstop material beyond the joint.

2. Upon inspection and approval, such prefabricated waterstop joint assemblies shall be installed in the forms and the ends of the 24-inch strips shall be butt-welded to the straight run portions of waterstop in place in the forms.

E. Where a centerbulb waterstop intersects and is jointed with a non-centerbulb waterstop, care shall be taken to seal the end of the centerbulb, using additional PVC material if needed.

3.03 JOINT CONSTRUCTION

A. Setting Waterstops

1. In order to eliminate faulty installation that may result in joint leakage, particular care shall be taken as to the correct positioning of the waterstops during installation.

2. Adequate provisions shall be made to support and anchor the waterstops during the progress of the WORK and to ensure proper embedment in the concrete.

3. The symmetrical halves of the waterstops shall be equally divided between the concrete pours at the joints.

4. The center axis of the waterstops shall be coincident with the joint openings.

5. Thoroughly work the concrete in the vicinity of joints for maximum density and imperviousness.

B. Waterstop Placement

1. In placing waterstops in the forms, means shall be provided to prevent them from being folded over by the concrete as it is placed.

2. Waterstops shall be held in place with light wire ties on 12-inch centers, which shall be passed through hog rings at the edge of the waterstop and tied to the curtain of reinforcing steel.

3. Horizontal waterstops, with their flat face in a vertical plane, shall be held in place with continuous supports to which the top edge of the waterstop shall be tacked.

4. In placing concrete around horizontal waterstops with their flat face in a horizontal plane, the concrete shall be worked under the waterstops by hand in order to avoid the formation of air and rock pockets.

C. In placing centerbulb waterstops in expansion joints, the centerbulb shall be centered on the joint filler material.

D. Waterstop in vertical wall joints shall terminate 6 inches from the top of the wall, where such waterstop does not connect with any other waterstop and is not to be connected to a future concrete placement.

E. Joint Location

1. Construction joints and other types of joints shall be provided where indicated.

2. If not indicated, construction joints shall be provided at a 25-foot maximum spacing.

3. Where joints are indicated to be spaced greater than 40 feet apart, additional joints shall be provided to maintain the 25-foot maximum spacing.

4. The location of joints, regardless of type, shall be submitted for acceptance by the ENGINEER OF RECORD.

F. Joint Preparation

1. Special care shall be used in preparing concrete surfaces at joints where bonding between 2 sections of concrete is required.

2. Unless otherwise indicated, such bonding shall be required at every horizontal joint in walls.

3. Surfaces shall be prepared in accordance with Section 03 31 00 – Cast-in-Place Concrete.

G. Retrofit Joint Preparation

1. Existing surfaces to receive a retrofit waterstop shall be clean and free from any loose or foreign material.

2. The surface shall be given a light sandblast or hydroblast finish to 1/8-inch amplitude prior to the application of epoxy and waterstop.

H. Construction Joint Sealant

1. Construction joints in water-bearing floor slabs and elsewhere as indicated shall be provided with tapered grooves which shall be filled with a construction joint sealant.

2. The material used to form the tapered grooves shall be left in the grooves until just before the grooves are cleaned and filled with joint sealant.

3. After removing the forms from the grooves, laitance and fins shall be removed, and the grooves shall be sand blasted.

4. The grooves shall be allowed to thoroughly dry, after which they shall be blown out and immediately thereafter they shall be primed and filled with the construction joint sealant.

5. The primer shall be furnished by the sealant manufacturer, and no sealant shall be used without a primer.

6. Care shall be used to completely fill the sealant grooves.

7. Areas designated to receive a sealant fillet shall be thoroughly cleaned as outlined for the tapered grooves prior to application of the sealant.

I. The primer and sealant shall be placed strictly in accordance with the printed recommendations of the manufacturer, taking special care to properly mix the sealant prior to application.

J. The sides of the sealant groove shall not be coated with bond breaker, curing compound, or any other substance which would interfere with proper bonding of the sealant.

K. The sealant shall achieve final cure at least 7 Days before the structure is filled with water.

L. The sealant shall be installed by a competent waterproofing specialty contractor with a successful record of performance in similar installations.

M. Mixing

1. Catalyst-cured, 2-part materials shall be thoroughly and uniformly mixed, and special care shall be taken to properly mix the sealer before its application.

2. Before any sealer is placed, the CONTRACTOR shall arrange to have workers performing the WORK carefully instructed on the proper method of mixing and application by a representative of the sealant manufacturer.

N. Failure to Cure

1. Any joint sealant that fails to fully and properly cure after the manufacturer's recommended curing time for the conditions of the WORK shall be completely removed, and the groove shall be thoroughly sandblasted to remove traces of the uncured or partially cured sealant and primer.

2. The groove shall be re-sealed with the indicated joint sealant.

3. Costs of such removal, joint treatment, re-sealing, and appurtenant WORK shall be the CONTRACTOR’s responsibility as part of the WORK.

O. Hydrophilic Waterstop

1. Where a hydrophilic waterstop is indicated, it shall be installed in accordance with the manufacturer's instructions and recommendations except as may be modified in this Section.

2. When requested by the CONSTRUCTION MANAGER, the CONTRACTOR shall arrange for the manufacturer to furnish technical assistance in the field.

3. Hydrophilic waterstop shall only be used where complete confinement by concrete is provided.

4. Hydrophilic waterstop shall not be used in expansion or contraction joints nor in the first 6 inches of a non-intersecting joint.

5. Location

   a. The hydrophilic waterstop shall be located as near as possible to the center of the joint, and it shall be continuous around the entire joint.

   b. The minimum distance from the edge of the waterstop to the face of the member shall be 5 inches.

6. Placement

   a. Where the thickness of the concrete member to be placed on the hydrophilic waterstop is less than 12 inches, the waterstop shall be placed in grooves formed or ground into the concrete.

   b. The groove shall be at least 3/4 inch deep and 1-1/4 inches wide.

   c. When placed in the groove, the minimum distance from the edge of the waterstop to the face of the member shall be 2-1/2 inches.

7. Where a hydrophilic waterstop is used in combination with PVC waterstop, the hydrophilic waterstop shall overlap the PVC waterstop for a minimum of 6 inches and shall be adhered to PVC waterstop by a single component water-swelling sealant as recommended by the manufacturer.

8. The hydrophilic waterstop shall not be installed where the air temperature falls below the manufacturer's recommended range.

9. Preparation

    a. The concrete surface under the hydrophilic waterstop shall be smooth and uniform, and the concrete shall be ground smooth if needed.

    b. Alternatively, the hydrophilic waterstop shall be bonded to the surface using an epoxy grout that completely fills voids and irregularities beneath the waterstop material.

    c. Prior to installation, the concrete surface shall be wire brushed to remove any laitance or other materials that may interfere with the bonding of epoxy.

10. Securing

    a. The hydrophilic waterstop shall be secured in place with concrete nails and washers at 12-inch maximum spacing.

    b. The above requirement shall be in addition to the adhesive recommended by the manufacturer.

P. Retrofit Waterstop

1. Retrofit waterstops shall be set in a bed of epoxy over a sandblasted surface with stainless steel batten bars and 1/4-inch diameter stainless steel anchors at 6 inches on-center, staggered, and in accordance with the manufacturer's written recommendations.

END OF SECTION

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SECTION 03 54 00

CAST UNDERLAYMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Standard Provisions and Special Provisions apply to this Section.

1.02 SUMMARY

A. Section includes polymer-modified, self-leveling, hydraulic cement underlayment.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include plans indicating substrates, locations, and average depths of underlayment based on survey of substrate conditions.

1.04 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, if requested.

1.05 CLOSEOUT SUBMITTALS

A. Warranty: Manufacturer’s standard form.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: Installer who is pre-approved and trained by cast underlayment manufacturer for application of underlayment products required for this Project.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer’s unopened packaging until ready for installation.

B. Keep products dry and protect from direct sun exposure, freezing, and ambient temperature as recommended by manufacturer.

1.08 FIELD CONDITIONS

A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ventilation, ambient temperature and humidity, and other conditions affecting underlayment performance.

1. Place hydraulic cement underlayments only when ambient temperature and temperature of substrates are between 50 and 80 deg F (10 and 27 deg C).

1.09 WARRANTY

A. Manufacturer's standard form.

1. Warranty Period: 10 years beginning from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 HYDRAULIC CEMENT UNDERLAYMENTS

A. Hydraulic Cement Underlayment: Polymer-modified, self-leveling, hydraulic cement product that can be applied in minimum uniform thickness of 1/8 inch (3 mm) and that can be feathered at edges to match adjacent floor elevations.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Uzin NC 170 LevelStar Premium Self Leveling Compound or a comparable product.
2. Cement Binder: ASTM C 150/C 150M, Portland cement, or hydraulic or blended hydraulic cement as defined by ASTM C 219.
3. Compressive Strength: Not less than 5300 psi at 28 days when tested according to ASTM C 109/C 109M.
4. Flexural Strength: Not less than 1100 psi at 28 days when tested according to ASTM C348.
5. Underlayment Additive: Resilient-emulsion product of underlayment manufacturer, formulated for use with underlayment when applied to substrate and conditions indicated.

B. Trowelable Patching Compounds/Joint and Crack Filler:

1. Material: Latex-modified, Portland cement based or blended hydraulic cement based formulation provided or approved by floor covering manufacturer for applications indicated.
2. Basis-of-Design Product: Subject to compliance with requirements, provide Uzin NC 888 Turbo Patching Compound or a comparable product.

C. Aggregate: Sand as recommended by underlayment manufacturer.

1. Provide aggregate when recommended in writing by underlayment manufacturer for underlayment thickness required.

D. Water: Potable and at a temperature of not more than 70 deg F (21 deg C).

E. Primers:

1. Primer at First Floor Levels on Grade: Product of underlayment manufacturer recommended in writing for substrate, conditions, and application indicated.

a. Basis-of-Design Product: Subject to compliance with requirements, provide Koster VAP I 06 Primer, or a comparable product as recommended by cast underlayment manufacturer.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, with Installer present, for conditions affecting performance of the Work.

B. Proceed with application only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. General: Prepare and clean substrate according to manufacturer's written instructions.

1. Treat nonmoving substrate cracks according to manufacturer's written instructions to prevent cracks from telegraphing (reflecting) through underlayment.
2. Fill substrate voids to prevent underlayment from leaking.

B. Concrete Substrates: Mechanically remove, according to manufacturer's written instructions, laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants that might impair underlayment bond.

C. Adhesion Tests: After substrate preparation, test substrate for adhesion with underlayment according to manufacturer's written instructions.

3.03 APPLICATION

A. General: Mix and apply underlayment components according to manufacturer's written instructions.

1. Close areas to traffic during underlayment application and for time period after application recommended in writing by manufacturer.
2. Coordinate application of components to provide optimum adhesion to substrate and between coats.
3. At substrate expansion, isolation, and other moving joints, allow joint of same width to continue through underlayment.

B. Apply primer over prepared substrate at manufacturer's recommended spreading rate.

C. Fill cracks, holes, and depressions in substrates with trowelable patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

D. Apply underlayment to produce uniform, level surface.

1. Apply a final layer without aggregate to product surface.

2. Feather edges to match adjacent floor elevations.

E. Cure underlayment according to manufacturer's written instructions. Prevent contamination during application and curing processes.

F. Remove and replace underlayment areas that evidence lack of bond with substrate, including areas that emit a "hollow" sound when tapped.

3.04 PROTECTION

A. Protect underlayment from concentrated and rolling loads for remainder of construction period.

END OF SECTION

SECTION 03 60 00

GROUTING

PART 1 -- GENERAL

1.01 THE SUMMARY

A. The CONTRACTOR shall provide grout, complete and in place, in accordance with the Contract Documents. For concrete repair material and procedures, reference Section 03 01 30 – Concrete Repair and Rehabilitation.

B. Grout provided as a base support for mechanical and electrical equipment shall conform to manufacturer's requirements and the requirements of this section.

C. The following types of grout are covered in this Section:

1. Non-Shrink Grout

2. High Strength Non-Shrink Grout

3. Non-Shrink Epoxy Grout

4. Topping Grout and Concrete/Grout Fill

1.02 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. ASTM C109 - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or 50-mm Cube Specimens)

B. ASTM C307 -- Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacings

C. ASTM C531 – Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes

D. ASTM C579 – Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes

E. ASTM C580 – Standard Test Method for Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes

F. ASTM C827 – Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures

G. ASTM C882 - Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear

H. ASTM C1090 – Standard Test Method for Measuring Changes in Height of Cylindrical Specimens from Hydraulic-Cement Grout

I. ASTM C1107 – Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)

J. ASTM C1116 – Standard Specification for Fiber-Reinforced Concrete

K. ASTM C1339 – Standard Test Method for Flowability and Bearing Area of Chemical-Resistant Polymer Machinery Grouts

1.03 RELATED SECTIONS

A. Section 03 01 30 Concrete Repair and Rehabilitation

B. Section 03 21 00 Reinforcement Steel

C. Section 03 31 00 Cast-in-Place Concrete

1.04 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 7 of Standard Provisions – Submittal Management.

1. Certified testing lab reports for tests indicated herein.

2. Test results and service report from the field tests and the demonstration and training session verifying the requirements indicated herein.

3. Manufacturer’s literature containing instructions and recommendations on the mixing, handling, placement, curing, and appropriate uses for each type of grout used in the WORK, and location of use.

4. Documentation indicating that the grouts contain no chlorides or other chemicals that cause corrosion.

5. Manufacturer’s Safety Data Sheet documenting composition of grouts.

6. Submit manufacturer's written warranty as indicated herein.

7. Name and telephone number of grout manufacturer's representative who will give on-site service. The representative shall have at least one year of experience with the indicated grouts.

1.05 QUALITY ASSURANCE

A. Field Tests

1. Compression test specimens will be taken from the first placement of each type of grout, and at intervals thereafter selected by the ENGINEER OF RECORD. The specimens will be made by the ENGINEER OF RECORD or its representative.

2. Compression tests and fabrication of specimens for cement grout and cement based non-shrink grout will be performed in accordance with ASTM C1107 at intervals during construction selected by the ENGINEER OF RECORD.

3. Compression tests and fabrication of specimens for topping grout and concrete/grout fill will be performed in accordance with Section 03 31 00 - Cast-in-Place Concrete at intervals during construction selected by the ENGINEER OF RECORD.

4. Compression tests and fabrication of specimens for epoxy grouts will be performed in accordance with ASTM C579, Method B, at intervals during construction selected by the ENGINEER OF RECORD. A set of 3 specimens will be made for testing at 7 Days and each earlier time period as appropriate.

5. The cost of laboratory tests on grout will be paid by the OWNER except where test results show the grout to be defective. In such case, the CONTRACTOR shall pay for the tests, removal and replacement of Defective Work, and re-testing, all as part of the WORK.

6. The CONTRACTOR shall assist the CONSTRUCTION MANAGER in obtaining specimens for testing and shall furnish materials necessary for fabricating the test specimens.

B. Construction Tolerances: Construction tolerances shall be as indicated in Section 03 31 00 unless indicated otherwise.

C. Pre-Installation Demonstration and Training

1. Non-Shrink Grouts

a. The grout manufacturer shall give a demonstration and training session for the cement based and epoxy non-shrink grouts to be used on the project before any installation of grout is allowed.

b. The CONTRACTOR shall transport the test cubes to an independent test laboratory, obtain the test reports, and report these demonstration and training test cube strengths to the CONSTRUCTION MANAGER.

1.06 SPECIAL CORRECTION OF DEFECTS PROVISIONS

A. Manufacturer's Warranty

1. Furnish one year warranty for WORK provided under this section.

2. Manufacturer's warranty shall not contain a disclaimer limiting responsibility to the purchase price of products or materials.

PART 2 -- PRODUCTS

2.01 APPLICATION

A. Unless indicated otherwise, grouts shall be provided as listed below whether indicated on the Drawings or not.

Application	Type of Grout
Beam and column (1 or 2 story) base plates less than 16-inches in the least dimension.	Non-Shrink
Column base plates (greater than 2 story or larger than 16-inches in the least dimension)	High Strength Non-Shrink
Under precast concrete elements	High Strength Non-Shrink
Storage tanks and other non-motorized equipment or machinery under 30 horsepower	Non-Shrink
Motorized equipment over 30 horsepower and equipment under 30 horsepower but subject to severe shock loads and high vibrations	Non-Shrink Epoxy
Filling blockout spaces for embedded items such as railing posts, gate guide frames, etc.	Non-Shrink
Toppings and concrete/grout fill less than 3-inches thick	Topping Grout
Toppings and concrete/grout fill greater than 3-inches thick	Structural Concrete 03 31 00
Anchor bolts, anchor rods and reinforcing steel required to be set in epoxy or adhesive.	Post Installed Anchors in Concrete per Section 05 05 19
Repair of holes and defects in concrete members.	Concrete Repair and Rehabilitation per Section 03 01 30

2.02 NON-SHRINK GROUTS

A. General

1. All non-shrink grout shall be cement based unless otherwise noted.

2. Cement-based non-shrink grout shall be a prepackaged, inorganic, fluid, non-gas liberating, non-metallic, cement type grout requiring only the addition of water. Cement from kilns burning metal-rich hazardous waste fuel shall not be used.

3. Manufacturer's instructions shall be printed on each bag or other container in which the materials are packaged. The specific formulation for each non-shrink grout shall be as recommended by the manufacturer for the particular application.

4. The manufacturer's product information shall state the acceptability of the non-shrink grout for the intended purpose and location.

5. Grout shall not contain chlorides or additives that may contribute to corrosion.

6. Grout placed in continuously wet environments or in exterior conditions shall not contain gypsum or calcium salt.

7. All cement-based non-shrink grout shall have the following general properties:

   a. Meet the requirements of ASTM C1107.

   b. Have a maximum early age height change of 4.0 percent expansion, and shall have no shrinkage (0.0 percent) in accordance with ASTM C827. The grout when tested shall not bleed or segregate at maximum allowed water.

   c. No shrinkage (0.0 percent) and a maximum of 0.3 percent expansion in the hardened state when tested in accordance with ASTM C1090.

   d. A minimum bond strength (concrete to grout) of 1900 psi per modified ASTM C882.

8. Environmental and ambient conditions shall be a factor in the selection of non-shrink grout. If a non-shrink grout is to be used in a high sulfate environment, marine environment, high temperature environment, or freeze/thaw environment, the manufacturer's product information shall state the acceptability for each environmental condition.

B. Non-Shrink Grout

1. Non-Shrink Grout shall have a minimum 28 Day compressive strength of 5000 psi when mixed at a fluid consistency and tested per ASTM C109.

2. Non-Shrink Grout shall be **Five Star Grout** by **Five Star Products, Five Star Fluid Grout 100** by **Five Star Products, Sikagrout 212** by **Sika Corporation,** or approved equal.

C. High Strength Non-Shrink Grout

1. High Strength Non-Shrink Grout shall have a minimum 28-Day compressive strength of 10,000 psi when mixed at a fluid consistency and tested per ASTM C109.

2. High Strength Non-Shrink Grout shall be **Five Star High Strength Grout** by **Five Star Products, Sikagrout 428 FS,** or approved equal.

2.03 NON-SHRINK EPOXY GROUT

A. Non-shrink epoxy grout shall be a flowable, non-shrink, 100 percent solids system. The epoxy grout system shall have 3 components: resin, hardener, and specially blended aggregate, each premeasured and prepackaged. The resin component shall not contain any non-reactive diluents.

B. The manufacturer's product information shall state the acceptability of the epoxy grout for the intended purpose and location.

C. Variation of component ratios is not permitted unless specifically recommended by the manufacturer. Manufacturer's instructions shall be printed on each container in which the materials are packaged.

D. Resins containing butyl glycidyl ether (BGE) or other highly volatile and hazardous reactive diluents are not acceptable.

E. Non-shrink epoxy grout shall have a negligible (less than 0.0006 in/in) length change after hardening, and a coefficient of thermal expansion less than 0.00003 in/in F when tested in accordance with ASTM C531.

F. Non-shrink epoxy grout shall develop a minimum compressive strength of 9000 psi in 24 hours and 13,000 psi in seven days when tested in accordance with ASTM C579, method B.

G. The effective bearing area shall be a minimum of 85 percent effective bearing area (EBA) in accordance with ASTM C1339, for bearing area and flow.

H. The chemical formulation of the non-shrink epoxy grout shall be that recommended by the manufacturer for the particular application. Do not reduce aggregate loading or add solvents to increase flowability.

I. Non-shrink epoxy grout shall have the following minimum properties when tested at 7 Days:

1. Minimum bond strength to concrete of 3000 psi per ASTM C882 modified.

2. Minimum bond strength to steel of 1700 psi per ASTM C882 modified.

3. Minimum flexural strength of 2500 psi per ASTM C580.

4. Minimum tensile strength of 2000 psi per ASTM C307.

J. Non-shrink epoxy grout shall be **Five Star DP Epoxy Grout** by **Five Star Products, Inc.**, **Masterflow 648** by **BASF Corporation**, **Sikadur 42 Grout-Pak** by **Sika Corporation**, or approved equal.

2.04 TOPPING GROUT AND CONCRETE/GROUT FILL

A. Where fill thickness is 3-inches or greater, structural concrete as indicated in Section 03 31 00 - Cast-in-Place Concrete, may be used when accepted by the ENGINEER OF RECORD. Fiber reinforcing shall be as indicated below.

B. Grout for topping of slabs and concrete/grout fill for built-up surfaces of tanks, channels, and basin bottoms shall be composed of cement, fine aggregate, coarse aggregate, water, and admixtures proportioned and mixed as indicated. Materials and procedures indicated for structural concrete in Section 03 31 00 - Cast-in-Place Concrete, shall apply unless indicated otherwise.

C. Topping grout and concrete/grout fill shall contain a minimum of 564 pounds of cement per cubic yard with a maximum water/cement ratio of 0.45. Topping grout in mixing tanks shall contain between 750 and 800 pounds of cement per cubic yard with a maximum water/cement ratio of 0.42.

D. Coarse aggregate shall be graded as follows:

U.S. Standard Sieve Size	Percent By Weight Passing
1/2 in	100
3/8 in	90-100
No. 4	20-55
No. 8	5-30
No. 16	0-10
No. 30	0

E. Final mix design shall be as determined by trial mix design as indicated in Section 03 31 00, except that drying shrinkage tests are not required.

F. Topping grout and concrete grout/fill shall contain air-entraining agent per Section 03 31 00.

Strength: Minimum compressive strength of topping grout and concrete/grout fill at 28 days shall be 4000 psi.

G. Topping grout used in mixing tanks, or where the fill thickness is 3 inches or greater shall contain fiber reinforcing, unless otherwise shown on the Contract Documents. Fiber reinforcing shall be 100 percent virgin polypropylene fibrillated fibers specifically manufactured in a blended gradation for use as concrete secondary reinforcement. Fibers shall be added at a rate of 1.5 pounds per cubic yard of concrete. Fibers shall conform to ASTM C1116.

2.05 CURING MATERIALS

A. Curing materials shall be in accordance with Section 03 31 00 and as recommended by the manufacturer of prepackaged grouts.

2.06 CONSISTENCY

A. The consistency of grout shall be as necessary to completely fill the space to be grouted for the particular application. Dry pack consistency is defined such that the grout is plastic and moldable but will not flow. Where "dry pack" is called for in the Contract Documents, it shall mean a grout of that consistency; the type of grout to be used shall be as indicated herein for the particular application.

B. The slump for topping grout and concrete/grout fill shall be adjusted to match placement and finishing conditions but shall not exceed 4-inches.

2.07 MEASUREMENT OF INGREDIENTS

A. Measurements for cement grout shall be made accurately by volume using containers. Shovel measurements shall not be allowed.

B. Prepackaged grouts shall have ingredients measured by means recommended by the manufacturer.

PART 3 -- EXECUTION

3.01 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Grout shall be stored in accordance with manufacturer's recommendations.

3.02 GENERAL

A. CONTRACTOR shall arrange for the manufacturer of prepackaged grouts to provide on-site technical assistance within 72 hours of request, as part of the WORK.

B. Grout shall not be placed until base concrete or masonry has attained its design strength, unless authorized otherwise by the ENGINEER OF RECORD.

C. When cementitious grouts are used on concrete surfaces, the concrete surface shall be saturated with water for 24 hours prior to placement. Upon completion of the saturation period, excess water shall be removed with clean, oil free compressed air prior to grouting. Concrete substrate shall not be wet prior to placement of epoxy grouts.

D. Surface preparation, curing, and protection of cement grout shall be in accordance with Section 03 31 00. The finish of the grout surface shall match that of the adjacent concrete unless otherwise indicated.

E. Surfaces that will be in contact with grout shall be free of dirt, loose rust, oil, wax, grease, curing compounds, laitance, loose concrete, and other deleterious materials.

F. Shade the WORK from sunlight for at least 24 hours before and 48 hours after grouting.

G. Contact the grout manufacturer's representative for assistance on hot and cold weather grouting techniques and precautions if applicable.

3.03 GROUTING PROCEDURES

A. General: Mixing, surface preparation, handling, placing, consolidation, curing, and other means of execution for prepackaged grouts shall be done according to the instructions and recommendations of the manufacturer.

B. Structural, equipment, tank, and piping support bases shall be grouted, unless indicated otherwise.

1. The original concrete shall be blocked out or finished off a sufficient distance below the plate to provide for a minimum one-inch thickness of grout or other thickness if indicated.

2. After the base plate has been set in position at the proper elevation by steel wedges or double nuts on the anchor bolts, the space between the bottom of the plate and the original pour of concrete shall be filled with non-shrink-type grout through a headbox of appropriate size. The mixture shall be of a fluid consistency and poured continuously into the space between the plate and the base concrete. Forms for grout shall be tight against retaining surfaces, and joints shall be sealed as recommended by the grout manufacturer to be liquid-tight. Forms shall be coated as recommended by the grout manufacturer for easy form release. Where this method of placement is not practical or where required by the ENGINEER OF RECORD, alternate grouting methods shall be submitted by the CONTRACTOR for acceptance by the ENGINEER OF RECORD.

3. Concrete equipment pads for equipment bases that will be epoxy-grouted shall be sized so that, when the equipment base is fully grouted, the epoxy grout is stopped not less than 4-inches from the edge of the pad.

C. Topping Grout and Concrete/Grout Fill

1. Mechanical, electrical, and finish WORK shall be completed prior to placement of topping or concrete/grout fill. To ensure bonding to the base slab, the base slab shall be given an exposed aggregate finish. Alternatively, where accepted by the ENGINEER OF RECORD, the base slab shall be given a roughened textured surface by a close-spaced rake while the surface is green. After curing, high pressure washing shall expose the aggregates and produce not less than a 3/16-inch amplitude roughness. Jackhammers or chipping hammers shall not be used.

2. The minimum thickness of grout topping and concrete/grout fill shall be one-inch. Where the finished surface of concrete/grout fill is to form an intersecting angle of less than 45 degrees with the concrete surface it is to be placed against, a key shall be formed in the concrete surface at the intersection point. The key shall be a minimum of 3-1/2 inches wide by 1-1/2 inches deep.

3. The base slab shall be thoroughly cleaned and wetted to saturated surface dry (SSD) condition per the International Concrete Repair Institute (ICRI) -- Technical

Guide for Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays, prior to placing topping grout and grout fill. No topping grout shall be placed until the slab is completely free from standing pools or ponds of water. A thin coat of neat cement grout shall be broomed into the surface of the slab just before topping or fill placement. The neat cement grout shall not be allowed to dry before topping placement. If it does dry, it must be immediately removed using wet stiff brooms and reapplied. The topping and fill shall be compacted by rolling or thorough tamping, brought to established grade, and floated. Grouted fill for tank and basin bottoms where scraping mechanisms are to be installed shall be screeded by blades attached to the revolving mechanism of the equipment in accordance with the procedures outlined by the equipment manufacturer after the grout is brought to the established grade. Coat surface with evaporation retardant as needed to prevent plastic shrinkage cracks.

4. Topping grout placed on sloping slabs shall proceed uniformly from the bottom of the slab to the top, for the full width of the placement.

5. The surface shall be tested with a straight edge to detect high and low spots which shall be immediately eliminated. When the topping or fill has hardened sufficiently, it shall be steel troweled to a smooth surface free from pinholes and other imperfections. An approved type of mechanical trowel may be used as an assist in this operation, but the last pass over the surface shall be by hand-troweling. During finishing, no water, dry cement, or mixture of dry cement and sand shall be applied to the surface.

6. As soon as topping or fill finishing is completed, coat surface with curing compound. After the topping is set and sufficiently hard in clarifiers and where required by the ENGINEER OF RECORD, the tank shall be filled with sufficient water to cover the entire floor for 14 days.

3.04 CONSOLIDATION

A. Grout shall be placed in such a manner, for the consistency necessary for each application, to assure that the space to be grouted is completely filled.

END OF SECTION

SECTION 04 05 19.29

POST-INSTALLED ANCHORS IN MASONRY

PART 1 -- >GENERAL

1.01 THE SUMMARY

A. Provide post-installed anchors and appurtenances, complete and in place, as indicated in accordance with the Contract documents.

B. Unless otherwise indicated, drilled masonry anchors shall be adhesive anchors.

C. Section Includes:

1. Adhesive anchors
2. Expansion anchors
3. Screw anchors

1.02 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Definitions

1. Epoxy anchors are considered adhesive anchors.
2. Expansion anchors, screw anchors, and undercut anchors are considered mechanical anchors.

B. References

1. TMS 402-16 Building Code Requirements for Masonry Structures
2. TMS 602-16 Specification for Masonry Structures
3. ASCE 7-16 ASCE Standard ASCE/SEI 7 Minimum Design Loads for Buildings and Other Structures
4. ASCE 41-13 ASCE Standard ASCE/SEI 41 Seismic Evaluation and Retrofit of Existing Buildings
5. ICC ES AC01 Acceptance Criteria for Expansion Anchors in Masonry Elements
6. ICC ES AC58 Acceptance Criteria for Adhesive Anchors in Masonry Elements
7. ICC ES AC106 Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements
8. NSF 61-2016 NSF/ANSI 61 Drinking Water System Components – Health Effects

1.03 RELATED SECTIONS

A. Section 04 22 00 Reinforced Concrete Block Masonry

1.04 SUBMITTALS

A. Furnish submittals in accordance with Section 7 of Standard Provisions – Submittal Management.

B. Submit the following:

1. Product data and technical information

2. Safety Data Sheets (SDS) for adhesives

3. Manufacturer's literature containing installation instructions and appropriate uses for each type of post-installed anchor and location of use

4. Current ICC-ES or IAPMO-UES Evaluation Reports

5. Certification for each installer demonstrating that they have been qualified in accordance with the Quality Assurance requirements below

C. No substitution for the indicated anchors will be considered unless accompanied with an ICC-ES or IAPMO-UES report verifying strength and material equivalency.

D. Complete structural calculations and anchorage details shall be prepared and submitted by the Contractor for all anchors and anchor groups that are shown but not completely detailed (type, size, location, spacing and embedment) on the Contract Documents. Calculations and anchorage details shall be completed and submitted in accordance with Section 13.05 of Special Provisions – Contractor's Engineering and Design.

1. Where adhesive anchors are used for structural applications (such as dowels between new and existing masonry) and an embedment depth is not shown on the contract documents, the anchor shall be installed in accordance with Method 1 or Method 2 below:

a. Method 1: The minimum depth of embedment shall be greater than or equal to the development length (l_d) determined in accordance with TMS 402 for a cast in place reinforcing bar of the same diameter and grade, unless it can be shown by calculation that the anchor spacing and edge distance is sufficient to develop the tensile strength of the anchor in a lesser depth of embedment. Calculations shall be submitted in accordance with Section 7 of Standard Provisions – Submittal Management and Section 13.05 of Special Provisions – Contractor's Engineering and Design.

b. Method 2: Adhesive anchors in masonry that cannot develop the tensile capacity of the steel element may be used to transfer forces, provided that the loads on the anchor are amplified by the system overstrength factor (Ω_o) in ASCE 7, or where unreduced forces are used in accordance with ASCE 41 for existing structures. Calculations shall be submitted in accordance with Section

7 of Standard Provisions – Submittal Management and Section 13.05 of Special Provisions – Contractor's Engineering and Design.

1.05 QUALITY ASSURANCE

A. Special inspection for all post-installed anchor installations shall be provided:

1. As recommended or required by the ICC-ES or IAPMO-UES report.

2. As required by the enforceable building code.

3. As otherwise indicated in the Contract Documents.

B. The most stringent of the above requirements shall be used. The cost of Special Inspection of post-installed anchors shall be paid for by the OWNER.

C. Before installing adhesive anchors in the WORK, anchor installers shall be trained and qualified at the Site by the manufacturer's representative. Training and qualification for each installer shall include at least:

1. Hole drilling procedure, hole preparation and cleaning techniques, adhesive injection technique and dispenser training/maintenance, rebar dowel preparation and installation, and proof loading if required.

2. Each installer shall be re-qualified every 6 months for the duration of the project by the same qualifying procedure.

D. Before installing mechanical anchors in the WORK, anchor installers shall be trained and qualified at the Site by the manufacturer's representative. Training and qualification for each installer shall include at least:

1. Hole drilling procedure, hole preparation and cleaning techniques, and torqueing.

2. Each installer shall be re-qualified every 6 months for the duration of the project by the same qualifying procedure.

E. Defective anchors noted by the Special Inspector shall be replaced and re-installed by the CONTRACTOR at a location approved by the ENGINEER OF RECORD.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to job site in manufacturer's or distributor's packaging undamaged, complete with installation instructions.

B. Protect and handle materials in accordance with manufacturer's recommendations to prevent damage or deterioration.

C. Anchoring adhesives shall be stored at temperatures prescribed by the manufacturer and must not be used beyond the expiration date.

1.07 FIELD OR SITE CONDITIONS

A. Post-installed anchors shall be installed in grout filled, concrete masonry having the minimum age required by the ICC-ES or IAPMO-UES report, or manufacturer's instructions, at the time of anchor installation.

B. The anchor or fastener coating, plating, or steel type must provide suitable corrosion resistance for the environment in which the anchor or fastener is installed. Anchors, nuts, and washers in the locations listed below shall be fabricated from Type 316 or 304 stainless steel:

1. buried locations

2. locations subject to seasonal or occasional flooding

3. inside buried vaults, manholes, and structures that do not drain through a gravity sewer or to a sump with a pump

4. chemical handling areas

5. inside trenches, containment walls, and curbed areas

6. locations indicated or designated by the ENGINEER OF RECORD to be provided with stainless steel anchors.

PART 2 -- PRODUCTS

2.01 ADHESIVE ANCHORS

A. General

1. The adhesive anchor system shall consist of: 1) adhesive product; and 2) threaded rod or reinforcing bar insert. The complete system shall be compatible as required by the adhesive manufacturer.

2. Adhesives shall be injectable, two-component, cartridge-type systems dispensed and mixed through a static mixing nozzle supplied by the manufacturer.

3. The evaluation report issued by ICC-ES or IAPMO-UES shall state the acceptability of the adhesive anchor for the intended purpose and location.

4. Adhesive anchors shall be permitted when regular ambient temperatures are consistent with manufacturer's recommendation for long and short term temperatures.

5. Adhesive anchors shall not be used where anchors are subject to vibration or fire.

6. Adhesive anchors shall not be used in overhead applications.

7. Adhesive shall meet the requirements of NSF/ANSI Standard 61.

8. Adhesive shall be capable of being used in submerged applications once cured.

B. Adhesive Anchors in Grout Filled Concrete Masonry Units

1. Threaded rod inserts shall meet the requirements of Section 05 50 00- Miscellaneous Metalwork.

2. Reinforcing dowel inserts shall meet the material requirements of Section 03 21 00 – Reinforcement Steel and 03 31 00 – Cast-in-Place Concrete.

3. Adhesive anchors shall have an evaluation report issued by ICC-ES or IAPMO-UES and shall have been tested and qualified for performance in grout filled concrete masonry adhesive anchors in accordance with ICC-ES AC 58 to resist static, wind, and earthquake (Seismic Design Categories A through F).

4. Adhesive anchors for masonry shall be **AC100+ Gold by DeWalt/Powers Fasteners, HIT-HY 270 by Hilti, SET-XP by Simpson Strong-Tie,** or equal.

2.02 EXPANSION ANCHORS

A. General

1. Expansion anchors are post-installed torque-controlled mechanical expansion anchors used to resist structural loads.

2. Expansion anchors shall be an imperial sized, threaded stud with an integral cone expander, expansion clip, nut and washer.

3. Lead caulking anchors will not be permitted.

4. Non-embedded buried or submerged anchors shall be fabricated from stainless steel.

5. The evaluation report issued by ICC-ES or IAPMO-UES shall state the acceptability of the expansion anchor for the intended purpose and location.

6. Anchors subjected to dynamic or vibratory loading shall be suitable for the intended loading and location as indicated in the manufacturer's technical product data.

B. Expansion Anchors for Grout Filled Concrete Masonry Units

1. Anchors shall have an evaluation report issued by ICC-ES or IAPMO-UES and have been tested and qualified for performance in grout filled, uncracked concrete masonry units in accordance with ICC-ES AC01.

2. Expansion anchors for grout filled concrete masonry shall be **Strong-Bolt 2 by Simpson Strong-Tie, Kwik-Bolt TZ by Hilti, Power-Stud+ SD1 by DeWalt/Powers Fasteners,** or equal.

2.03 SCREW ANCHORS

A. General

1. Screw anchors used in exterior and corrosive environments shall be fabricated from stainless steel.

2. The evaluation report issued by ICC-ES or IAPMO-UES shall state the acceptability of the screw anchor for the intended purpose and location.

3. Anchors subjected to dynamic or vibratory loading shall be suitable for the intended loading and location as indicated in the manufacturer's technical product data.

B. Screw Anchors for Grout Filled Concrete Masonry

1. Anchors shall have an evaluation report issued by ICC-ES or IAPMO-UES and have been tested and qualified for performance in grout filled concrete masonry in accordance with ICC-ES AC106.

2. Screw anchors for grout filled concrete masonry shall be **Titen HD by Simpson Strong-Tie, Kwik HUS-EZ (KH-EZ) by Hilti, Screw Bolt + by DeWalt/Powers,** or equal.

PART 3 -- >EXECUTION

3.01 INSTALLATION REQUIREMENTS

A. Post-installed anchors shall be installed in strict accordance with the manufacturer's instructions, the ICC-ES or IAPMO-UES report, and project specific design requirements indicated on the Contract Documents or in the design calculations provided by the CONTRACTOR per Section 1.3.D.

B. Where holes are drilled in masonry, holes shall be accurately and squarely drilled, and the holes shall be cleaned in accordance with the manufacturer's recommendations.

C. Acceptable installation and performance temperature ranges shall be verified with manufacturer's literature prior to installation. Minimum substrate temperatures shall be maintained during the full curing period as required by the manufacturer.

D. Adhesive anchors shall not be loaded until the adhesive has reached its indicated strength in accordance with the manufacturer's instructions.

E. The CONTRACTOR shall identify the position of reinforcing steel and other embedded items prior to drilling holes. Care shall be exercised in drilling to avoid damaging existing reinforcing or embedded items. The location of drilled holes shall be adjusted to avoid drilling through or cutting any existing reinforcing bars or embedded items. Notify the CONSTRUCTION MANAGER if reinforcing steel or other embedded items are encountered during drilling. Take precautions as necessary to avoid damaging prestressing tendons, electrical and communications conduit, and piping.

F. Core drilling of holes is not allowed.

G. Identification of reinforcing steel and/or embedded items, relocation of drilled holes and adjustments or modifications to anchored or fastened items shall be considered part of the WORK and shall be provided at no additional cost to the OWNER.

H. All abandoned drilled holes shall be repaired in accordance with Section 03 01 30 - Concrete Repair and Rehabilitation at no additional cost to the OWNER.

END OF SECTION

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SECTION 04 22 00

REINFORCED CONCRETE BLOCK MASONRY

PART 1 -- GENERAL

1.01 THE SUMMARY

A. The CONTRACTOR shall provide concrete masonry and appurtenant WORK, complete and in place, in accordance with the Contract Documents.

1.02 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. References

1. TMS 402 – Building Code Requirements for Masonry Structures (TMS 402-16)

2. TMS 602 – Specification for Masonry Structures (TMS 602-16)

1.03 RELATED SECTIONS

A. Section 04 05 19.29 Reinforced Concrete Block Masonry

1.04 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 7 of Standard Provisions – Submittal Management.

B. Samples

1. If the required product is a colored and textured unit, the samples shall be colored and textured units. Submit samples of concrete masonry units illustrating colors and textures available for the ENGINEER OF RECORD to choose. Full size samples of the blocks selected shall be submitted for final approval after color selection, if requested.

2. Samples of mortar colors for color selection.

3. A minimum 4-ft square free-standing sample panel shall be prepared for approval before starting masonry WORK. The panel shall remain at the Site for reference until masonry WORK is completed.

C. Documentation

1. Reports from testing masonry units

2. Reports from mortar and grout testing.

3. Reports from prism testing.

D. Grout and mortar mix design

1. Proportions for components

2. Mill tests for cement

3. Admixture certification. Include chloride ion content.

4. Aggregate graduation and certification

5. Lime certification

6. Fly ash certification and chemical analysis.

1.05 QUALITY ASSURANCE

A. Applicable Standards: Concrete masonry shall conform to California Building Code (CBC), The Masonry Society TMS 402/602 - Building Code Requirements and Specifications for Masonry Structures.

B. WORK shall conform to the standard of quality established by the approved free-standing sample panel.

C. Concrete block masonry units shall be sampled and tested in accordance with ASTM C 140 - Test Methods of Sampling and Testing Concrete Masonry and Related Units.

D. Testing of Mortar and Grout: The CONTRACTOR shall have the mortar and grout tested to assure compliance with the Specifications and the governing codes by a recognized testing laboratory approved by the CONSTRUCTION MANAGER. Test reports shall be submitted to the CONSTRUCTION MANAGER.

1. Tests shall be taken at the following times:

a. At commencement of masonry WORK, at least 2 test samples each of mortar and grout shall be taken on 3 successive Days.

b. At any change in materials or job conditions, at least 2 samples of each modified material, grout, and mortar shall be tested.

c. Make 4 random tests each of mortar and grout. The random test samples shall be taken when requested by the CONSTRUCTION MANAGER.

d. Additional samples and tests may be required whenever, in the judgment of the CONSTRUCTION MANAGER, additional tests beyond the 4 random tests are necessary to determine the quality of the materials.

e. The costs of tests and test reports, except for any additional tests requested by the CONSTRUCTION MANAGER, shall be paid by the CONTRACTOR as part of the WORK. The costs of the additional tests and reports, when reports verify compliance with the Contract Documents, will be paid by the OWNER. When tests or reports do not verify compliance, the cost of every additional test and report shall be paid by the CONTRACTOR.

2. Samples shall be stored in a moist environment until tested, unless directed otherwise by the CONSTRUCTION MANAGER or the testing laboratory. Testing for mortar shall be in accordance with ASTM C 270 - Mortar for Unit Masonry. Grout shall be tested per ASTM C 1019 - Standard Test Method for Sampling and Testing Grout.

E. Test of Masonry Prisms: The OWNER will test masonry prisms to assure compliance with the Specifications and the governing Codes. Testing will be by a recognized testing laboratory.

1. Tests will be made of the following items:

a. Prior to construction, at least 5 masonry prisms shall be made for each type of block herein, except separate prisms are not required for block which only varies by texture.

b. At any change in materials during construction, at least 5 masonry prisms shall be made for each type of block affected.

c. One set of at least 5 masonry prisms shall be made for each masonry structure, besides the structure that the sample is part of, or for each week in which block is laid, for each type of block involved; whichever occurs first.

d. Additional sets of at least 5 masonry prisms may be required whenever, in the judgment of the CONSTRUCTION MANAGER, additional tests are necessary to determine the quality of the materials.

e. The CONTRACTOR shall submit a letter of certification from the CMU Supplier at the time of or prior to delivery of the materials to the Site, that the materials used in construction are representative of the materials used to construct the prisms.

2. The prisms shall be constructed by the CONTRACTOR in the presence of the CONSTRUCTION MANAGER. The same individuals who lay the block in the structure shall construct the masonry prism.

3. The masonry prism shall be constructed and tested in accordance with ASTM C 1314 - Test Methods for Compressive Strength of Masonry Prisms.

4. Compression tests made on sets of specimens made during construction shall include 2 prisms tested at 7 Days after grouting and 3 prisms tested at 28 Days after grouting.

5. The average compressive strength of prisms tested at 28 Days after grouting, multiplied by the appropriate correction factor as given in ASTM C 1314, shall not be less than the indicated masonry compressive strength.

6. If the tested compressive strength with correction factor of the prisms fails to meet or exceed the required strength, adjustments shall be made to the mix designs for the mortar or grout, or both, as needed to produce the required strength. The masonry units shall also be retested to verify compliance to the requirements of ASTM C 90.

7. If the tested compressive strength with correction factor of the prism fails to meet or exceed the required strength, prisms or cores shall be cut from the walls in sufficient numbers and in sufficient locations to adequately determine the strength of the walls. Those portions of the walls represented by specimens failing to meet the required compressive strength are subject to being removed and replaced.

F. Inspection: Whenever required under the provisions of the Building Code, WORK hereunder will be subject to inspection by a Special Inspector selected by the CONSTRUCTION MANAGER and approved by the local Building Code representative having jurisdiction. Costs of such inspection will be paid by the OWNER. The Special Inspector will work under the supervision of the CONSTRUCTION MANAGER. Special inspection will be per specification Section 01 41 60 - Special Inspections.

G. Extreme Weather Construction: Cold weather construction shall be per the more stringent of TMS 402/602 IBC Section 2104.3, and local Code requirements. Hot weather construction shall be per the more stringent of TMS 402/602, IBC Section 2104.4, and local Code requirements.

H. Product Storage: Cement, lime, and other cementitious materials shall be delivered and stored in dry, weather-tight sheds or enclosures, in unbroken bags, barrels, or other approved containers, plainly marked and labeled with the manufacturers' names and brands. Mortar and grout shall be stored and handled in a manner that prevents the inclusion of foreign materials and damage by water or dampness. Masonry units shall be handled with care to avoid chipping and breakage, and shall be stored as directed in ACI 530.1. Materials stored on newly constructed floors shall be stacked in such manner that the uniformly distributed loading does not exceed 30 psf. Masonry materials shall be protected from contact with the earth and exposure to the weather and shall be kept dry and clean until used.

PART 2 -- PRODUCTS

2.01 CONCRETE MASONRY UNITS

A. Concrete masonry units shall conform to ASTM C 90 - Load-Bearing Concrete Masonry Units. Units shall be normal weight units unless indicated otherwise.

B. Concrete masonry units shall be 8-inch by 8-inch by 16-inch or 12-inch by 8-inch by 16-inch modular size, with split faces, to match the existing concrete masonry units. Units shall be of a color to match the existing concrete masonry units.

C. Concrete masonry veneer units shall be 2-inch by 8-inch by 16-inch size, with split face. Units shall be of a color to match the existing concrete masonry units.

D. Bond beam, corner, lintel, sill, and other specially shaped blocks shall be provided where required or necessary. Specially shaped non-structural blocks may be constructed by saw cutting. Color and texture shall match that of adjacent units.

E. Concrete masonry units hidden from view entirely may be natural color units the same size as other adjacent masonry units.

F. Concrete masonry units at interior walls shall be normal weight block 8-inch by 8-inch by 16-inch modular size without split face. All interior smooth faced concrete block, except fire-rated units, shall have recycled masonry content of at least 25 percent.

2.02 MATERIALS

A. Portland cement shall be Type I or II, low alkali, conforming to ASTM C 150 - Portland Cement.

B. Fly Ash shall conform to ASTM C618 – Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete, except that loss on ignition shall not be greater than 3 percent. Fly ash substitution, if used, shall be a minimum of 30 percent by weight of cement, but shall not exceed 40 percent.

C. Ground blast furnace slag cement shall conform to ASTM C989 - Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars, grade 100 or 120. Blended cements shall conform to ASTM C595 – Blended Hydraulic Cements, Type 1S, or ASTM C1157 – Performance Specification for Hydraulic Cement. Slag cement substitution, if used, shall be not less than 25 nor more than 50 percent by weight of cement. Slag cement substitution shall not be used with fly ash substitution.

D. Water-repellant and efflorescence control admixture

1. Provide integral water repellant admixture in block and in mortar in all exterior exposed concrete masonry walls, including exterior single-wythe walls, exposed faces of screen walls, retaining walls, and other locations as indicated on the drawings

2. For block, provide admixture as recommended by the manufacturer to obtain ASTM E 514-90–Standard Test Method for Water Penetration and Leakage Through Masonry – test extended to 72 hours, Class E rating. Admixtures shall be **BASF "MasterPel 240", Euclid Chemical Company "Eucon Blocktite"**, or equal.

E. Hydrated lime shall be Type S conforming to ASTM C 207 - Hydrated Lime for Masonry Purposes.

F. Aggregate for mortar shall conform to ASTM C 144 - Aggregate for Masonry Mortar. Aggregate for grout shall conform to ASTM C 404 - Aggregates for Masonry Grout.

G. Water for mixing shall be clear potable water.

H. Reinforcing steel shall be deformed bars conforming to ASTM A 615 - Deformed and Plain Billet-Steel Bars for Concrete Reinforcement, Grade 60.

I. Joint reinforcing

1. Joint reinforcing shall conform to ASTM A 951 – Masonry Joint Reinforcement.

2. The minimum size of longitudinal and cross wires shall be W1.7 (9-gauge). Longitudinal wires shall be deformed. Maximum spacing of cross wires in ladder-type and points of connection of cross wires to longitudinal wire of truss-type shall be 16-inches.

3. Joint reinforcement shall be hot-dip galvanized after fabrication per ASTM A 153 – Zinc Coating (Hot-Dip) on Iron and Steel Hardware, Class B.

4. Corners and wall intersections shall use prefabricated corners and tees.

5. Joint reinforcement shall be continuous or

a. lapped by 54 wire diameters in a grouted cell, or

b. lapped by 75 wire diameters in a mortared bed joint, or

c. in alternate bed joints of running bond masonry, lapped a distance not less than 54 diameters plus twice the spacing of the bed joints.

J. Integral water repellant admixture is required for mortar for exterior masonry units, and shall be **BASF MasterPel 240 MA, Euclid Blocktite Mortar Admixture,** or equal. The admixture shall not be detrimental to the bonding or help the process of efflorescence.

K. Admixture for grout shall be **Sika Co., Sika Grout Aid, Type II**, **BASF Pozzolith,** normal, or equal.

L. Veneer ties shall be per TMS 402/602 - Building Code Requirements and Specifications for Masonry Structures. Additional ties shall be provided around openings larger than 16-inches in either direction.

M. Masonry cleaner shall be a non-acidic cleaner, **SafEtch by Prosoco, Inc.,** or equal.

2.03 MORTAR

A. Mortar for concrete block masonry shall conform to ASTM C 270 and IBC section 2103.7 for cement-lime Type S, with a minimum 28 Day compressive strength of 1800 psi.

2.04 GROUT

A. Grout shall conform to ASTM C 476 - Grout for Masonry and have a minimum 28 Day compressive strength of 2000 psi. Where the grout space is less than 4-inches, coarse aggregate shall be omitted.

B. Admixtures may only be used when approved by the ENGINEER OF RECORD. If approved for use, admixtures shall be used in accordance with the manufacturer's published recommendations for the grout.

PART 3 -- EXECUTION

3.01 GENERAL

A. Measurements for mortar and grout shall be accurately made. Shovel measurements are not acceptable. Mortar proportions shall be accurately controlled and maintained.

B. WORK shall be performed in accordance with the provisions of TMS402/602, the CBC, and the local codes for reinforced concrete hollow-unit masonry.

C. The CONTRACTOR shall set or embed anchors, bolts, reglets, sleeves, conduits, and other items as required.

D. Block cutting shall be by machine.

E. Masonry units shall be supported off the ground and shall be covered to protect them from rain. Only clean, dry, uncracked units shall be incorporated.

F. Reinforcing steel shall be cleaned of loose rust and scale, oil, dirt, paint, laitance, or other substances that may be detrimental to or reduce bonding of the steel and concrete.

G. Immediately before starting WORK, concrete upon which the masonry will be laid shall be cleaned with water under pressure.

H. Full mortar joint for first course shall be provided.

I. Units shall be shoved tightly against adjacent units to assure good mortar bond.

J. Equipment for mixing and transporting the mortar and grout shall be clean and free from set mortar, dirt, or other foreign matter.

3.02 MIXING

A. Mortar shall be mixed by placing 1/2 of the water and sand in the operating mixer, after which the cement, lime, and remainder of the sand and water shall be added. After ingredients are in the mixer, they shall be mechanically mixed for not less than 5 minutes. Retempering shall be done on the mortar board by adding water within a basin formed within the mortar, and the mortar reworked into the water. Mortar that is not used within one hour shall be discarded.

3.03 ERECTION OF CONCRETE BLOCK MASONRY

A. Masonry WORK shall be erected in plane, plumb, level, straight and true to dimensions, and be executed in accordance with acceptable practices of the trade and the tolerances of TMS 402/602.

B. Unless indicated otherwise, masonry shall be laid up in straight uniform courses with running bond.

C. Masonry shall be erected to preserve the unobstructed vertical continuity of the cells measuring not less than 3 inches by 3 inches in cross-section. Walls and cross webs shall be full bedded in mortar. Head (or end) joints shall be solidly filled with mortar for a distance in from the face of the wall or unit not less than the thickness of the longitudinal face shells.

3.04 JOINTS

A. Vertical and horizontal joints shall be uniform and approximately 3/8 inch wide. Exterior joints and interior exposed block joints shall be concave-tooled to a dense surface. Special care shall be used in tooling joints so as to match existing construction. Interior or exterior non-exposed masonry and masonry behind plaster shall have flush joints.

3.05 CLEANOUTS

A. Cleanout openings shall be provided at the bottoms of cells to be filled at each lift or pour of grout where such lift or pour is over 4 feet in height. Any overhanging mortar or other obstructions or debris shall be removed from the insides of such cell walls. The cleanouts shall be sealed before grouting and after inspection. Cleanout openings shall match the finished wall in exposed masonry.

3.06 REINFORCEMENT

A. Deep cut bond beam blocks shall be used where horizontal reinforcing steel is embedded. H-block bond beams may be used at locations other than openings.

B. Knock-out openings shall have no steel or joint reinforcing running through the opening. Head, jambs, and sill blocks shall be used to provide an even finish surface to install windows when blocks are removed. Joints at heads, jambs, and sills shall be stacked and continuous.

C. Vertical reinforcement shall be held in position at top and bottom and at intervals not exceeding 112 diameters of the reinforcement.

3.07 GROUTING

A. Cells and bond beam spaces shall be filled solidly with grout unless indicated otherwise. Grouting shall not be started until the wall has cured for 24 hours. Grout shall not be poured in more than 5-ft lifts.

B. Grout shall be consolidated at time of pouring by puddling or vibrating. If the grouting operation has been stopped for one hour or longer, horizontal construction joints shall be formed by stopping the grout pour 1-1/2 inches below the top of the uppermost unit.

3.08 PIPE OR CONDUITS EMBEDDED IN MASONRY

A. Pipes, conduits, and sleeves passing vertically or horizontally through the masonry shall not be placed closer than 3 diameters on center, nor shall they impair the strength of the construction. Pipes, conduits, and sleeves passing vertically shall not be placed in the same cell as the vertical reinforcing. Pipes, conduits, and sleeves passing horizontally shall not be placed in a bond beam.

B. Maximum area of vertical conduits, pipes, or sleeves placed in masonry columns or pilasters shall not displace more than 2 percent of the net cross section.

3.09 PROTECTION

A. Wall surfaces shall be protected from droppings of mortar or grout during construction.

3.10 FINISHING AND CLEANING

A. Masonry shall not be wet-finished unless exposed to extreme hot weather or hot wind and then only by using a nozzle-regulated fog spray sufficient only to dampen the face but not of such quantity to cause water to flow down over the masonry.

B. Finish masonry shall be cleaned and pointed in a manner satisfactory to the CONSTRUCTION MANAGER, based upon the standards established by the approved sample panel.

C. Interior and exterior colored masonry WORK exposed to view shall be cleaned by whip light sandblasting to remove stains and other imperfections.

D. Exposed masonry surfaces of openings and window and door openings such as sills, heads, and jambs shall be finish block surfaces, not formed surfaces, unless indicated otherwise. Closed bottom bond beam blocks shall be used at heads and sills. Pour holes may be used at the sill under window frame and where approved by the CONSTRUCTION MANAGER.

END OF SECTION

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SECTION 05 05 19

POST-INSTALLED ANCHORS IN CONCRETE

PART 1 -- GENERAL

1.01 THE SUMMARY

A. Provide post-installed anchors and appurtenances, complete and in place, as indicated in accordance with the Contract documents.

B. Unless otherwise indicated, drilled concrete anchors shall be adhesive anchors.

C. Section Includes:

1. Adhesive anchors
2. Expansion anchors
3. Screw anchors
4. Undercut anchors (dynamic loading)

1.02 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Definitions

1. Epoxy anchors are considered to be adhesive anchors.
2. Expansion anchors, screw anchors, and undercut anchors are considered to be mechanical anchors.

B. References

ACI 318-14	Building Code Requirements for Structural Concrete and Commentary
ACI 350-06	Code Requirements for Environmental Engineering Concrete Structures and Commentary
ACI 355.2-07	Qualification of Post Installed Mechanical Anchors in Concrete and Commentary
ACI 355.4-07	Qualification of Post Installed Mechanical Anchors in Concrete and Commentary
ASCE 7-16	ASCE Standard ASCE/SEI 7 Minimum Design Loads for Buildings and Other Structures
ASCE 41-13	ASCE Standard ASCE/SEI 41 Seismic Evaluation and Retrofit of Existing Buildings

ICC ES AC 193	Mechanical Anchors in Concrete Elements
ICC ES AC 308	Post Installed Adhesive Anchors in Concrete Elements
NSF 61-2016	NSF/ANSI 61 Drinking Water System Components – Health Effects

1.03 RELATED SECTIONS

Section 03 01 30	Concrete Repair and Rehabilitation
Section 03 21 00	Reinforcement Steel
Section 03 32 00	Joints in Concrete
Section 03 60 00	Grouting

1.04 SUBMITTALS

A. Furnish submittals in accordance with Section 7 of Standard Provisions – Submittal Management.

B. Submit the following:

1. Product data and technical information
2. Safety Data Sheets (SDS) for adhesives
3. Manufacturer's literature containing installation instructions and appropriate uses for each type of post-installed anchor and location of use
4. Current ICC-ES or IAPMO-UES Evaluation Reports
5. Certification for each installer demonstrating that they have been qualified in accordance with the Quality Assurance requirements below

C. No substitution for the indicated anchors will be considered unless accompanied with an ICC-ES or IAPMO-UES report verifying strength and material equivalency.

D. Complete structural calculations and anchorage details shall be prepared and submitted by the Contractor for all anchors and anchor groups that are shown but not completely detailed (type, size, location, spacing and embedment) on the Contract Documents. Calculations and anchorage details shall be completed and submitted in accordance with Section 13.05 of Special Provisions – Contractor's Engineering and Design.

1. Where adhesive anchors are used for structural applications (such as dowels between new and existing concrete) and an embedment depth is not shown on the contract documents, the anchor shall be installed in accordance with Method 1 or Method 2 below:

a. Method 1: The minimum depth of embedment shall be greater than or equal to the development length (l_d) determined in accordance with ACI 318/350 for a cast in place reinforcing bar of the same diameter and grade, unless it can be shown by calculation that the anchor spacing and edge distance is sufficient to develop the tensile strength of the anchor in a lesser depth of embedment. Calculations shall be submitted in accordance with Section 7 of Standard Provisions – Submittal Management and Section 13.05 of Special Provisions – Contractor's Engineering and Design.

b. Method 2: Adhesive anchors in concrete that cannot develop the tensile capacity of the steel element may be used to transfer forces, provided that the loads on the anchor are amplified by the system overstrength factor (Ω_o) in Table 12.2-1 of ASCE 7-16, or where unreduced forces are used in accordance with ASCE 41-13 for existing structures. Calculations shall be submitted in accordance with Section 7 of Standard Provisions – Submittal Management and Section 13.05 of Special Provisions – Contractor's Engineering and Design.

1.05 QUALITY ASSURANCE

A. Special inspection for all post-installed anchor installations shall be provided:

1. As recommended or required by the ICC-ES or IAPMO-UES report.

2. As required by the enforceable building code.

3. As otherwise indicated in the Contract Documents.

B. The most stringent of the above requirements shall be used. The cost of Special Inspection of post-installed anchors shall be paid for by the OWNER.

C. Before installing adhesive anchors in the WORK, anchor installers shall be trained and qualified at the Site by the manufacturer's representative. Training and qualification for each installer shall include at least:

1. Hole drilling procedure, hole preparation and cleaning techniques, adhesive injection technique and dispenser training/maintenance, rebar dowel preparation and installation, and proof loading if required.

2. Each installer shall be re-qualified every 6 months for the duration of the project by the same qualifying procedure.

D. Before installing mechanical anchors in the WORK, anchor installers shall be trained and qualified at the Site by the manufacturer's representative. Training and qualification for each installer shall include at least:

1. Hole drilling procedure, hole preparation and cleaning techniques, and torqueing.

2. Each installer shall be re-qualified every 6 months for the duration of the project by the same qualifying procedure.

E. Defective anchors noted by the Special Inspector shall be replaced and re-installed by the CONTRACTOR without any additional compensation.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to job site in manufacturer's or distributor's packaging undamaged, complete with installation instructions.

B. Protect and handle materials in accordance with manufacturer's recommendations to prevent damage or deterioration.

C. Anchoring adhesives shall be stored at temperatures prescribed by the manufacturer and must not be used beyond the expiration date.

1.07 SITE CONDITIONS

A. Post-installed anchors shall be installed in concrete having a minimum age of 21 days at time of anchor installation.

B. The anchor or fastener coating, plating, or steel type must provide suitable corrosion resistance for the environment in which the anchor or fastener is installed. Anchors, nuts, and washers in the locations listed below shall be fabricated from type 316 or 304 stainless steel:

1. buried locations
2. submerged locations
3. locations subject to seasonal or occasional flooding
4. inside hydraulic structures below the top of the structure
5. inside buried vaults, manholes, and structures that do not drain through a gravity sewer or to a sump with a pump
6. chemical handling areas
7. inside trenches, containment walls, and curbed areas
8. locations indicated or designated by the ENGINEER OF RECORD to be provided with stainless steel anchors.

PART 2 -- PRODUCTS

2.01 ADHESIVE ANCHORS

A. General

1. The adhesive anchor system shall consist of 1) adhesive product; and 2) threaded rod or reinforcing bar insert. The complete system shall be compatible as required by the adhesive manufacturer.

2. Adhesives shall be injectable, two-component, cartridge-type systems dispensed and mixed through a static mixing nozzle supplied by the manufacturer.

3. The evaluation report issued by ICC-ES or IAPMO-UES shall state the acceptability of the adhesive anchor for the intended purpose and location.

4. Adhesive anchors shall be permitted when regular ambient temperatures are consistent with manufacturer's recommendation for long and short term temperatures.

5. Adhesive anchors shall not be used where anchors are subject to vibration or fire.

6. Adhesive anchors shall not be used in overhead applications.

7. Where required, adhesive shall be capable of being used in submerged applications once cured.

8. For any anchors installed on a structure in contact with potable water shall use an adhesive meeting the requirements of NSF/ANSI Standard 61.

B. Adhesive Anchors in Concrete

1. Threaded rod inserts shall meet the requirements of Section 05 50 00- Miscellaneous Metalwork.

2. Reinforcing dowel inserts shall meet the material requirements of Section 03 21 00 – Reinforcement Steel and 03 31 00 – Cast-in-Place Concrete.

3. Adhesive for use in concrete adhesive anchors shall be certified for use in resisting seismic loads in cracked concrete applications in accordance with ICC-ES AC 308.

4. Where not detailed on the drawings, adhesive anchors shall be designed in accordance with ACI 318 as amended by the specific design provisions of ICC-ES AC 308.

5. Adhesive anchors shall have an evaluation report issued by ICC-ES or IAPMO-UES and shall have been tested and qualified for performance in cracked and uncracked concrete in accordance ICC-ES AC308 to resist static, wind, and earthquake (Seismic Design Categories A through F).

6. Adhesive anchors for concrete shall be **Pure110+ by DeWalt**, **HIT-RE 500 V3 by Hilti** or **SET-3G by Simpson Strong-Tie**, or equal.

2.02 EXPANSION ANCHORS

A. General

1. Expansion anchors are post-installed torque-controlled mechanical expansion anchors used to resist structural loads.

2. Expansion anchors shall be an imperial sized, threaded stud with an integral cone expander, expansion clip, nut and washer.

3. Lead caulking anchors will not be permitted.

4. Non-embedded buried or submerged anchors shall be fabricated from stainless steel.

5. The evaluation report issued by ICC-ES or IAPMO-UES shall state the acceptability of the expansion anchor for the intended purpose and location.

6. Anchors subjected to dynamic or vibratory loading shall be suitable for the intended loading and location as indicated in the manufacturer's technical product data.

B. Expansion Anchors for Concrete

1. Anchors shall be designed in accordance with ACI 318, which requires post-installed mechanical anchors to be qualified according to ACI 355.2.

2. Anchors shall have an evaluation report issued by ICC-ES or IAPMO-UES and have been tested and qualified for performance in cracked and uncracked concrete in accordance with ACI 355.2 and ICC-ES AC193.

3. Expansion anchors shall be **Strong-Bolt 2 by Simpson Strong-Tie, Kwik-Bolt TZ by Hilti, Power-Stud+ SD1 by DeWalt,** or equal.

2.03 SCREW ANCHORS

A. General

1. Screw anchors used in exterior and corrosive environments shall be fabricated from stainless steel.

2. The evaluation report issued by ICC-ES or IAPMO-UES shall state the acceptability of the screw anchor for the intended purpose and location.

3. Anchors subjected to dynamic or vibratory loading shall be suitable for the intended loading and location as indicated in the manufacturer's technical product data.

B. Screw Anchors for Concrete

1. Anchors shall be designed in accordance with ACI 318 as amended by the specific design provisions of ICC-ES AC193.

2. Anchors shall have an evaluation report issued by ICC-ES or IAPMO-UES and have been tested and qualified for performance in cracked and uncracked concrete in accordance with ICC-ES AC193.

3. Screw anchors for concrete shall be **Titen HD by Simpson Strong-Tie, Kwik HUS-EZ (KH-EZ) by Hilti, Screw-Bolt+ by DeWalt,** or equal.

2.04 UNDERCUT ANCHORS

A. General

1. Undercut anchors are post-installed mechanical anchors that require pre-drilling and a special undercut notch configuration cut into the concrete before installation.

2. Self-undercutting anchors are post-installed torque-controlled mechanical anchors that cut their own undercut notch by application of a setting torque that forces a sleeve over a cone.

3. The evaluation report issued by ICC-ES or IAPMO-UES shall state the acceptability of the undercut anchor for the intended purpose and location.

4. Anchors subjected to dynamic or vibratory loading shall be suitable for the intended loading and location as indicated in the manufacturer's technical product data.

5. Undercut anchors used in exterior and corrosive environments shall be fabricated from stainless steel.

B. Undercut Anchors for Concrete

1. Anchors shall be designed in accordance with ACI 318 as amended by the specific design provisions of ICC-ES AC193.

2. Anchors shall have an evaluation report issued by ICC-ES or IAPMO-UES and have been tested and qualified for performance in cracked and uncracked concrete in accordance with ACI 355.2 and ICC-ES AC193.

3. Undercut anchors for concrete shall be **HDA by Hilti, Atomic+ Undercut by DeWalt,** or equal.

PART 3 -- EXECUTION

3.01 INSTALLATION REQUIREMENTS

A. Post-installed anchors shall be installed in strict accordance with the manufacturer's instructions, the ICC-ES or IAPMO-UES report, and project specific design requirements indicated on the Contract Documents or in the design calculations provided by the CONTRACTOR per Section 1.3.D.

B. Where holes are drilled in concrete, holes shall be accurately and squarely drilled, and the holes shall be cleaned in accordance with the manufacturer's recommendations.

C. Post-installed anchors shall not be installed until the concrete has reached the required 21 days or per manufacturer's requirements, whichever is longer.

D. Acceptable installation and performance temperature ranges shall be verified with manufacturer's literature prior to installation. Minimum substrate temperatures shall be maintained during the full curing period as required by the manufacturer.

E. Adhesive anchors shall not be loaded until the adhesive has reached its indicated strength in accordance with the manufacturer's instructions.

F. The CONTRACTOR shall identify the position of reinforcing steel and other embedded items prior to drilling holes. Care shall be exercised in drilling to avoid damaging existing reinforcing or embedded items. The location of drilled holes shall be adjusted to a location acceptable by the CONSTRUCTION MANAGER in order to avoid drilling through or cutting any existing reinforcing bars or embedded items. Notify the CONSTRUCTION MANAGER if reinforcing steel or other embedded items are encountered during drilling. Take precautions as necessary to avoid damaging prestressing tendons, electrical and communications conduit, and piping.

G. Core drilling of holes is not allowed.

H. Identification of reinforcing steel and/or embedded items, relocation of drilled holes and adjustments or modifications to anchored or fastened items shall be considered part of the WORK and shall be provided at no additional cost to the OWNER.

I. All abandoned drilled holes shall be repaired in accordance with Section 03 01 30 - Concrete Repair and Rehabilitation at no additional cost to the OWNER.

END OF SECTION

SECTION 05 12 00

STRUCTURAL STEEL FRAMING

PART 1 -- GENERAL

1.01 THE SUMMARY

A. The CONTRACTOR shall provide structural steel framing and appurtenant metal parts required for permanent connection of the structural steel system, complete and in place, in accordance with the Contract Documents.

B. The design, fabrication, and erection of structural steel elements in buildings and non-building structures, and elements thereof, shall be in accordance with the CBC and AISC 360 and AISC 341.

1.02 REFERENCED STANDARDS

A. The edition of the standards applicable to the WORK shall be those editions referenced by the 2019 California Building Code If the standard is not referenced by the CBC, nor an CBC-referenced standard listed below, the edition of the standard applicable to the WORK shall be the edition in effect on the date of award of this contract.

B. Federal Specifications and Commercial Standards

AISC 303	Code of Standard Practice for Steel Buildings and Bridges
AISC 341	Seismic Provisions for Structural Steel Buildings
AISC 358	Prequalified Connections for Special and Intermediate Steel Moment Frames for Seismic Applications
AISC 360	Specification for Structural Steel Buildings
ASTM A36	Standard Specification for Carbon Structural Steel
ASTM A53	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A193	Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
ASTM A194	Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
ASTM A307	Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000 PSI Tensile Strength

ASTM A500	Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A992	Standard Specification for Structural Steel Shapes
ASTM F3125	Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi and 150 ksi Minimum Tensile Strength
AWS B1.5	Standard for the Qualification of Welding Inspectors
AWS D1.1	Structural Welding Code – Steel
AWS D1.8	Structural Welding Code – Seismic Supplement
RCSC	Specification for Structural Joints Using High-Strength Bolts

1.03 RELATED SECTIONS

A. Section 09 96 00 Protective Coating

1.04 CONTRACTOR SUBMITTALS

A. Submit in accordance with Section 7 of Standard Provisions – Submittal Management.

B. Shop Drawings, including fabrication and erection drawings for all WORK, shall conform to AISC recommendations and specifications and shall show all holes, etc. required for other work. Drawings shall include complete details showing members and their connections, anchor bolt layouts, schedules for fabrication procedures, and diagrams showing the sequence of erection.

C. Testing laboratory certifications for shop and field welders shall be submitted directly to the CONSTRUCTION MANAGER with copies to the CONTRACTOR and others as required.

D. Contractor's Statement of Responsibility, as required by the CBC Section 1704.4.

E. Quality Control inspection reports.

1.05 QUALITY ASSURANCE

A. Quality Assurance shall be provided as required by the CBC, AISC 360, and AISC 341.

1. Special Inspections and Tests requirements indicated in the CBC Chapter 17, and Quality Assurance requirements indicated in AISC 360 Chapter N and AISC 341 Chapter J, will be provided by and paid for by the OWNER.

2. Structural Observations, if required by the Building Official or requested by the OWNER, will be provided by and paid for by the OWNER.

3. Contractor Responsibility requirements indicated in the CBC Chapter 17 shall be provided by and paid for by the CONTRACTOR.

B. The CONTRACTOR shall be aware of all Quality Assurance requirements and shall provide advance notice and full access to the CONSTRUCTION MANAGER and ENGINEER OF RECORD to conduct the inspections, tests, and observations.

1. For inspections and tests at locations away from the project site, a minimum of 14 days' notice shall be provided in writing.

2. For inspections, tests and observations at the project site, a minimum of 7 days' notice shall be provided in writing.

3. The CONTRACTOR shall provide safe access, including fall protection equipment, to all locations necessary to conduct the inspections, tests, and observations.

C. The CONTRACTOR shall supply material for testing at no cost to the OWNER and shall assist the CONSTRUCTION MANAGER in obtaining material for test samples.

D. The CONTRACTOR shall correct or repair all defective WORK. All costs associated with corrections, repairs, and retesting shall be paid for by the CONTRACTOR.

E. Refer to PART 2 for Quality Control requirements.

PART 2 -- PRODUCTS

2.01 MATERIALS

A. Structural steel

Wide Flange Shapes	ASTM A992
Other Shapes, Plates, Bars	ASTM A36
Pipe, Pipe Columns, Bollards	ASTM A53, Type E or S, Grade B standard weight unless noted otherwise
HSS	ASTM A500 Grade B

B. Bolts for connections shall be ASTM F3125 Grade A325, unless indicated otherwise.

1. ASTM F3125 Grade A490 bolts shall be used where indicated.

2. Use of ASTM F3125 Grade F1852 or Grade F2280 Twist-Off/Tension-Control bolts in place of Grade A325 or Grade A490 Heavy Hex Head bolts, respectively, is subject to ENGINEER OF RECORD approval.

C. Bolts used to connect dissimilar metals shall be ASTM A193 and A194, Type 316 stainless steel.

D. Welded anchor studs shall be headed concrete anchor studs (HAS), or deformed bar anchors (DBA), or threaded studs (TAS), as indicated on the Drawings and as supplied by **Nelson Stud Welding Company**, **Omark Industries, KSM Fastening Systems Division,** or equal.

E. Structural steel shall be cleaned and coated in accordance with Section 09 96 00 - Protective Coating.

F. Steel members in contact with aluminum shall be galvanized per Section 05 50 00 - Miscellaneous Metalwork, unless indicated otherwise.

G. Structural members shall be furnished full length without splices unless otherwise indicated or approved by the ENGINEER OF RECORD.

2.02 QUALITY CONTROL

A. Quality Control shall be provided as required by AISC 360 and AISC 341.

1. Quality Control requirements indicated in AISC 360 Chapter N and AISC 341 Chapter J shall be provided by and paid for by the CONTRACTOR.

PART 3 -- EXECUTION

3.01 MEASUREMENT

A. The CONTRACTOR shall verify dimensions and shall make any field measurements necessary and shall be fully responsible for accuracy and layout of WORK. The CONTRACTOR shall review the Drawings, and any discrepancies shall be reported to the CONSTRUCTION MANAGER for clarification prior to starting fabrication.

3.02 FABRICATION

A. Structural steel shall be fabricated in accordance with the Drawings, AISC Specifications, AWS Codes, and the Shop Drawings.

B. Materials shall be properly marked and match-marked for field assembly.

C. Where finishing is required, assembly shall be completed including bolting and welding of units, before start of finishing operations.

3.03 BOLTED CONSTRUCTION

A. The CONTRACTOR shall comply with the requirements of the AISC and RCSC specifications applicable to bolted connections.

B. Surfaces for slip-critical connections shall be prepared in accordance with RCSC specifications.

3.04 WELDED CONSTRUCTION

A. The CONTRACTOR shall comply with the AISC specifications, AWS D1.1 and AWS D1.8 for procedures, appearance, and quality of welds and welders, and methods used in correcting Defective WORK. Welded architectural metal that is exposed to view shall have welds ground smooth. Shielded metal arc welding method or gas metal arc welding methods shall be used for welding structural steel.

B. Unless otherwise indicated, butt and bevel welds shall be complete penetration.

3.05 HOLES FOR OTHER WORK

A. Holes shall be provided as necessary or as indicated for securing other WORK to structural steel framing, and for the passage of other WORK through steel framing members. No torch cut holes will be permitted.

3.06 SHOP PAINT PRIMER

A. Shop paint primer shall be applied in accordance with Section 09 96 00 – Protective Coating. Omit shop-applied primer at field weld locations, for the portion of a member to be embedded in concrete, and where galvanizing with no further coating is required.

3.07 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Structural members shall be loaded in such a manner that they may be transported and unloaded without being excessively stressed, deformed, or otherwise damaged.

B. Structural steel members and packaged materials shall be protected from corrosion and deterioration. Material shall be stored in a dry area and shall not be placed in direct contact with the ground. Materials shall not be placed on the structure in a manner that might cause distortion or damage to the members or the supporting structures. Repair or replace damaged materials or structures as directed.

3.08 ERECTION

A. The CONTRACTOR shall comply with the AISC Specifications and Code of Standard Practice, and with indicated requirements.

B. High-strength bolts shall be installed in accordance with the RCSC Specification. The connections shall be the slip-critical, unless indicated otherwise.

C. Anchor rods and other connectors required for securing structural steel to in-place WORK and templates and other devices for presetting bolts and other anchors to accurate locations shall be furnished by the CONTRACTOR.

D. The CONTRACTOR shall be responsible for designing and installing any temporary bracing required for the safe erection of structural steel members.

3.09 SETTING BASES AND BEARING PLATES

A. Prior to the placement of non-shrink grout beneath base and bearing plates, the bottom surface of the plates shall be cleaned of all bond-reducing materials, and concrete and masonry bearing surface shall also be cleaned of all bond-reducing materials and be roughened to improve bonding.

B. Loose and attached baseplates and bearing plates for structural members shall be set on wedges, leveling nuts, or other adjustable devices.

C. Anchor rods shall be tightened after the supported members have been positioned and plumbed and the non-shrink grout has attained its indicated strength.

D. Baseplates shall be grouted with non-shrink grout to assure full uniform bearing. Grouting shall be done prior to placing loads on the structure.

3.10 FIELD ASSEMBLY

A. Structural frames shall be set accurately to the lines and elevations indicated. The various members shall be aligned and adjusted to form a part of a complete frame or structure before permanently fastening. Bearing surfaces and other surfaces that will be in permanent contact shall be cleaned before assembly. Necessary adjustments to compensate for discrepancies in elevations and alignments shall be performed.

B. Individual members of the structure shall be leveled and plumbed within AISC tolerances.

C. Required leveling and plumbing measurements shall be established on the mean operating temperature of the structure.

3.11 MISFITS AT BOLTED CONNECTIONS

A. Where misfits in bolting are encountered, the CONSTRUCTION MANAGER shall be immediately notified. The CONTRACTOR shall submit a method to remedy the misfit for review by the ENGINEER OF RECORD. The ENGINEER OF RECORD will determine whether the remedy is acceptable or if the member must be refabricated.

B. Incorrectly sized or misaligned holes in members shall not be enlarged by burning or by the use of drift pins.

C. Correction of misfits is part of the WORK.

3.12 GAS CUTTING

A. Gas cutting torches shall not be used in the field for correcting fabrication errors in the structural framing, except when approved by the ENGINEER OF RECORD. Gas-cut sections shall be finished equal to a sheared appearance.

3.13 TOUCH-UP PAINTING

A. Immediately after erection, field welds, bolted connections, and abraded areas shall be cleaned of the shop paint primer. Touch-up paint primer applied by brush or spray shall be the same thickness and material as used for the shop coat. Galvanized surfaces that have been field welded or damaged shall be repaired in accordance with Section 05 50 00 – Miscellaneous Metalwork.

B. Finish coating of structural steel shall be as indicated in Section 09 96 00 – Protective Coating.

END OF SECTION

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SECTION 05 30 00

METAL DECKING

PART 1 -- GENERAL

1.01 THE SUMMARY

A. The CONTRACTOR shall provide steel decking and accessory items, complete and in place, in accordance with the Contract Documents.

1.02 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Specifications and Commercial Standards

AISI	Design of Cold - Formed Steel Structural Members.
SDI	Design Manual for Composite Decks, Form Decks, and Roof Decks.
ASTM A 446	Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality.
ASTM A 653	General Requirements for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvanealed) by the Hot-Dip Process.
ASTM A 611	Steel, Sheet, Carbon, Cold-Rolled, Structural Quality
AWS D1.3	Structural Welding Code-Sheet Steel

B. ICC-ES or IAPMO-UES Evaluation Reports for each type of metal decking used in the WORK.

1.03 RELATED SECTIONS

A. Section 05 12 00 Structural Steel Framing

B. Section 05 50 00 Miscellaneous Metalwork

1.04 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 7 of Standard Provisions – Submittal Management.

B. Prior to the commencement of any WORK, the CONTRACTOR shall submit an affidavit furnished by the deck manufacturer certifying to the yield strength. The CONTRACTOR shall submit gauge and section properties of the metal deck. The CONTRACTOR shall also furnish the diaphragm shear values for the deck using the welding pattern and/or shear capacity indicated. Failure to conform to this requirement shall be justification for rejection of the material.

C. Submit a layout drawing showing the location of deck sheets, end laps, side laps, types and locations of welds and details of accessories.

D. Submit an ICC-ES or IAPMO-UES Evaluation Report for each type of metal decking used in the WORK.

1.05 QUALITY ASSURANCE

A. No insulation, roofing materials, or other permanent coverings shall be placed over the decking until the CONSTRUCTION MANAGER has inspected it for placement, welds, and accessories. Stored materials and debris shall be removed to facilitate the inspection. Welds found to be defective shall be replaced as a part of the WORK.

1.06 MATERIAL STORAGE

A. Decking stored at the Site before installation shall be stacked on the ground on platforms or pallets and be covered with tarpaulins or other weatherproof covering.

PART 2 -- PRODUCTS

2.01 STEEL DECK

A. Unless indicated otherwise, metal deck shall be manufactured from steel conforming to ASTM A 611, Grades C, D, or E; or A 446, Grades A, B, C, D, E, or F, or equal, having a minimum yield strength of 33,000 psi. The maximum design working stress in the deck shall not exceed the product of 0.6 times the yield strength.

B. The metal deck structural properties shall be as indicated. The moment of inertia and section modulus of the metal deck unit shall be computed in accordance with the Steel Deck Institute specifications, and in accordance with the American Iron and Steel Institute, "Specification for the Design of Cold-Formed Steel Structural Members."

C. Steel decking shall be galvanized and shall conform to ASTM A 653 and to the applicable requirements of Section 05 50 00 - Miscellaneous Metalwork. Steel deck shall be free of oil, grease, and dirt before dipping.

D. Steel deck shall be finished in accordance with Section 09 96 00 - Protective Coatings. Deck shall be free of oil, grease and dirt before coating application.

E. The metal deck shall have sheet length that covers 3 or more spans.

F. The metal deck sheets shall be formed at the longitudinal sides in such a manner that they will overlap and/or interlock. Where the end of sheets overlap, they shall be die-formed in such a manner that the sheet in the next row telescopes and snugly overlaps the sheet laid previously.

G. Plates needed to connect decking to supports or to maintain deck continuity shall be 14-gauge galvanized sheet.

H. Structural steel shapes, including angles and inserts, shall be in accordance with Section 05 12 00 - Structural Steel Framing.

2.02 MANUFACTURERS

A. The metal decking shall be manufactured by **Verco Manufacturing Company**, **ASC Pacific Inc.**, **Vulcraft Nucor Corporation Inc.,** or equal.

PART 3 -- EXECUTION

3.01 INSTALLATION REQUIREMENTS

A. The CONTRACTOR shall inspect supporting members for correct layout and alignment, and shall not proceed with installation until defects are corrected and supporting members are completely installed and secured.

B. Metal deck sheets and accessories shall be placed in accordance with the manufacturer's recommendations and the Shop Drawings. Roofs having a slope of 1/4-inch per foot or more shall be installed starting at the low side, to ensure that end laps are shingle fashion.

C. Metal deck sheets shall be positioned on supporting steel framework and adjusted to final position with ends bearing a minimum of 2-inches on supporting members. Units shall be placed end to end, with ribs aligned over the entire length of the run before being permanently fastened.

D. Special care shall be exercised not to damage or overload the deck during installation. The deck shall not be used for storage or as working platforms until permanently secured in position. Construction loads shall not exceed the deck carrying capacity, as recommended by the manufacturer.

E. Openings in the deck shall be cut and fitted neatly and shall be reinforced with structural steel members to distribute the load.

F. Where concrete fill is required, deck shall be installed with closure plates and other accessories as needed to prevent loss of water, cement, and fines during placing and consolidation of the concrete.

G. Edges of any cut openings or any minor surface damage areas shall be repaired in accordance with applicable requirements of the Sections 09 96 00 – Protective Coating and 05 50 00 – Miscellaneous Metalwork.

H. After installation, surfaces shall be cleaned and left free of grime and dirt. The CONTRACTOR shall remove unused materials, tools, scaffolding, and debris from the premises and leave the area broom clean.

3.02 WELDING

A. Care shall be exercised in the selection of electrodes and amperage to provide positive welds and to prevent high amperage blowholes. Welds shall be made from the top side of the deck immediately after alignment.

B. Welds shall be free of sharp points or edges. Welds shall be cleaned immediately by chipping or wire brushing and shall be coated with a zinc dust type primer paint.

C. Welding shall conform to the applicable requirements of AISC "Light Gauge Steel Design." Welders shall be AWS certified.

END OF SECTION

SECTION 05 50 00

MISCELLANEOUS METALWORK

PART 1 -- GENERAL

1.01 THE SUMMARY

A. Provide miscellaneous metalwork and appurtenances, complete and in place, as indicated in accordance with the Contract Documents.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Federal Specifications

MIL-G-18015 A (3)	(Ships) Aluminum Planks. (6063-T6)
MIL-PRF-907F	Antiseize Thread Compound, High Temperature

B. Codes

OSHA 1910.23	Ladders
Cal/OSHA §3277	Fixed Ladders

C. Commercial Standards

AA-M32C22A41	Aluminum Assn.
AASHTO HS-20	Design Truck Loading
AISC	Manual of Steel Construction
AISI	Design of Light Gauge, Cold-Formed Steel Structural Members
ASTM A 36	Carbon Structural Steel
ASTM A 48	Gray Iron Castings
ASTM A 53	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 123	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 193	Alloy Steel and Stainless Steel Bolting Materials for High Temperature Service

ASTM A 194	Carbon and Alloy Steel Nuts for Bolts for High Pressure and High Temperature Service
ASTM A 307	Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
ASTM A 325	Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A 500	Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 992	Steel for Structural Shapes for Use in Building Framing
ASTM F 1554	Standard Specification for Anchor Bolts, Steel, 36, 55 and 105-ksi Yield Strength
ANSI/AWS D1.1	Structural Welding Code - Steel
ANSI/AWS D1.2	Structural Welding Code - Aluminum
ANSI/AWS QC1	Qualification and Certification of Welding Inspectors

1.03 RELATED SECTIONS

A. Section 01 33 17 Structural Design, Support and Anchorage

B. Section 05 12 00 Structural Steel Framing

C. Section 05 30 00 Metal Decking

D. Section 09 96 00 Protective Coating

1.04 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with the requirements of Section 7 of Standard Provisions – Submittal Management.

B. Calculations

C. Calculations for deferred submittal items shall be stamped and signed by a Professional Civil or Strutural Engineer registered in the State of California.Shop Drawings

1. Shop Drawings shall conform to AISC recommendations and specifications, and shall show holes, and the like, as may be required for other parts of the WORK.

2. Shop Drawings shall include complete details of members and connections, anchor bolt layouts, schedules for fabrication procedures, and diagrams for the sequence of erection.

3. Where shop drawings pertain to a deferred submittal item, shop drawing shall be submitted with a memo stamped and signed by the design engineer, stating the shop drawings are in conformance to the design calculations.

D. Grating

1. Submit layout drawings for grating, showing the direction of span, type and depth of grating, size and shape of grating panels, seat angle details, and details of grating hold down fasteners.

2. Submit load and deflection tables for each style and depth of grating used.

E. Anchor Submittals

1. For post installed anchors in concrete other than powder-drive pins or impact anchors, refer to Section 05 05 19 – Post Installed Anchors in Concrete.

2. For post installed anchors in concrete masonry units other than powder-drive pins or impact anchors, refer to Section 04 05 19.29 – Post Installed Anchors in Masonry.

3. For powder-drive pins or impact anchors, complete structural calculations and anchorage details shall be prepared and submitted by the Contractor for all anchors and anchor groups that are shown but not completely detailed (type, size, location, spacing and embedment) on the Contract Documents. Calculations and anchorage details shall be signed and stamped by a Professional Engineer registered in the state in which the project is located.

1.05 QUALITY ASSURANCE

A. Weld procedures and welder qualifications shall be available in the CONTRACTOR's field office for review.

B. Welding Special Inspection shall be performed by the OWNER in accordance with the enforceable Building Code.

PART 2 -- PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Steel

Wide Flange Shapes	ASTM A 992
Shapes, Plates, Bars	ASTM A 36
Pipe, Pipe Columns, Bollards	ASTM A 53, Type E or S, Grade B standard weight unless indicated otherwise
HSS	ASTM A 500 Grade B

B. Corrosion Protection

1. Unless otherwise indicated, fabricated steel metalwork which will be used in a corrosive environment and/or will be submerged in water or wastewater shall be coated in accordance with the requirements of Section 09 96 00 - Protective Coating, and shall not be galvanized prior to coating.

2. Other miscellaneous steel metalwork shall be hot-dip galvanized after fabrication.

C. Stainless Steel

1. Unless otherwise indicated, stainless steel metalwork and bolts shall be fabricated from Type 316 stainless steel.

2. Where anaerobic conditions are noted, Type 304 stainless steel shall be used.

D. Aluminum

1. Unless otherwise indicated, aluminum metalwork shall be fabricated from Alloy 6061-T6.

2. Aluminum in contact with concrete, masonry, wood, porous materials, or dissimilar metals shall have contact surfaces coated in accordance with the requirements of Section 09 96 00 - Protective Coating.

E. Cast Iron

1. Unless otherwise indicated, iron castings shall conform to the requirements of ASTM A 48, Class 50B, or better.

2.02 ALUMINUM RAILINGS

A. General

1. Aluminum handrails and railings shall be component systems, complete with anchors, attachments, balusters, brackets, caps, fasteners, gates (swing with self-latching hardware or be removable), posts, sleeves, trim, and any other related items as required or necessary for a complete installation.

2. Gates and removable rail sections shall be complete with hardware such as self-closing hinges, self-latching latches, hasps, and the like.

3. Railings shall conform to Building Code and OSHA requirements, General Industry Occupational Safety and Health Standards (29CFR1910).

B. Materials shall conform to the following requirements:

1. Aluminum

a. Aluminum shall be U.S. Alloy 6063 T-5 or T-6.

b. Aluminum pipe rail shall not be less than 1-1/2-inch diameter Schedule 40 pipe.

2. Electrolysis protective material shall be in accordance with the requirements of Section 09 96 00 - Protective Coating.

3. Sleeves shall be of galvanized steel or PVC.

4. Grout for handrail posts shall consist of an inorganic, non-shrink, non-metallic premixed grout in accordance with the requirements of Section 03 60 00 - Grouting, with a minimum 28-Day compressive strength of 4,000 psi.

5. Fasteners, screws, and bolts shall be concealed and shall be fabricated from stainless steel or aluminum.

6. Aluminum welding rods shall be of a type recommended by the aluminum manufacturer for anodized finished products.

7. Kickplates shall be provided on railings and not set in curbs.

C. Pipe railing systems, including handrails, railings, tube caps, and other miscellaneous parts of the rails, shall be provided with a clear anodized finish, AA-M32C22A41.

D. Manufacturers or Equal

1. C-V Pipe Rail by Crane Veyor Corp.

2. Connectorail by Julius Blum and Co.

2.03 METAL STAIRS

A. Metal Stairs

1. Metal stairs shall be composed of steel or aluminum stringers and supports, shall be fabricated in accordance with the standard practice of the National Association of Ornamental Metal Manufacturers, and shall be as indicated.

2. Steel stair members shall be hot-dip galvanized after fabrication.

2.04 GRATING STAIR TREADS

A. Grating stair treads shall be designed to support a live load of 100 psf or a concentrated load at mid-span of 300 pounds, whichever creates the higher stress.

B. The maximum deflection due to the uniform live load shall be as required for metal grating, below.

C. Grating stair treads shall be provided with an integral non-slip nosing.

2.05 SAFETY STAIR NOSINGS

A. Safety stair nosing shall be provided on concrete stairs and other locations as indicated.

B. The nosing shall be 3 inches wide and fabricated from extruded aluminum with cast-in abrasive strips and integral extruded anchors.

C. The color of the cast abrasive shall be as selected by the ENGINEER OF RECORD from among the manufacturer's standard colors.

D. The nosing shall be **Amstep Products Style 231-A, Grating Pacific XRS-3, Robertson Grating Products Type 9511,** or equal.

2.06 METAL STAIR AND WALKWAYS AT MIXING TANKS

A. Materials

1. Materials for stairs and walkway system shall conform to the requirements of this specification, unless otherwise noted below.

2. Walkway steel members shall be provided with corrosion protection, per Section 2.01.

B. Design Criteria

1. Stairs and walkway grating shall be designed for a minimum uniform live load of 100 psf and a minimum concentrated live load of 1000 pounds located at any point on the grating.

2. Walkway shall be designed to support the weight of the mixers and any operational and start-up loads.

3. Grating deflection shall not exceed a deflection of 1/4 inch or the span divided by 180, whichever is less.

4. Steel beam deflection shall not exceed the span divided by 180.

5. Lateral seismic and wind design shall be in compliance with Specification Section 01 33 17 Structural Design, Support and Anchorage.

2.07 LADDERS

A. Materials

1. Ladders which may be partially or wholly submerged or which are located inside a hydraulic structure shall be fabricated entirely of Type 316 stainless steel.

2. Other ladders shall be fabricated from carbon steel, hot-dip galvanized after fabrication unless otherwise noted.

B. Fixed Step-Through Ladders shall be equipped with grab bar extensions meeting OSHA requirements.

1. Approved products include **Model 504 Access Ladder** by **O'Keefe's**, or equal. Grab bars by **CAI Safety Systems** may be added to other existing or new ladders.

C. Fall Prevention System (Ladder Safety System)

1. The fall prevention system at ladders shall include top and bottom brackets, ladder rung clamps, a steel cable that runs the height of the ladder, sleeves and full body harness (one per ladder), dismount section, and other components as necessary for a complete system.

2. All requirements of OSHA 1910.29 must be met.

3. The system shall be stainless steel unless noted otherwise. When steel ladders are specified, the ladder safety system is permitted to be galvanized steel.

4. Approved products include **Lad-Saf** by **DBI Sala**, or equal.

D. Pop-Up Extension

1. Every ladder that does not extend above the access level shall be equipped with a pop-up ladder extension.

2. The pop-up ladder extension device shall be manufactured of the same material and finish as the ladder, and shall be provided with a telescoping tubular section that locks automatically when fully extended.

3. Upward and downward movement shall be controlled by stainless steel spring balancing mechanisms.

4. The units shall be completely assembled with fasteners for securing to the ladder rungs in accordance with the manufacturer's instructions.

2.08 METAL GRATING

A. General

1. Metal grating shall be of the indicated design, size, and type.

2. Grating shall be supported around an opening by support members.

3. Where grating is supported on concrete, unless otherwise indicated provide embedded support angles that match the grating material and are mitered and welded at their corners.

4. Banding

a. The grating shall be completely banded at edges and cutouts.

b. The banding material and cross-section shall be equivalent to the bearing bars.

c. The banding shall be welded to each cut bearing bar.

5. The grating pieces shall be fastened to each support in 2 locations.

6. Where grating forms the landing at the top of a stairway, the edge of the grating that forms the top riser shall have an integral non-slip nosing with a width equal to that of the stairway.

7. Where the grating depth is not indicated, provide grating within allowable stress levels and which shall not exceed a deflection of 1/4 inch or the span divided by 180, whichever is less.

8. Design Loading

a. For standard duty plank and safety grating, the loading to be used for determining stresses and deflections shall be the uniform live load of the adjacent floor or 100 psf, whichever is greater, or a concentrated load of 1000 pounds.

b. For heavy duty grating, the loading used for determining stresses and deflections shall be in accordance with AASHTO HS-20.

B. Material

1. Except where indicated otherwise, bar grating shall be fabricated entirely of:

a. aluminum

1) **Bearing and Banding Bars: Alloy 6061-T6**

2) **Cross Bars: Alloy 6063-T5**

2. Safety grating shall be fabricated from **aluminum alloy 5052-H32**.

3. Plank grating shall be fabricated from **aluminum alloy 6063-T6**.

4. Grating that may be partially or wholly submerged shall be fabricated entirely of Type 316 stainless steel

C. Standard-Duty Grating

1. No single piece of grating shall weigh more than 80 pounds, unless indicated otherwise.

2. Standard duty grating shall be composed of serrated bar grating.

3. Cross bars shall be welded or mechanically locked tightly into position such that there is no movement between the bearing and cross bars.

D. Safety Grating

1. Safety grating shall be fabricated from sheet metal punched into an open serrated diamond pattern and be formed into plank sections.

2. The open diamond shapes shall be approximately 1-7/8 inches by 11/16-inch in size.

3. Safety grating shall be **Grip Strut** by **Metal Products Division, United States Gypsum Company, Deck Span** by **IKG Industries**, or equal.

E. Heavy-Duty Grating

1. Heavy-duty grating shall be fabricated from welded steel, galvanized after fabrication.

2. Crossbars shall be welded in position.

F. Plank Grating

1. Plank grating shall be extruded in 6-inch widths with a minimum of 6 integral one-bar type bearing bars per plank.

2. The top surface shall be solid with raised ribs, unless indicated otherwise.

3. Where punched grating is required, the top surface shall be provided with a pattern of 3-inch by 19/32-inch rectangular openings spaced at 4 inches on-center.

4. The planks shall have a continuous tongue-and-groove type interlock at each side, except that interlocking planks shall be arranged such that any 4-foot wide section may be removed independently from the other grating sections.

5. Plank grating shall be provided with a clear anodized finish, except that punched grating may have a standard mill finish.

2.09 CHECKERED PLATE

A. Checkered plate shall be provided with a pattern of raised lugs on one face, and shall be smooth on the opposite face.

B. Lugs

1. Lugs shall be a minimum of one inch in length and raised a maximum of 1/2 inch above the surface.

2. The lugs shall be located in a pattern in which the lugs are oriented at 90 degrees from the adjacent lugs in 2 orthogonal directions.

3. The rows of lugs shall be oriented at 45 degrees from the edges of the plates.

C. Where no material is indicated, the plates shall be fabricated from aluminum.

D. Unless indicated otherwise, the minimum plate thickness shall be as required to limit deflection resulting from a live load of 100 psf to 1/4 inch, or the span divided by 240, whichever is less.

2.10 HATCHES

A. Where access hatches are mounted on a floor slab (including top slabs that are not covered with a roofing membrane) or on a concrete curb, the hatch shall be flush-type as indicated.

B. Hatches shall be fabricated from aluminum 5086 H34, 6063-T5 or 6061-T6, unless otherwise indicated.

C. Hatch hardware shall be fabricated from Type 316 stainless steel, and shall be of the gutter-type.

D. The design live load shall be 300 psf, unless indicated otherwise.

E. Configuration

1. Hatch opening sizes, number and swing direction of door leaves, and locations shall be as indicated.

2. Indicated sizes are for the clear opening.

3. Where the number of leaves is not indicated, openings larger than 42 inches in either direction shall be provided with double-leaf doors.

4. Unless indicated otherwise, hinges shall be located on the longer dimension side.

5. Unless indicated otherwise, ladder hatches shall be a minimum of 30 inches wide by 36 inches long, with the ladder centered on the shorter dimension and the door hinge opposite the ladder.

F. Door leaves shall be fabricated from a minimum of 1/4-inch thick checkered-pattern plate.

G. Channel frames shall be fabricated from a minimum 1/4-inch material with an anchor flange around the perimeter.

H. Hatches shall be provided with an automatic hold-open arm with release handle.

I. Hatches shall be designed for easy opening from both inside and outside and shall include springs or hydraulic assist for ease of opening.

J. Hatches shall be designed to be water-tight and shall be equipped with a joint gutter, a moat-type edge drain, and drain piping of the length and size necessary to remove the drain water from all dry spaces accessed by the hatch.

K. A minimum 1-1/2 inch diameter drain connection shall be provided, located by the manufacturer.

L. Submersible Pump Station Hatches

1. Hatches for submersible pump stations shall include a Unistrut, or equal, channel around the frame perimeter.

2. The face of the channel shall be flush with the face of the frame, and shall be compatible with the upper guide rail bracket of the submersible wastewater pump.

M. Hatches shall be provided with a recessed hasp for a padlock covered by a hinged lid that is flush with the surface.

N. Hatches shall be **Bilco Type J** or **JD, Babcock-Davis Type B-FGA**, or equal.

O. Nets

1. Unless indicated otherwise, hatch nets shall be provided on floor hatches.

2. Hatch nets shall conform to OSHA requirements.

3. Hatch nets shall be **Hatch Net 121**, as manufactured by **Safe Approach, Inc,** Auburn, ME, or equal.

2.11 HIDDEN-HINGED ACCESS MANWAYS

A. Hidden-hinged access manways shall be of the 36–inch clear opening quick-opening, hidden-hinged type suitable for mounting in concrete walls.

B. Manway shall open into the structure and shall seal an ASME flanged and dished head against a liquid-tight, replaceable gasket.

C. Manway and spool shall be of carbon steel and coated per Specifications 09 96 00 – Protective Coating.

D. Release shall provide access within 60 seconds without unbolting or use of tools.

E. Lockout protection shall be provided.

F. Manways shall be mounted in walls at elevations shown on the Drawings.

G. Manways shall be designed for the hydrostatic and hydrodynamic pressures at the installation depth shown on the Drawings.

H. Manways in new structures shall be model CM-1 by **Chase Associates, Inc., Edgecomb, Maine; (888) 626-9297**, or equal.

I. Manways installed in existing structures shall be model CM-3 by **Chase Associates, Inc., Edgecomb, Maine; (888) 626-9297**, or equal.

2.12 IRON CASTINGS

A. General

1. Iron castings shall be of uniform quality, free from blowholes, porosity, hard spots, shrinkage, distortion, or other defects.

2. The castings shall be smooth and well cleaned by shotblasting.

3. Covers and grates shall fit together evenly, such that the cover fits flush with the surrounding finished surface and such that the cover does not rock or rattle when a loading is applied.

4. Round covers and frames shall be provided with machined bearing surfaces.

B. Covers and grates with matching frames shall be designed to support the following loadings:

1. Where located within a structure, the design loading shall match that required for the adjacent floor area, or, if no floor loading is indicated, a minimum of 300 pounds per square foot.

2. Exterior covers and grates shall be designed for AASHTO HS-20 loading unless indicated otherwise.

2.13 MANHOLE RUNGS

A. Rungs shall meet ASTM C 478 - Precast Reinforced Concrete Manhole Sections and the following requirements:

1. Rungs shall be spaced not less than 10 inches apart nor more than 14 inches apart, as measured between centerlines of the rungs.

2. Rungs shall be parallel, level, and uniformly spaced.

3. The rungs shall be shaped such that a person's foot cannot slide off the end of the rung.

4. Rungs shall be surfaced to prevent injury from punctures or lacerations, and to prevent snagging of clothing.

5. The minimum perpendicular clearance between rungs and any obstruction behind the ladder shall be 6 inches.

6. The minimum width of rungs shall be 14 inches.

B. Submit certified test results in accordance with ASTM C 497 - Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile, Section 10, for the following loads:

1. The horizontal pull-out load shall be 400 pounds.

2. The vertical load shall be 800 pounds.

C. Material

1. Rungs shall be fabricated from co-polymer polypropylene that encapsulates a minimum 1/2-inch grade 60 steel reinforcing rod.

2. The co-polymer polypropylene shall meet ASTM D 4101, Type PP200B33430.

2.14 FALL PREVENTION SYSTEM

A. The fall protection system at each ladder shall include a carrier rung, ladder ring clamps, sleeves and full body harnesses, dismount section, and other components as necessary for a complete system.

B. The carrier rail shall be fabricated from the same material as the ladder, except for fiberglass ladders, which shall be provided with stainless steel carrier, rails, and shall be the length recommended by the manufacturer for the ladder dimensions, including extensions.

C. The fall protection system shall be 2000 Climb Rite by Sellstrom Manufacturing Company, Saf-T-Climb by North Safety Products Ltd., or approved equal.

2.15 INTERIOR SAFETY SCREENS

A. Interior safety screens shall be located directly beneath existing skylights.

B. Anchorage

1. Anchor to framing in accordance with manufacturer's installation recommendations and instructions with the following limitations.

a. All 4 sides of the safety screen shall be anchored to the structural members framing the skylight opening.

b. Anchor points on the safety screen shall be capable of being fastened to the vertical face of steel framing members at sides where difference in member depth do not allow for fastening to the bottom of the member

c. Anchorage of the safety screen shall be a minimum of #10-16 x ¾ self-drilling screws spaced a maximum of 18" on-center on all 4 sides.

C. Interior safety screens shall be Velux Model CRGA ICD; 3/16" welded steel mesh, spaced at 6" on center, factory primed and finished in white, or approved equal.

2.16 BOLTS AND ANCHORS

A. Standard Service (Non-Corrosive Application)

1. Bolts, anchor rods, anchor bolts, washers, and nuts shall be fabricated from steel as indicated.

2. Threads on galvanized bolts, rods and nuts shall be formed with suitable taps and dies such that they retain their normal clearance after hot-dip galvanizing.

3. Except as otherwise indicated, steel for bolt material, anchor rods, anchor bolts, and cap screws shall be in accordance with the following requirements:

   a. Structural Connections: ASTM A 307, Grade A or B, hot-dip galvanized

   b. Headed Anchor Rods and Anchor Bolts: ASTM F1554, Grade 36, hot-dip or mechanically galvanized with Grade A matching nuts

   c. High-Strength Bolts, where indicated: ASTM A 325

   d. Pipe and Equipment Flange Bolts: ASTM A 193, Grade B-7

B. Corrosive Service

1. Bolts, anchor rods, anchor bolts, nuts, and washers in the locations listed below shall be fabricated from stainless steel as indicated.

   a. buried locations

   b. submerged locations

   c. locations subject to seasonal or occasional flooding

   d. inside hydraulic structures below the top of the structure

   e. inside buried vaults, manholes, and structures that do not drain through a gravity sewer or to a sump with a pump

   f. chemical handling areas

   g. inside trenches, containment walls, and curbed areas

   h. locations indicated or designated by the ENGINEER OF RECORD to be provided with stainless steel bolts

C. Unless otherwise indicated, stainless steel bolts, nuts, anchor rods, and washers shall be fabricated from Type 316 stainless steel, Class 2, conforming to ASTM A 193 for bolts and to ASTM A 194 for nuts.

D. Buried pipe flange bolts and nuts on pipe of Class 275 and greater shall be in accordance with ASTM A193/A194, Grade B7.

E. Coating

1. Threads on stainless steel bolts and rods shall be protected with an antiseize lubricant suitable for submerged stainless steel bolts, meeting government specification MIL-A-907E.

2. Buried bolts in poorly drained soil shall be coated the same as the buried pipe.

3. Antiseize lubricant shall be classified as acceptable for potable water use by the NSF.

4. Antiseize lubricant shall be "PURE WHITE" by **Anti-Seize Technology,** Franklin Park, IL, 60131, **AS-470** by **Dixon Ticonderoga Company,** Lakehurst, NJ, 08733, or equal.

F. Bolt Requirements

1. The bolt and nut material shall be free-cutting steel.

2. The nuts shall be capable of developing the full strength of the bolts.

3. Threads shall be Coarse Thread Series conforming to the requirements of the American Standard for Screw Threads.

4. Bolts and cap screws shall have hexagon heads and nuts shall be Heavy Hexagon Series.

5. Bolts and nuts shall be installed with washers fabricated from material matching the base material of bolts, except that hardened washers for high-strength bolts shall conform to the requirements of the AISC Specification.

6. Lock washers fabricated from material matching the bolts shall be installed where indicated.

7. The length of each bolt shall be such that the bolt extends at least 1/8 inch beyond the outside face of the nut before tightening, except for anchor bolts which shall be flush with the face of the nut before tightening.

2.17 POWDER-DRIVEN PINS

A. Powder-driven pins for installation in concrete or steel shall be fabricated from heat-treated steel alloy and shall have a diameter of 0.157” minimum.

B. If the pins are not inherently sufficiently corrosion-resistant for the conditions to which they will be exposed, they shall be protected in an acceptable manner.

C. Pins shall have capped or threaded heads capable of transmitting the loads the shanks are required to support.

D. Pins that are connected to steel shall be provided with longitudinal serrations around the circumference of the shank.

2.18 IMPACT ANCHOR

A. Impact anchors shall be an expansion-type anchor in which a nail-type pin is driven to produce the expansive force.

B. The pin shall be provided with a zinc sleeve with a mushroom-style head and stainless steel nail pin.

C. Anchors shall be **Zinc Nailon Anchors**, manufactured by **Simpson Strong-Tie, Inc.**, **Metal Hit Anchors,** manufactured by **Hilti, Inc., Rawl Zamac Nailin,** manufactured by the **Rawlplug Company,** or equal.

PART 3 -- EXECUTION

3.01 FABRICATION AND INSTALLATION REQUIREMENTS

A. Fabrication and Erection: Except as otherwise indicated, the fabrication and erection of structural steel shall conform to the requirements of the American Institute of Steel Construction "Manual of Steel Construction."

B. Aluminum Railings

1. Aluminum railing fabrication and installation shall be performed by craftsmen experienced in the fabrication of architectural metalwork.

2. Exposed surfaces shall be free from defects or other surface blemishes.

3. Dimensions and conditions shall be verified in the field.

4. Joints, junctions, miters, and butting sections shall be precision fitted with no gaps occurring between sections, and with surfaces flush and aligned.

5. Electrolysis protection of materials shall be provided.

C. Unless otherwise indicated, provide a 1/2-inch drain line to the nearest floor drain for floor hatches.

D. Powder-Driven Pins

1. Powder-driven pins shall be installed by a craftsperson certified by the manufacturer as being qualified to install the manufacturer's pins.

2. Pins shall be driven in one initial movement by an instantaneous force that has been carefully selected to attain the required penetration.

3. Driven pins shall conform to the following requirements where "D" is equal to the pin shank diameter:

Material Penetrated by Pin	Material Minimum Thickness	Pin Shank Penetration in Supporting Material	Minimum Space From Pin's CL to Edge of Penetrated Material	Minimum Pin Spacing
Concrete	16D	6D minimum	14D	20D
Steel	1/4-inch	Steel thickness	4D	7D

3.02 WELDING

A. Method

1. Welding shall be performed by the metal-arc method or gas-shielded arc method as described in the American Welding Society "Welding Handbook" as supplemented by other pertinent standards of the AWS.

2. The qualification of the welders shall be in accordance with the AWS Standards.

B. Quality

1. In assembly and during welding, the component parts shall be adequately clamped, supported, and restrained in order to minimize distortion and for control of dimensions.

2. Weld reinforcement shall be as indicated by the AWS Code.

3. Upon completion of welding, remove weld splatter, flux, slag, and burrs left by attachments.

4. Welds shall be repaired in order to produce a workmanlike appearance, with uniform weld contours and dimensions.

5. Sharp corners of material that is to be painted or coated shall be ground to a minimum of 1/32 inch on the flat.

3.03 GALVANIZING

A. Structural steel plates shapes, bars, and fabricated assemblies required to be galvanized shall, after the steel has been thoroughly cleaned of rust and scale, be galvanized in accordance with the requirements of ASTM A 123.

B. Any galvanized part that becomes warped during the galvanizing operation shall be straightened.

C. Bolts, anchor rods, anchor bolts, nuts, and similar threaded fasteners, after being properly cleaned, shall be galvanized in accordance with the requirements of ASTM A 153.

D. Field Repairs

1. Field repairs to damaged galvanizing shall be performed by preparing the surface and applying a coating.

2. Surface preparation shall consist of removing oil, grease, soil, and soluble material by cleaning with water and detergent (SSPC SP1) followed by brush-off blast cleaning (SSPC SP7) over an area extending at least 4 inches into the undamaged area.

3. The coating shall be applied to at least 3 mils dry film thickness, and shall be **Zinc-Clad XI** by **Sherwin-Williams**, **Galvax** by **Alvin Products**, **Galvite** by **ZRC Worldwide**, or equal.

3.04 FALL PREVENTION SYSTEM

A. A fall prevention system shall be provided on ladders used to ascend heights exceeding 24 feet.

END OF SECTION

SECTION 06 10 00

ROUGH CARPENTRY

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Standard Provisions and Special Provisions apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Framing with dimension lumber.
2. Shear wall panels.
3. Wood blocking, cants, and nailers.
4. Wood furring.
5. Wood sleepers.
6. Plywood backing panels.

1.03 DEFINITIONS

A. Boards or Strips: Lumber of less than 2 inches nominal size in least dimension.

B. Dimension Lumber: Lumber of 2 inches nominal size or greater but less than 5 inches nominal size in least dimension.

C. Exposed Framing: Framing not concealed by other construction.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.

3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.

4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

B. Fastener Patterns: Full-size templates for fasteners in exposed framing.

1.05 INFORMATIONAL SUBMITTALS

A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.

B. Evaluation Reports: For the following, from ICC-ES:

1. Wood-preservative-treated wood.

2. Fire-retardant-treated wood.

3. Engineered wood products.

4. Shear panels.

5. Power-driven fasteners.

6. Post-installed anchors.

7. Metal framing anchors.

1.06 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.01 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. For exposed lumber indicated to receive a stained or natural finish, [mark grade stamp on end or back of each piece] [or] [omit grade stamp and provide certificates of grade compliance issued by grading agency].
3. Dress lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber: 19 percent unless otherwise indicated.

C. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.

1. Allowable design stresses, as published by manufacturer, shall meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.02 WOOD-PRESERVATIVE-TREATED LUMBER

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.
2. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.

C. Application: Treat items indicated on Drawings, and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.

2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.

3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.

4. Wood framing members that are less than 18 inches above the ground in crawlspaces or unexcavated areas.

5. Wood floor plates that are installed over concrete slabs-on-grade.

2.03 DIMENSION LUMBER FRAMING

A. Non-Load-Bearing Interior Partitions: Construction or No. 2 grade.

1. Application: All interior partitions

2. Species:
   a. Western woods; WCLIB or WWPA.

2.04 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: Plywood, DOC PS 1, Exposure 1, C-D Plugged, in thickness indicated or, if not indicated, not less than 1/2-inch nominal thickness.

2.05 FASTENERS

A. General: Fasteners shall be of size and type indicated and shall comply with requirements specified in this article for material and manufacture.

1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

2. For redwood, use stainless-steel or hot-dip galvanized steel fasteners.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

D. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193 or ICC-ES AC308 as appropriate for the substrate.

1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.

2. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2.

E. Stainless-steel bolts: ASTM F593, Alloy Group 1 or 2 (ASTM F 738M, Grade A1 or Grade A4); with ASTM F 594, Allow Group 1 or 2 (ASTM F 836M, Grade A1 or A4) hex nuts and, where indicated, flat washers.

2.06 METAL FRAMING ANCHORS

A. Simpson Strong-Tie

B. Allowable design loads, as published by manufacturer, shall meet or exceed those of basis-of-design products. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency. Framing anchors shall be punched for fasteners adequate to withstand same loads as framing anchors.

C. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 coating designation.

1. Use for interior locations unless otherwise indicated.

D. Stainless-Steel Sheet: ASTM A 666. [Type 304][Type 316]

E. Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A 653/A 653M; structural steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 coating designation; and not less than 0.036 inch thick.

1. Use for wood-preservative-treated lumber and where indicated.

F. Joist Hangers: U-shaped joist hangers with 2-inch-long seat and 1-1/4-inch-wide nailing flanges at least 85 percent of joist depth.

1. Strap and nailing as shown on plans.

G. Top Flange Hangers: U-shaped joist hangers, full depth of joist, formed from metal strap with tabs bent to extend over and be fastened to supporting member.

1. Strap and nailing as shown on plans.

H. Bridging: Rigid, V-section, nailless type, 0.050 inch thick, length to suit joist size and spacing.

I. Post Bases: Adjustable-socket type for bolting in place with standoff plate to raise post 1 inch above base and with 2-inch-minimum side cover, socket 0.062 inch thick, and standoff and adjustment plates 0.108 inch thick.

J. Joist Ties: Flat straps, with holes for fasteners, for tying joists together over supports.

1. Strap and nailing as shown on plans.

K. Rafter Tie-Downs: Bent strap tie for fastening rafters or roof trusses to wall studs below, 1-1/2 inches wide by 0.050 inch thick. Tie fastens to side of rafter or truss, face of top plates, and side of stud below.

L. Rafter Tie-Downs (Hurricane or Seismic Ties): Bent strap tie for fastening rafters or roof trusses to wall studs below, 2-1/4 inches wide by 0.062 inch thick. Tie fits over top of rafter or truss and fastens to both sides of rafter or truss, face of top plates, and side of stud below.

2.07 MISCELLANEOUS MATERIALS

A. Sill-Sealer Gaskets: Glass-fiber-resilient insulation, fabricated in strip form, for use as a sill sealer; 1-inch (25-mm) nominal thickness, compressible to 1/32 inch (0.8 mm); selected from manufacturer's standard widths to suit width of sill members indicated.

B. Sill-Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch (6.4 mm) thick, selected from manufacturer's standard widths to suit width of sill members indicated.

C. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber or rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch.

D. Water-Repellent Preservative: NWWDA-tested and -accepted formulation containing 3-iodo-2-propynyl butyl carbamate, combined with an insecticide containing chloropyrifos as its active ingredient.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

B. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.

C. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels.

D. Install shear wall panels to comply with manufacturer's written instructions.

E. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

F. Install sill sealer gasket to form continuous seal between sill plates and foundation walls.

G. Do not splice structural members between supports unless otherwise indicated.

H. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.

I. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:

1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.

2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal thickness.

3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. and to solidly fill space below partitions.
4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet o.c.

J. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

K. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

1. Use inorganic boron for items that are continuously protected from liquid water.

2. Use copper naphthenate for items not continuously protected from liquid water.

L. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

M. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code (IBC).

2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.

3. ICC-ES evaluation report for fastener.

N. Use steel common nails unless otherwise indicated. Select fastener length that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

O. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced, and with adjacent rows staggered.

1. Comply with indicated fastener patterns where applicable. Retain one of two subparagraphs below. Retain second if finishing nails do not comply with structural requirements or if appearance of common nails is needed.

2. Use finishing nails unless otherwise indicated. Countersink nail heads and fill holes with wood filler.

3. Use common nails unless otherwise indicated. Drive nails snug but do not countersink nail heads.

3.02 WOOD BLOCKING, AND NAILER INSTALLATION

A. Install where indicated and where required for screeding or attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches (38 mm) wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.03 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet enough that moisture content exceeds that specified, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION

SECTION 06 80 00

FIBER GLASS REINFORCED PLASTIC FABRICATIONS

PART 1 -- GENERAL

1.01 THE SUMMARY

A. The CONTRACTOR shall provide fabricated fiberglass reinforced plastic (FRP) items, complete and in place, in accordance with the Contract Documents.

1.02 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 7 of Standard Provisions – Submittal Management.

B. Shop Drawings: Shop Drawings for every FRP item. Include plans, elevations, and profiles that clearly show material sizes, types, styles, part or catalog numbers. Drawings shall include complete details for the fabrication and erection of components, including location, dimensions, lengths, joining method, type and size of fasteners, clip angles, member sizes, and connection details.

C. Layout drawings for grating shall show the direction of span, type and depth of grating, size and shape of grating panels, seat angle details, and details of grating hold down fasteners.

D. Product Literature: Manufacturer's published literature including structural design data, structural properties, and load and deflection tables for each style and depth of grating, corrosion resistance tables, certificates of compliance, test reports (as applicable), anchoring system allowable load tables and ICBO reports.

E. Calculations: Structural calculations shall be submitted for stairs, stair support systems, handrails, railing systems, brackets, support flanges, ladders, and fasteners or anchors. Calculations shall be signed and sealed by a professional engineer registered in the State of California. The structural calculations shall conform to Section 01 33 17 – Structural Design, Support and Anchorage.

F. Samples: Samples of each type of product shall be submitted if requested by the ENGINEER OF RECORD.

G. Certification: The CONTRACTOR shall certify on the Shop Drawings that items and fabrications have been manufactured of materials suitable for potable water usage per NSF 61, and that fabricated items are of sufficient strength to serve their intended function without undue distortion or deflection.

1.03 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Items provided under this Section shall be furnished only by manufacturers having experience in the manufacture of similar products, with a record of 5 similar successful installations in the last 5 years.

B. Quality: Fiberglass items shall be constructed of new, first-class, commercial-quality, fiberglass fabric-reinforced polyester or vinyl ester resin laminate material of the strength, thickness, and dimensions indicated, using the matched die-molded method.

PART 2 -- PRODUCTS

2.01 GENERAL REQUIREMENTS

A. FRP items shall be composed of fiberglass reinforcement and resin in quantities, qualities, properties, arrangements, and dimensions as necessary to meet the design requirements and dimensions indicated.

B. Fiberglass reinforcement shall be continuous roving, continuous strand mat, and surfacing veil or a combination thereof in sufficient quantities for the application and physical properties required.

C. Unless indicated otherwise, resin shall be fire retardant isophthalic polyester or vinyl ester with chemical formulation as necessary to provide the corrosion resistance, strength, and other physical properties as required. FRP items used in chemical storage or containment areas shall be vinyl ester resin, with chemical formulations as necessary to provide the corrosion resistance, strength, and other physical properties required in those areas.

D. Finished surfaces of FRP items and fabrications shall be smooth, resin-rich, free of voids, and without dry spots, cracks, crazes, or unreinforced areas. Glass fibers shall be well covered with resin to protect against exposure from wear or weathering.

E. Resin shall include an ultraviolet (UV) inhibitor additive. FRP products located in exterior locations exposed to the weather or in UV facilities shall also have an additional 1-mil UV-resistant coating applied.

F. FRP products shall have a tested flame spread rating of 25 or less per ASTM E 84 - Surface Burning Characteristics of Building Materials. Gratings and stair treads shall also meet the self-extinguishing requirements of ASTM D 635 - Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.

G. Supports and Fasteners: The CONTRACTOR shall provide bolts, anchor bolts, nuts, washers, and supports as required for the WORK of this Section in accordance with the requirements of the manufacturers of the items. Bolts, anchor bolts, washers, and supports shall be Type 316 stainless steel. Concrete anchor systems shall be in accordance with Section 05 50 00 – Miscellaneous Metalwork.

H. Cut or machined edges, holes, scratches, gouges, and abrasions shall be sealed with a resin compatible with the resin matrix used in the original item.

2.02 FIBERGLASS GRATING

A. General

1. Seat Angles: Where grating is supported on concrete members, continuous embedded seat angles shall be provided on all sides. Grating seat angles shall be made of FRP and be as detailed on the Drawings; except that specially manufactured pultruded FRP seat angles intended to be cast in concrete may be submitted for acceptance by the ENGINEER OF RECORD.

2. Raised Floor Grating: Wherever raised floor grating is indicated, provide a complete system of FRP grating, FRP support legs, and seat angles, fastening devices, and other accessories necessary for a complete installation. Grating and supports shall be designed to fit together tightly with no movement when subjected to the design loading. The support legs and grating shall be produced by the same manufacturer and be intended to work together as a unit. The spacing of the legs shall be determined so as not to interfere with piping and equipment and to meet the requirements indicated herein.

3. Load/Deflection Requirements: Grating shall be capable of spanning the distances indicated with a minimum safety factor of 3 for stresses and without exceeding a deflection equal to the lesser of 1/4-inch or the span divided by 180. The loading used for determining stresses and deflections shall be the uniform live load of the adjacent floor area or 300 pounds per square foot, whichever is greater, or a concentrated load of 1000 pounds at the center of the span, unless otherwise indicated.

4. Color: The color of the grating and seat angles shall match. The color selected shall result in no additional cost to the OWNER.

5. The top surface of grating shall be provided with a non-slip surface by embedding or bonding grit to the FRP.

6. Penetrations: Cutouts shall be provided were needed for penetrations through the grating. The grating shall be reinforced where necessary to meet the load/deflection requirements despite the cutouts.

7. Dimensional Requirements: When grating is designed to span primarily in one direction, the grating shall be fabricated to span in the shorter span direction, unless indicated otherwise. Individual pieces of grating shall not exceed 80 pounds in weight, unless indicated otherwise.

8. Mechanical grating clips shall be manufactured of Type 316 stainless steel. Grating hold-down clips shall be provided, spaced at a maximum of 4-feet apart or as

recommended by the manufacturer, whichever is less. A minimum of 4 clips per piece of grating is required.

2.03 MOLDED FRP GRATING

A. Molded FRP grating shall be of a one piece molded construction with tops and bottoms of bearing bars and cross bars in the same plane. Grating shall have a square mesh pattern.

B. Gratings shall be reinforced with continuous rovings of equal number of layers in each direction to provide bidirectional load bearing.

C. Non-slip surfacing: Grating shall have grit on the top of each bar for maximum slip resistance.

D. Molded FRP grating shall be **Fibergrate** by **Fibergrate Composite Structures, Inc., Corgrate Molded Fiberglass Grating** by **IKG Industries, Duragrate** by **Strongwell**; or equal.

2.04 PULTRUDED FRP GRATING

A. Pultruded FRP grating shall be fabricated from bearing bars and cross rods manufactured by the pultrusion process. The glass fiber reinforcement for the bearing bars shall have a core of continuous glass strand rovings wrapped with a continuous strand glass mat. The outermost layer covering shall be a surface veil to provide a resin-rich surface. Bearing bars shall be interlocked and chemically bonded into place to provide a panel that resists twist forces and prevents internal movement of the bearing bars.

B. Pultruded FRP grating shall be **Safe-T-Span** by **Fibergrate Composite Structures, Inc.**; **Corgrate** by **IKG Industries; Duradek** by **Strongwell**; or equal

2.05 FRP STAIR TREADS

A. Stair treads shall be of a one-piece molded construction reinforced with continuous rovings.

B. Non-slip surfacing: Stair treads shall be manufactured with either a concave profile on the top of each bar or shall have grit bonded or embedded to provide maximum slip resistance. For additional safety and to meet OSHA requirements, stair treads shall be manufactured with a minimum 1-1/2 inch molded nosing. Nosing shall be bonded with angular grit.

C. Load/Deflection Criterion: Stair treads shall be within allowable stress levels and shall not exceed a deflection of 1/4-inch or the span divided by 180, whichever is less. The loading to be used for determining stresses and deflections shall be a uniform live load of 100 psf or a concentrated load of 300 pounds at the center of the span.

D. Hardware: Type 316 stainless steel hold-down clips shall be provided, spaced as recommended by the manufacturer. A minimum of four hold-down clips shall be required for each tread.

E. FRP stair treads shall be **Fibertred** by **Fibergrate Composite Structures, Inc., Molded Cortreads** by **IKG Industries, Duradek Stair Treads** by **Strongwell**, or equal.

2.06 RAILINGS

A. Posts and rails shall be structural shapes manufactured by the pultrusion process.

B. Handrails that are used in industrial-commercial, non-public areas shall be a 3 rail system with equal open spaces between rails and toeboard with no open space larger than 12-inches as required by the OSHA.

C. Posts shall be not less than 2-inches square for square systems or 1.9-inches diameter for round rail systems. Rails and railings shall be not less than 1-1/2 inch square for square rail systems or 1.9-inches diameter for round rail systems and shall be provided with bottom enclosures. Top railings shall be as long as possible and the posts shall not project through the top rails.

D. The minimum mechanical properties for structural shapes used in the handrail shall be as required for structural shapes below.

E. Color: Rails, posts, and kick plates shall be integrally pigmented gray.

F. Loading Conditions: Railings and handrail brackets shall be capable of withstanding the following non-simultaneous loading conditions without exceeding the allowable working stress of the material and without permanent deformation, with a minimum factor of safety on loading of 2.0.

1. A 200 pound concentrated load applied to any point in any direction

2. A 50 pound per linear foot loading applied perpendicular to the top rail.

G. The post/rail connection shall be fabricated such that the rails are unbroken and continuous through the post without the use of packs or splices. Exposed post corners shall be radiused to eliminate sharp edges. The rails shall be joined to the post through a combination of bonding and mechanical fastening. No sharp or protruding edges shall remain after assembly of the railing. Spacing of the posts shall not exceed 6-feet for straight runs or 4-feet for inclined runs.

H. The base of the posts shall be reinforced to a minimum height of one-inch above the uppermost bolthole.

I. Full posts shall be located not more than 18-inches from horizontal or vertical change in railing direction.

J. Hardware: Fasteners in the railing system shall be Type 316 stainless steel.

K. FRP handrail shall be **Dynarail** by **Fibergrate Composite Structures, Inc., Corgrip** by **IKG Industries, Safrail** by **Strongwell,** or equal.

2.07 LADDERS

A. Ladder side rails, rungs, ladder mounting brackets, and cage straps shall be FRP structural shapes manufactured by the pultrusion process. The minimum mechanical properties for structural shapes used in ladders shall be as required for structural shapes below.

B. Wall brackets connecting the ladder to the wall shall be spaced at a maximum of 6-feet on centers.

C. Rungs shall penetrate the wall of the tube side rails and shall be connected to the rails with both chemical and mechanical fastenings.

D. Non-slip surfacing: Ladder rungs shall be provided with either continuous flutes around the rung or a quartz grit integrally molded into the top surface of the rung.

E. Color: Ladder and cage components shall be integrally pigmented yellow. Wall and floor mount brackets shall be gray.

F. Loading Criterion: The completed ladder and cage installation shall meet the load requirements as set forth in OSHA 1910 (latest edition) with a minimum factor of safety on loading of 2.0. The ladder shall also be capable of supporting an ultimate concentrated vertical load of 1,200 pounds applied at the mid-span of the rung. The ladder manufacturer shall be required to provide supporting test data for rung capacity.

G. FRP ladders shall be **Dynarail Ladders** by **Fibergrate Composite Structures, Inc., FRP Ladders** by **IKG Industries, Safrail Ladder** by **Strongwell,** or equal.

2.08 STRUCTURAL SHAPES

A. Structural shapes shall be manufactured by the pultrusion process and have a maximum of 55 percent and a minimum of 45 percent glass content (by weight).

B. Pultruded structural shapes are to have the minimum longitudinal mechanical properties listed below:

Property	ASTM Method	Minimum Value	Units
Tensile Stress (Lengthwise)	D 638	30,000	psi
Tensile Modulus (Lengthwise)	D 638	2.5×10^6	psi
Flexural Stress (Lengthwise)	D 790	30,000	psi
Flexural Modulus (Lengthwise)	D 790	1.6×10^6	psi
Short Beam Shear (Lengthwise)	D 2344	4,500	psi

Shear Modulus (Lengthwise)	N/A	4.2×10^{5}	psi
Coefficient of Thermal Expansion (Lengthwise)	D 696	4.4×10^{-6}	in/in/°F

C. FRP structural shapes shall be **Dynaform Fiberglass Structural Shapes** by **Fibergrate Composite Structures, Inc, Extren** by **Strongwell, CorLight by IKG Fiberglass Systems**, or equal.

PART 3 -- EXECUTION

3.01 PRODUCT DELIVERY AND STORAGE

A. Delivery of Materials: Manufactured materials shall be delivered in original, unbroken pallets, packages, containers, or bundles bearing the label of the manufacturer. Adhesives, resins, catalysts, and hardeners shall be crated or boxed separately.

B. Storage of Products: Materials shall be carefully handled to protect them from abrasion, cracking, chipping, twisting, deformations, and other types of damage. Store items in an enclosed area and free from contact with soil and water. Store adhesives, resins, catalysts, and hardeners in dry indoor storage facilities between 70 and 85 degrees F (21 to 29 degrees C). There shall be labels on the outside of the boxes indicating that the products shall be stored as described above.

3.02 GENERAL

A. FRP products shall meet the dimensional requirements and tolerances indicated. The CONTRACTOR shall verify measurements and determine correct size and locations of required holes or cutouts from field dimensions before fabrication.

B. FRP products shall be fabricated free from warps, twists, or other defects that affect appearance and serviceability.

C. The CONTRACTOR shall give ample notice prior to the beginning of any fabrication work so that the CONSTRUCTION MANAGER can perform shop inspections.

D. The CONTRACTOR shall install FRP structures in accordance with the manufacturer's assembly drawings. Field cut and drill FRP products with carbide or diamond tipped bits and blades. Seal cut or drilled surfaces in accordance with manufacturer's instructions. Follow manufacturer's instructions when cutting or drilling fiberglass products or using resin products.

E. Bonding of FRP items shall be through the use of an epoxy adhesive recommended by the manufacturer of the particular item. The surfaces to be bonded shall be solvent cleaned and abraded sufficiently to remove the surface gloss and to remove any mold release agent or other contaminants which may interfere with proper bonding. The

adhesive manufacturer's instructions and recommendations shall be followed. The items bonded shall not be stressed until at least 48 hours have passed.

3.03 GRATING

A. Layout: Each grating section shall be readily removable except where indicated. As much as possible, manufacturer shall provide openings and holes where indicated on the Contract Drawings. Grating openings which fit around protrusions (pipes, cables, machinery, etc.) shall be discontinuous at approximately the centerline of opening so each section of grating is readily removable.

1. Install the grating with a minimum 1.5-inch bearing surface at the support ends.

2. Tolerances between sections shall provide for not more than 1/4-inch clearance between adjacent sections or between grating and frames. Adjacent sections shall line up to form an uninterrupted straight line where possible.

3. The grating shall be as free, as commercially possible from visual defects such as foreign inclusions, delamination, blisters, resin burns, air bubbles, and pits. The surface shall have a smooth finish (except for non-slip surfaces).

4. Seat angles shall be mitered and bonded at corners to produce smooth, even, level seating surface.

5. Grating shall be installed so that the top surface is level and even with adjacent walking surfaces. There shall be no protrusions above the top surface.

6. Grating shall be fastened to supports.

3.04 LADDERS

A. Ladders shall be fully shop assembled. Ladder cages shall be test assembled and drilled to ensure a proper fit in the field. Ladder cage brackets shall remain attached to the ladder for shipping, but ladder cage components can be disassembled, packaged, and shipped separately to prevent damage in transit. Cage components shall be bundled with each respective ladder.

3.05 RAILINGS

A. Component Systems

1. Unless otherwise indicated, handrails and railings shall be component systems, complete and ready for use with anchors, attachments, pickets, brackets, caps, fasteners, gates, posts, sleeves, trim, and all other related items required or necessary for the complete installation.

2. Installation instructions, splice fasteners, and adhesive shall be included in each shipment. Handrails shall have cut edges sealed. The handrail will be shipped pre-fabricated, requiring only post, kick plate, and rail splicing.

B. Workmanship: Work shall be performed by craftsmen experienced in the fabrication of structural fiberglass items. Exposed surfaces shall be free from defects or other surface blemishes. Dimensions and conditions shall be verified in the field in advance. Joints, junctions, miters, and butting sections shall be precision-fitted, with no gaps occurring between sections, and surfaces shall be flush and aligned.

C. Alignment: Pultruded, case-molded, or bent work shall be straight and with true edges. Railings and handrails shall be provided with continuous top rails, without post projections or other obstructions.

D. Expansion/Contractions: Exterior railing systems shall provide for 1/4-inch expansion and contraction per 20 linear feet of railing. Interior railing systems shall provide for 1/8-inch expansion or contraction per 20 linear feet of railing.

E. Railing Continuity and End Treatment: Handrails and railings shall be designed to form a continuous run system with elbow turns and bends that do not interfere with hand movement. Handrails shall be continuous for the full length of the stairs and landings. Handrails shall extend not less than 12-inches beyond the top and bottom risers. Ends of handrails shall be returned to wall or shall be terminated in newel posts or safety terminals. Newel posts and safety terminals may be used only when approved by the ENGINEER OF RECORD.

F. Gates and Removable Sections

1. Gates shall be provided with self-closing hinges and self-closing latch bolts. Removable handrail sections shall be provided where indicated. The gate and removable railing hardware color shall match that of the railing system of which it is a part.

2. Railing posts installed into sleeves shall be provided with weep holes for condensation drainage.

3.06 STRUCTURAL SHAPES

A. Measurement: The CONTRACTOR shall verify dimensions, making any field measurements necessary, and shall be fully responsible for accuracy and layout of WORK. The CONTRACTOR shall review the Drawings, and any discrepancies shall be reported to the CONSTRUCTION MANAGER for clarification prior to starting fabrication.

B. Fabrication

1. Structural FRP shall be fabricated in accordance with the Drawings and as indicated on the Shop Drawings.

2. Materials shall be properly marked and match-marked for field assembly.

3. Where finishing is required, assembly shall be completed including bolting before starting of finishing operations.

C. Connections: Shop and field connections shall be bonded and bolted as indicated. Unless indicated otherwise, connections shall develop full strength of members joined.

D. Holes for other WORK: Holes shall be provided as necessary or as indicated for securing other WORK to FRP framing, and for the passage of other WORK through FRP members. Threaded nuts shall be epoxied to framing, and other specialty items as indicated to receive other WORK. Field cuts and drilled edges shall be sealed with a resin compatible with the original resin and recommended by the manufacturer. The sealing of the edges shall prevent premature fraying at the field cut edges.

E. Erection

1. Anchor bolts and other connectors required for securing structural FRP to in-place WORK and templates and other devices for presetting bolts and other anchors to accurate locations shall be furnished by the CONTRACTOR.

2. The CONTRACTOR shall be responsible for designing and installing any temporary bracing required for the safe erection of all structural FRP members.

F. Setting bases and bearing plates

1. Prior to the placement of nonshrink grout beneath base and bearing plates, the bottom surface of the plates shall be cleaned of bond-reducing materials. Concrete and masonry bearing surface shall also be cleaned of bond-reducing materials and be roughened to improve bonding.

2. Loose and attached base plates and bearing plates for structural members shall be set on wedges, leveling nuts, or other adjustable devices.

3. Anchor bolts shall be tightened after the supported members have been positioned and plumbed and the nonshrink grout has attained its required strength.

4. Base plates shall be grouted with nonshrink grout to assure full uniform bearing. Grouting shall be done prior to placing loads on the structure.

G. Field Assembly

1. Structural frames shall be set accurately to the lines and elevations indicated. The various members shall be aligned and adjusted to form a part of a complete frame or structure before permanent fastening. Bearing surfaces and other surfaces that will be in permanent contact shall be cleaned before assembly. Necessary adjustments to compensate for discrepancies in elevations and alignments shall be performed.

2. Individual members of the structure shall be leveled and plumbed within required tolerances. The CONTRACTOR shall provide and install all temporary bracing required until structure is complete.

H. Misfits at Bolted Connections

1. Where misfits in bolting are encountered, the CONSTRUCTION MANAGER shall be immediately notified. The CONTRACTOR shall submit a method to remedy the misfit for review by the ENGINEER OF RECORD. The ENGINEER OF RECORD will determine whether the remedy is acceptable or if the member must be refabricated. Methods of remedy may include, but are not limited to the following:

   a. Reaming holes that must be enlarged to admit oversized bolts.

   b. Drilling additional holes in the connection, to conform to manufacturer's standards for bolt spacing, end, and edge distances, and adding additional bolts.

   c. Rejecting the improperly fabricated member and fabricating a new member to ensure proper fit.

2. Mis-sized or misaligned holes in members shall not be enlarged by burning or by the use of drift pins.

3. The CONTRACTOR shall pay costs associated with the repair of misfits.

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SECTION 07 41 13

METAL ROOF PANELS

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Standard Provisions and Special Provisions apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Patching batten roof panels.

2. Flashing at metal roofing.

3. Division 07 Section "Sheet Metal Flashing and Trim" for flashing not part of roofing and other sheet metal work.

1.03 PERFORMANCE REQUIREMENTS

A. General: Provide manufactured roof panel assemblies complying with performance requirements indicated and capable of withstanding structural movement, thermally induced movement, and exposure to weather without failure or infiltration of water into the building interior.

B. Unless more stringent requirements are indicated, comply with ASTM E 1514.

C. Wind-Uplift Resistance: Provide roof panel assemblies that meet requirements of UL 580 for Class 90 wind-uplift resistance.

D. Structural Performance: Provide manufactured roof panel assemblies capable of safely supporting design loads indicated under in-service conditions with vertical deflection no greater than the following, based on testing manufacturer's standard units according to ASTM E 1592 by a qualified independent testing and inspecting agency.

1. Maximum Deflection: 1/240 of the span.

E. FM Approvals Listing: Provide metal roof panels and component materials that comply with requirements in FM Approvals 4471 as part of a panel roofing system and that are listed in FM Approvals' "RoofNav" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals markings.

1. Fire/Windstorm Classification: Class 1A-90.

F. Air Infiltration: Air leakage through assembly of not more than the following when tested according to ASTM E 1680, based upon 16-inch-wide panel:

1. Maximum 0.005 cfm/sq. ft. of roof area at test-pressure difference of minus 1.57 lbf/sq. ft.

G. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 1646 at a minimum differential pressure of 20 percent of inward acting, wind-load design pressure of not less than 6.24 lb/sq. ft. and not more than 12.0 lb/sq. ft.

H. Hydrostatic-Head Resistance: No water penetration when tested according to ASTM E 2140.

I. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 degrees F, ambient; 180 degrees F, material surfaces.

1.04 SUBMITTALS

A. Product Data: Include manufacturer's product specifications, standard details, certified product test results, and general recommendations, as applicable to materials and finishes for each component and for total panel assemblies.

B. Samples for Verification: Provide sample panels 12 inches long by actual panel width, in the profile, style, color, and texture indicated. Include clips, caps, battens, fasteners, closures, and other exposed panel accessories.

C. Qualification Data: For firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience, if requested. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for the following:

1. Metal Roof and Soffit Panels: Include reports for air infiltration, water penetration, solar reflectance, and structural performance.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer who has completed metal roof panel projects similar in material, design, and extent to that indicated for this Project and with a record of successful in- service performance.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver panels and other components so they will not be damaged or deformed. Package panels for protection against damage during transportation or handling.

B. Handling: Exercise care in unloading, storing, and erecting roof panels to prevent bending, warping, twisting, and surface damage.

C. Stack materials on platforms or pallets, covered with tarpaulins or other suitable weathertight and ventilated covering. Store panels to ensure dryness. Do not store panels in contact with other materials that might cause staining, denting, or other surface damage.

1.07 PROJECT CONDITIONS

A. Field Measurements: Verify location of structural members and openings in substrates by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, either establish opening dimensions and proceed with fabricating roof panels without field measurements or allow for trimming panel units. Coordinate roof construction to ensure actual locations of structural members and to ensure opening dimensions correspond to established dimensions.

1.08 WARRANTY

A. General Warranty: Special warranties specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Special Weathertightness Warranty for Batten Metal Roof Panels: Install metal roof panels to maintain existing warranty.

PART 2 – PRODUCTS

2.1 METALS AND FINISHES

A. Metallic-Coated Steel Sheet Prepainted with Coil Coating: Steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755 and the following requirements:

1. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792, Class AZ50 coating designation, Grade 50 (ASTM A 792M, Class AZM150 coating designation, Grade 340); structural quality.

2. Thickness: Match existing Surface: Match existing

3. Finish: Apply the following organic coating in thickness indicated. Furnish appropriate air-drying spray finish in matching color for touchup.

   a. Fluoropolymer 2-Coat Coating System: Manufacturer's standard 2-coat, thermocured system composed of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight with a total minimum dry film thickness of 0.9 mil and 30 percent reflective gloss when tested according to ASTM D 523.

      1) Durability: Provide coating field tested under normal range of weather conditions without significant peel, blister, flake, chip, crack, or check in finish; without chalking in excess of a chalk rating of 8 according to ASTM D 4214; and without fading in excess of 5 Hunter units.
      2) Color: Match existing.

4. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

2.2 ROOF PANEL ASSEMBLIES

A. Batten Metal Roof Panels: Factory-formed with vertical ribs at panel edges and intermediate stiffening ribs symmetrically spaced flat pan between ribs to match existing; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels and engaging opposite edge of adjacent panels, and mechanically seaming panels together.

   1. Clips: Low-movement floating clips to accommodate thermal movement; fixed where design permit, designed to meet negative-load requirements.

      a. Material: 24 gage thickness, zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet.

   2. Panel Seam: Batten panels to match existing.

   3. Joint Type: Field mechanically seamed, 180 degrees.

   4. Panel Shape: Match existing.

   5. Panel Width: Match existing.

   6. Eave Notch: Factory-formed.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   1. AEP Span; a BlueScope Steel company.

   2. CENTRIA Architectural Systems.

3. MBCI; a division of NCI Building Systems, L.P.

4. McElroy Metal, Inc.
5. Metal Sales Manufacturing Corporation.

6. Rheinzink.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.3 THERMAL INSULATION

A. Faced, Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 2 glass-fiber mat, Grade 3, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, based on tests performed on unfaced core. 0.02 perm. FM Approvals 4450/4470 approved. CFC-, HCFC-, and HFC- free. Thickness to match existing.

1. Insulation Seam Tape: Manufacturer's recommended tape compatible with insulation facing and with adjacent air barrier transition material.

2.4 UNDERLAYMENT MATERIALS

A. Waterproofing Membrane (Self-Adhering, High-Temperature Sheet): Where required to match existing; 30 to 40 mils thick minimum, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS- modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.

1. Thermal Stability: Stable after testing at 240 degrees F; ASTM D 1970.

2. Low Temperature Flexibility: Passes after testing at minus 20 degrees F; ASTM D 1970.

3. Products: Subject to compliance with requirements, products which may be incorporated in the Work include the following:

a. CCW MiraDRI, Carlisle Coatings & Waterproofing Incorporated, Division of Carlisle Companies Incorporated.

b. Grace Ultra, Grace Construction Products.

c. Blueskin PE 200 HT, HENRY Company.

d. MetShield, Metal-Fab Manufacturing, WIP 300H.

B. Building Paper: Where required to match existing; minimum 5 lb/100 sq. ft., rosin sized.

2.5 MISCELLANEOUS METAL FRAMING

A. Miscellaneous Metal Framing, General: ASTM C 645, cold-formed metallic-coated steel sheet, ASTM A 653/A 653M, G60 (Z180) hot-dip galvanized or coating with equivalent corrosion resistance unless otherwise indicated.

B. Zee Clips: 0.079-inch nominal thickness.

C. Base or Sill Channels: 0.079-inch nominal thickness.

D. Hat-Shaped, Rigid Furring Channels:

1. Nominal Thickness: As required to meet performance requirements, but not less than 0.025 inch.

2. Depth: Match existing.

E. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, and depth required to fit insulation thickness indicated.

1. Nominal Thickness: Match existing.

F. Fasteners for Miscellaneous Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten miscellaneous metal framing members to substrates.

2.6 MISCELLANEOUS MATERIALS

A. General: Provide materials required for a complete roof assembly to match existing and as recommended by roof panel manufacturer, unless otherwise indicated.

B. Glass-Mat Gypsum Sheathing Board: Where required to match existing; ASTM C 1177/C 1177M, paperless, glass-mat facing on, or embedded into each side of a water-resistant gypsum core.

1. Products: Subject to compliance with requirements, products which may be incorporated in the Work include, but are not limited to, the following:

a. Dens-Deck Roof Board, Georgia-Pacific 800-225-6119 www.gp.com

2. Type and Thickness: Regular, match existing thickness.

3. Size: 48 by 96 inches.

C. Thermal Spacers: Where panels attach directly to purlins, provide thermal spacers recommended by panel manufacturer.

D. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads.

1. Use stainless-steel fasteners for exterior applications and galvanized steel fasteners

for interior applications.

E. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat, unless otherwise indicated. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

F. Expansion-Joint Sealant: For hooked-type expansion joints that must be free to move, provide nonsetting, nonhardening, nonmigrating, heavy-bodied polyisobutylene sealant.

2.7 ACCESSORIES

A. Accessories, General: Unless otherwise specified, provide components approved by roof panel manufacturer and required for a complete roof panel assembly including trim, copings, fasciae, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items as required to match existing roofing system. Match materials and finishes of panels.

1. Closures: Provide closures at eaves, fabricated of same metal as metal roof panels.

2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.

B. Panel Sealants: Provide one of the following identical to that used in test panels meeting performance requirements and to match existing:

1. Pressure-sensitive, 99 percent solids, gray polyisobutylene or butyl rubber compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1 inch wide and 1/8 inch thick, with nylon spacer beads to prevent overcompression of the sealant tape.

2. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311, with nylon spacer beads to prevent overcompression of the sealant tape.

C. Flashing and Trim: Formed from same material as roof panels, prepainted with coil coating, minimum 0.028 inch thick. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, fasciae, and fillers. Finish flashing and trim with same finish system to match existing metal roof panels.

D. Pipe Penetration Flashing: Premolded EPDM pipe collar with flexible aluminum ring bonded to base and stainless steel pipe clamp to secure collar to pipe as required to match existing.

2.8 FABRICATION

A. General: Fabricate and finish panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

1. Site-rolled fabrication of panels or shop-rolling of panels using fixed equipment designed for site-rolling applications does not meet the requirements of this Section.

B. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

C. Fabricate panel joints with captive gaskets or separator strips that provide a tight seal and prevent metal-to- metal contact, in a manner that will minimize noise from movements within panel assembly.

D. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.

2. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.

3. Fabricate cleats and attachment devices of size and metal thickness recommended by SMACNA's "Architectural Sheet Metal Manual" or by metal roof panel manufacturer for application, but not less than thickness of metal being secured.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal roof panel supports, and other conditions affecting performance of the Work.

1. Examine primary and secondary roof framing to verify that rafters, purlins, angles, channels, and other structural panel support members and anchorages have been installed within alignment tolerances required by metal roof panel manufacturer.

2. Examine solid roof substrate to verify that substrate joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof panel manufacturer.

3. Examine roughing-in for components and systems penetrating metal roof panels to verify actual locations of penetrations relative to seam locations of metal

roof panels before metal roof panel installation.

4. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

5. Do not proceed with roof or soffit panel installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Substrate Board: Install substrate boards over roof substrate as required to match existing. Attach with substrate- board fasteners.

1. Clean substrates of substances harmful to insulation, including removing projections capable of interfering with insulation attachment.

2. Install substrate board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.

B. Miscellaneous Framing: Install subpurlins, eave angles, furring, and other miscellaneous roof panel support members as required to match existing and anchorage according to metal roof panel manufacturer's written instructions.

C. Coordinate metal panel roofing with rain drainage work; flashing; trim; and construction of decks, parapets, walls, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

D. Promptly remove protective film, if any, from exposed surfaces of metal panels. Strip with care to avoid damage to finish.

3.3 BOARD INSULATION INSTALLATION

A. General: Comply with insulation manufacturer's instructions and recommendations for the handling, installation, and bonding or anchorage of insulation to substrate. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice, rain, and snow. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.

B. Extend insulation in thickness to match existing at area of patching roof. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Seal all joints and penetrations air- and vapor-tight.

C. Where overall insulation thickness is 2 inches or greater, install 2 or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches in each direction.

D. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.

E. Secure insulation to deck using mechanical fasteners specifically designed and sized for attachment of specified board type insulation to deck type shown. Fasten insulation over entire area of roofing at spacing as required by FM for Windstorm Resistance Classification 1-90 and in accordance with requirements of appropriate UL Construction Number. Run long joints for insulation in continuous straight lines, perpendicular to roof slope with end joints staggered between rows. Fill gaps exceeding 1/4 inch with insulation.

F. Seam Tape: Tape seams of board insulation to form unbroken air barrier across plane of insulation. Repair damaged facing with seam tape.

G. Nailers: Install wood nailers at areas of patching to match existing thickness as insulation, set between insulation boards and spaced to match existing, depending on insulation board size. Anchor nailers to substrate. Run nailers perpendicular to slope of roof unless otherwise indicated.

3.4 PANEL INSTALLATION

A. General: Comply with panel manufacturer's written instructions and recommendations for installation, as applicable to project conditions and supporting substrates. Anchor panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Provide metal roof panels of full length from eave to eave unless otherwise indicated or restricted by shipping limitations.

2. Install panels with concealed fasteners, unless otherwise indicated, at each batten joint, at location, spacing, and fasteners recommended by manufacturer.

B. Accessories: Install components required for a complete roof panel assembly including trim, copings, fasciae, clips, seam covers, battens, flashings, sealants, gaskets, fillers, closure strips, and similar items.

C. Separate dissimilar metals by painting each metal surface in area of contact with a bituminous coating, by applying rubberized-asphalt underlayment to each metal surface, or by other permanent separation as recommended by manufacturers of dissimilar metals.

D. Install underlayment and building-paper slip sheet under metal panels, unless otherwise recommended by panel manufacturer. Install self-adhering high-temperature sheet underlayment where indicated or, if not indicated, as required or recommended by panel manufacturer. Use adhesive for temporary anchorage, where possible, to minimize use of mechanical fasteners under metal panels. Apply from eave to eave in shingle fashion and lap joints a minimum of 2 inches.

E. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not otherwise indicated, types recommended by panel manufacturer.

1. Flash and seal panels at eaves with rubber, neoprene, or other closures to exclude weather.

2. Seal panel end laps with double beads of tape or sealant, full width of panel. Seal side joints where recommended by panel manufacturer.

3. Prepare joints and apply sealants to comply with requirements of Division 7 Section "Joint Sealants."

F. Thermal Movement. Rigidly fasten metal roof panels to structure at one and only one location for each panel. Allow remainder of panel to move freely for thermal expansion and contraction. Predrill panels for fasteners.

1. Point of Fixity: Fasten each panel along a single line of fixing located at eave.

2. Avoid attaching accessories through roof panels in a manner that will inhibit thermal movement.

G. Batten Roof Panel Assembly: Fasten panels to supports with concealed clip according to panel manufacturer's written instructions.

1. Patch areas of existing roofing as indicated on Drawings.

2. Field cutting exterior panels by torch or abrasive saw is not permitted.

3. Locate and space fastenings in uniform vertical and horizontal alignment.

4. Anchor metal roof panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturer's written instructions.
5. Install clips at each support with self-drilling/self-tapping fasteners.

6. Provide metal closures at rake edges.

7. Flash and seal metal roof panels with weather closures at eaves, rakes, and perimeter of all openings.

8. End Splices: Locate panel end splices over, but not attached to, structural supports. Stagger panel end splices to avoid a four-panel splice condition.

9. Install metal flashing to allow moisture to run over and off metal roof panels.

10. At end laps of panels, install tape calk between panels.

11. Seaming: Complete seaming of panel joints by operating portable power-driven equipment of type recommended by panel manufacturer to provide a weathertight joint.

12. Apply a continuous ribbon of sealant or tape to seal joints of metal panels, using sealant or tape as recommend in writing by manufacturer as needed to make panels watertight.

13. Provide sealant or tape between panels and protruding equipment, vents, and accessories.

14. At panel splices, nest panels with minimum 6-inch end lap, sealed with sealant and fastened together by interlocking clamping plates

H. Fasteners: Use stainless-steel fasteners for surfaces exposed to the exterior and galvanized-steel fasteners for surfaces exposed to the interior.

I. Installation Tolerances: Shim and align panel units within installed tolerance of 1/4 inch in 20 on slope and location lines as indicated and within 1/8 inch offset of adjoining faces and of alignment of matching profiles.

3.5 ACCESSORY INSTALLATION

A. General: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal roof panel assembly including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.

B. Flashing and Trim: Comply with performance requirements and manufacturer's written installation instructions. Provide concealed fasteners where possible and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

1. Form trim and transition joints using compressed joints with captive butyl sealant capable of resisting static water pressure. Cleated joints and exposed joint sealants do not meet this requirement.

2. Install exposed flashing and trim that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.

3. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

C. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to metal roof panels as recommended by manufacturer.

3.6 FIELD QUALITY CONTROL

A. Remove and replace applications of metal roof panels where inspections indicate that they do not comply with specified requirements.

3.7 CLEANING AND PROTECTING

A. Damaged Units: Replace panels and other components of the Work that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

B. Cleaning: Remove temporary protective coverings and strippable films, if any, as soon as each panel is installed. On completion of panel installation, clean finished surfaces as recommended by panel manufacturer and maintain in a clean condition during construction.

END OF SECTION

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SECTION 07 62 00

SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Standard Provisions and Special Provisions apply to this Section.

1.02 SUMMARY

A. Work Included: Flashing and sheet metal, complete, as shown and specified.

B. Work Specified Elsewhere:

1. Joint Sealants: Section 07 92 00.

1.03 REFERENCE STANDARDS

A. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA): Architectural Sheet Metal Manual.

B. National Roofing Contractors Association (NRCA): Roofing and Waterproofing Manual.

1.04 SUBMITTALS

A. Product Data: Manufacturer's technical product data, installation instructions and recommendations for specified sheet material and fabrications.

B. Shop Drawings: Show layout, profiles, joining methods and anchorage details.

C. Samples: 8-inch-square samples of each specified sheet material.

1.05 PROJECT CONDITIONS

A. Coordination:

1. General: Coordinate Work of this Section with interfacing and adjoining Work for proper sequencing of each installation. Ensure best possible weather resistance and durability of Work and protection of materials and finishes.

2. Coordination Meeting: Participate in coordination meeting arranged by Contractor to assist in preparation of written step-by-step application procedure to integrate flashing and sheet metal Work with window installation Work for a complete watertight system.

PART 2 - PRODUCTS

2.01 SHEET METAL FLASHING AND TRIM MATERIALS

A. Galvanized Steel: Commercial quality with 0.20 percent copper, ASTM A 526 except ASTM A 527 for lock-forming, G90 hot-dip galvanized, mill phosphatized where indicated for painting; 0.0359-inch thick (20 gauge) except as otherwise indicated.

B. Aluminum Sheet: ASTM B209 (ASTM B209M), alloy as standard with manufacturer for finish required to match existing, with temper as required to suit forming operations and performance required; with smooth, flat surface.

2.02 MISCELLANEOUS MATERIALS AND ACCESSORIES

A. Fasteners: Same metal as flashing/sheet metal or other non-corrosive metal as recommended by sheet manufacturer. Match finish of exposed heads with material being fastened.

B. Bituminous Coating: SSPC - Paint 12, solvent-type bituminous mastic, nominally free of sulfur, compounded for 15-mil dry film thickness per coat.

C. Metal Accessories: Provide anchoring devices and similar accessory units as required for installation of work, matching or compatible with material being installed, noncorrosive, size and gage required for performance.

2.03 FABRICATED UNITS

A. General Metal Fabrication: Shop-fabricate work to greatest extent possible. Comply with details shown and with applicable requirements of Reference Standards and other recognized industry practices. Fabricate for waterproof and weather-resistant performance, with expansion provisions for running work, sufficient to permanently prevent leakage, damage, or deterioration of the work. Form work to fit substrates. Comply with material manufacturer instructions and recommendations for forming material. Form exposed sheet metal work without excessive oil-canning, buckling, and tool marks, true to line and levels indicated, with exposed edges folded back to form hems.

B. Seams: Fabricate nonmoving seams in sheet metal with flat-lock seams.

C. Expansion Provisions: Where lapped or bayonet-type expansion provisions in work cannot be used or would not be sufficiently water/weatherproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

D. Sealant Joints: Where movable, nonexpansion type joints are indicated or required for proper performance of work, form metal to provide for proper installation of elastomeric sealant, in compliance with Reference Standards.

E. Separations: Provide for separation of metal from noncompatible metal or corrosive substrates by coating concealed surfaces at locations of contact, with bituminous coating or other permanent separation as recommended by manufacturer/fabricator.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General: Except as otherwise indicated, comply with manufacturer's installation instructions and recommendations and with Reference Standards.

B. Anchorage: Anchor units of work securely in place by methods indicated, providing for thermal expansion of metal units; conceal fasteners where possible and set units true to line and level as indicated. Install work with laps, joints and seams that will be permanently watertight and weatherproof.

C. Flanges: Bed flanges of Work in thick coat of bituminous roofing cement where required for waterproof performance.

3.02 CLEANING AND PROTECTION

A. Exposed Metal Surfaces: Clean and remove substances that might cause corrosion of metal or deterioration of finishes.

B. Protect flashings and sheet metal work during construction to ensure that work will be without damage or deterioration other than natural weathering at time of Substantial Completion.

END OF SECTION

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SECTION 07 84 13

PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Standard Provisions and Special Provisions apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Penetrations in fire-resistance-rated walls.

2. Penetrations in horizontal assemblies.

3. Penetrations in smoke barriers.

B. Related Requirements:

1. Section 07 84 43 "Joint Firestopping" for joints in or between fire-resistance-rated construction, at exterior curtain-wall/floor intersections, and in smoke barriers.

1.03 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.

1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each penetration firestopping system, for tests performed by a qualified testing agency.

1.06 CLOSEOUT SUBMITTALS

A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.07 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

1.08 PROJECT CONDITIONS

A. Environmental Limitations: Do not install penetration firestopping system when ambient or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.

B. Install and cure penetration firestopping materials per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.09 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:

1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.

2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:

    a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.

        1) UL in its "Fire Resistance Directory."
        2) Intertek Group in its "Directory of Listed Building Products."
        3) FM Global in its "Building Materials Approval Guide."

2.02 PENETRATION FIRESTOPPING SYSTEMS

A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. 3M Fire Protection Products.
    b. A/D Fire Protection Systems Inc.
    c. Construction Solutions.
    d. Grabber Construction Products.
    e. Hilti, Inc.
    f. HOLDRITE.
    g. NUCO Inc.
    h. Passive Fire Protection Partners.
    i. RectorSeal.
    j. Specified Technologies, Inc.
    k. STC Sound Control.
    l. Tremco, Inc.

B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).

1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).

1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.

2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.

3. W-Rating: Provide penetration firestopping systems showing no evidence of water leakage when tested according to UL 1479.

D. Penetrations in Smoke Barriers: Penetration firestopping systems with ratings determined per UL 1479, based on testing at a positive pressure differential of 0.30-inch wg (74.7 Pa).

1. L-Rating: Not exceeding 5.0 cfm/sq. ft. (0.025 cu. m/s per sq. m) of penetration opening at and no more than 50-cfm (0.024-cu. m/s) cumulative total for any 100 sq. ft. (9.3 sq. m) at both ambient and elevated temperatures.

E. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E 84.

F. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.

1. Permanent forming/damming/backing materials.

2. Substrate primers.

3. Collars.

4. Steel sleeves.

2.03 FILL MATERIALS

A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer sleeve lined with an intumescent strip, a flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.

B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.

C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.

E. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.

F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

G. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

H. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.

I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

J. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants.

2.04 MIXING

A. Penetration Firestopping Materials: For those products requiring mixing before application, comply with penetration firestopping system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Surface Cleaning: Before installing penetration firestopping systems, clean out openings immediately to comply with manufacturer's written instructions and with the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping materials.

2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.

3. Remove laitance and form-release agents from concrete.

B. Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.03 INSTALLATION

A. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.

B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.

C. Install fill materials by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.04 IDENTIFICATION

A. Wall Identification: Permanently label walls containing penetration firestopping systems and label fire rated walls with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches (76 mm) high and with minimum 0.375-inch (9.5-mm) strokes.

1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet (4.57 m) from end of wall and at intervals not exceeding 30 feet (9.14 m).

B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical

fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."

2. Contractor's name, address, and phone number.

3. Designation of applicable testing and inspecting agency.

4. Date of installation.

5. Manufacturer's name.

6. Installer's name.

3.05 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E 2174.

B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.

C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.06 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping material and install new materials to produce systems complying with specified requirements.

3.07 PENETRATION FIRESTOPPING SYSTEM SCHEDULE

A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHEZ. Refer to Drawings.

B. Where Intertek Group-listed systems are indicated, they refer to design numbers in Intertek Group's "Directory of Listed Building Products" under "Firestop Systems."

C. Where FM Global-approved systems are indicated, they refer to design numbers listed in FM Global's "Building Materials Approval Guide" under "Wall and Floor Penetration Fire Stops."

END OF SECTION

SECTION 07 84 43

JOINT FIRESTOPPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Standard Provisions and Special Provisions apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Joints in or between fire-resistance-rated constructions.

2. Joints in smoke barriers.

B. Related Requirements:

1. Section 07 84 13 "Penetration Firestopping" for penetrations in fire-resistance-rated walls, horizontal assemblies, and smoke barriers

2. Section 09 22 16 "Non-Structural Metal Framing" for firestop tracks for metal-framed partition heads.

1.03 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: For each joint firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing agency.

1. Engineering Judgments: Where Project conditions require modification to a qualified testing agency's illustration for a particular joint firestopping system condition, submit illustration, with modifications marked, approved by joint firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each joint firestopping system, for tests performed by a qualified testing agency.

1.06 CLOSEOUT SUBMITTALS

A. Installer Certificates: From Installer indicating that joint firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.07 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with UL's "Qualified Firestop Contractor Program Requirements."

1.08 PROJECT CONDITIONS

A. Environmental Limitations: Do not install joint firestopping systems when ambient or substrate temperatures are outside limits permitted by joint firestopping system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Install and cure joint firestopping systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

1.09 COORDINATION

A. Coordinate construction of joints to ensure that joint firestopping systems can be installed according to specified firestopping system design.

B. Coordinate sizing of joints to accommodate joint firestopping systems.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:

1. Perform joint firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.

2. Test per testing standards referenced in "Joint Firestopping Systems" Article. Provide rated systems complying with the following requirements:

a. Joint firestopping systems shall bear classification marking of a qualified testing agency.

1) UL in its "Fire Resistance Directory."

2) Intertek Group in its "Directory of Listed Building Products."

2.02 JOINT FIRESTOPPING SYSTEMS

A. Joint Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.

B. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E 1966 or UL 2079.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. 3M Fire Protection Products.
   b. A/D Fire Protection Systems Inc.
   c. Blazeframe Industries.
   d. Grabber Construction Products.
   e. Hilti, Inc.
   f. Nelson Firestop; a brand of Emerson Industrial Automation.
   g. NUCO Inc.
   h. Passive Fire Protection Partners.
   i. RectorSeal.
   j. ROXUL.
   k. Specified Technologies, Inc.
   l. Thermafiber, Inc.; an Owens Corning company.
   m. Tremco, Inc.

2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed.

C. Joints in Smoke Barriers: Provide fire-resistive joint systems with ratings determined per UL 2079 based on testing at a positive pressure differential of 0.30-inch wg (74.7 Pa).

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. 3M Fire Protection Products.
   b. A/D Fire Protection Systems Inc.

c. Hilti, Inc.

d. Nelson Firestop; a brand of Emerson Industrial Automation.

e. NUCO Inc.

f. Passive Fire Protection Partners.

g. RectorSeal.

h. ROXUL.

i. Specified Technologies, Inc.

j. Thermafiber, Inc.; an Owens Corning company.

k. Tremco, Inc.

2. L-Rating: Not exceeding 5.0 cfm/ft. (0.00775 cu. m/s x m) of joint at both ambient and elevated temperatures.

D. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

E. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Surface Cleaning: Before installing fire-resistive joint systems, clean joints immediately to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:

1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of elastomeric fill materials or compromise fire-resistive rating.

2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with elastomeric fill materials. Remove loose particles remaining from cleaning operation.

3. Remove laitance and form-release agents from concrete.

B. Prime substrates where recommended in writing by joint firestopping system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.03 INSTALLATION

A. General: Install fire-resistive joint systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming materials and other accessories of types required to support elastomeric fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing elastomeric fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.

C. Install elastomeric fill materials for fire-resistive joint systems by proven techniques to produce the following results:

1. Elastomeric fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.

2. Apply elastomeric fill materials so they contact and adhere to substrates formed by joints.

3. For elastomeric fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.04 IDENTIFICATION

A. Joint Identification: Identify joint firestopping systems with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of joint edge so labels are visible to anyone seeking to remove or joint firestopping system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Joint Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.05 FIELD QUALITY CONTROL

A. Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E 2393.

B. Where deficiencies are found or joint firestopping systems are damaged or removed due to testing, repair or replace joint firestopping systems so they comply with requirements.

C. Proceed with enclosing joint firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.06 CLEANING AND PROTECTION

A. Clean off excess elastomeric fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by joint firestopping system manufacturers and that do not damage materials in which joints occur.

B. Provide final protection and maintain conditions during and after installation that ensure joint firestopping systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

3.07 JOINT FIRESTOPPING SYSTEM SCHEDULE

A. Designation of System as indicated on Drawings.

END OF SECTION

SECTION 07 92 00

JOINT SEALANTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Standard Provisions and Special Provisions apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Interior joint sealants as follows and as scheduled in PART 3:

a. Latex joint sealants.

b. Urethane joint sealants.

1.03 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.

2. Joint-sealant manufacturer and product name.

3. Joint-sealant formulation.

4. Joint-sealant color.

C. Qualification Data: For qualified Installer.

D. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.

E. Product Test Reports:

1. Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.

2. Preconstruction Compatibility and Adhesion Test Reports (from sealant manufacturer, indicating the following):

a. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.

b. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

F. Warranties: Sample of special warranties.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.

C. Product Testing: Test joint sealants using a qualified testing agency.

1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

D. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

1.05 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 degrees F (5 degrees C).

2. When joint substrates are wet.

3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.

4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.06 WARRANTY

A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.

2. Disintegration of joint substrates from natural causes exceeding design specifications.

3. Mechanical damage caused by individuals, tools, or other outside agents.

4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.01 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. Low-Emitting Materials:

1. VOC Content of Interior Sealants: Provide sealants and sealant primers for use inside the weatherproofing system that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

a. Architectural Sealants: Not more than 250 g/L.

b. Non-membrane Roof Sealants: 300 g/L.

c. Single-Ply Roof Membrane Sealants: 450 g/L.

d. Sealant Primers for Nonporous Substrates: Not more than 250 g/L.

e. Sealant Primers for Porous Substrates: Not more than 775 g/L.

f. Modified Bituminous Sealant Primers: 500 g/L.

C. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

D. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

E. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.02 LATEX JOINT SEALANTS

A. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. BASF Building Systems; Sonolac.

b. Bostik, Inc.; Chem-Calk 600.

c. Pecora Corporation; AC-20+.

d. Tremco Incorporated; Tremflex 834.

2.03 URETHANE JOINT SEALANTS

A. Urethane, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade P, Class 25, Uses T and NT.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. BASF Corporation.

b. Pecora Corporation.

c. Permathane®/Acryl-R®; ITW Polymers Sealants North America.

d. Polymeric Systems, Inc.

e. Sherwin-Williams Company (The).

2.04 JOINT SEALANT BACKING

A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material w/ a surface skin), Type B (bi-cellular material w/ a surface skin), or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.05 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants.

3. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:

   a. Concrete.

   b. Masonry.

4. Remove laitance and form-release agents from concrete.

5. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:

   a. Metal.

   b. Glass.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.03 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

   1. Do not leave gaps between ends of sealant backings.

   2. Do not stretch, twist, puncture, or tear sealant backings.

   3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

   1. Place sealants so they directly contact and fully wet joint substrates.

   2. Completely fill recesses in each joint configuration.

3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.

2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.

3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.

4. Provide flush joint profile where indicated per Figure 8B in ASTM C 1193.

5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 8C in ASTM C 1193.

a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.04 CLEANING AND PROTECTION

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

B. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.05 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.

1. Joint Locations:

a. Isolation joints in cast-in-place concrete slabs.

b. Control and expansion joints in tile flooring.

c. Other joints as indicated.

2. Joint Sealant: Urethane, single component, pourable, traffic grade, neutral curing.

3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

B. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

a. Vertical joints on exposed surfaces of partitions.

b. Perimeter joints between interior wall surfaces and frames of interior doors and windows.

c. Other joints as indicated.

2. Joint Sealant: Latex.

3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION

SECTION 08 11 13

HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Standard Provisions and Special Provisions apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Standard and custom hollow metal doors and frames.
2. Steel sidelight, borrowed lite and transom frames.
3. Louvers installed in hollow metal doors.
4. Light frames and glazing installed in hollow metal doors.

B. Related Sections:

1. Division 08 Section “Flush Wood Doors”.
2. Division 08 Section "Glazing" for glass view panels in hollow metal doors.
3. Division 08 Section "Door Hardware".
4. Division 09 Sections "Painting" for field painting hollow metal doors and frames.

C. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI/SDI A250.8 - Recommended Specifications for Standard Steel Doors and Frames.
2. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frames Anchors and Hardware Reinforcing.
3. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.
4. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
5. ANSI/SDI A250.11 - Recommended Erection Instructions for Steel Frames.
6. ASTM A1008 - Standard Specification for Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
7. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
8. ASTM A924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
9. ASTM C 1363 - Standard Test Method for Thermal Performance of Building Assemblies by Means of a Hot Box Apparatus.
10. ANSI/BHMA A156.115 - Hardware Preparation in Steel Doors and Frames.

11. ANSI/SDI 122 - Installation and Troubleshooting Guide for Standard Steel Doors and Frames.
12. ANSI/NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association.
13. ANSI/NFPA 105: Standard for the Installation of Smoke Door Assemblies.
14. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association.
15. UL 10C - Positive Pressure Fire Tests of Door Assemblies.
16. UL 1784 - Standard for Air Leakage Tests of Door Assemblies.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, hardware reinforcements, profiles, anchors, fire-resistance rating, and finishes.

B. Door hardware supplier is to furnish templates, template reference number and/or physical hardware to the steel door and frame supplier in order to prepare the doors and frames to receive the finish hardware items.

C. Shop Drawings: Include the following:

1. Elevations of each door design.
2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of anchorages, joints, field splices, and connections.
6. Details of accessories.
7. Details of moldings, removable stops, and glazing.
8. Details of conduit and preparations for power, signal, and control systems.

D. Samples for Verification:

1. Samples are only required by request of the architect and for manufacturers that are not current members of the Steel Door Institute.

1.04 QUALITY ASSURANCE

A. Source Limitations: Obtain hollow metal doors and frames through one source from a single manufacturer wherever possible.

B. Quality Standard: In addition to requirements specified, furnish SDI-Certified manufacturer products that comply with ANSI/SDI A250.8, latest edition, "Recommended Specifications for Standard Steel Doors and Frames".

C. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to UL10C (neutral pressure at 40” above sill) or UL 10C.

1. Oversize Fire-Rated Door Assemblies Construction: For units exceeding sizes of tested assemblies, attach construction label certifying doors are built to standard construction requirements for tested and labeled fire rated door assemblies except for size.
2. Temperature-Rise Limit: Where indicated and at vertical exit enclosures (stairwell openings) and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.
3. Smoke Control Door Assemblies: Comply with NFPA 105.

    a. Smoke "S" Label: Doors to bear “S” label, and include smoke and draft control gasketing applied to frame and on meeting stiles of pair doors.

D. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257. Provide labeled glazing material.

E. Pre-Submittal Conference: Conduct conference attendance by representatives of Supplier, Installer, and Contractor to review proper methods and procedures for installing hollow metal doors and frames and to verify installation of electrical knockout boxes and conduit at frames with electrified or access control hardware.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project site storage. Do not use non-vented plastic.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch high wood blocking. Do not store in a manner that traps excess humidity.

1. Provide minimum 1/4-inch space between each stacked door to permit air circulation. Door and frames to be stacked in a vertical upright position.

1.06 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.07 COORDINATION

A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.08 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

B. Warranty includes installation and finishing that may be required due to repair or replacement of defective doors.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide steel doors and frames from a SDI Certified manufacturer:

1. CECO Door Products (C).
2. Curries Company (CU).
3. Security Metal Products (SMP).

2.02 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

C. Frame Anchors: ASTM A 653/A 653M, Commercial Steel (CS), Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

2.03 HOLLOW METAL DOORS

A. General: Provide 1-3/4 inch doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8 and ANSI/NAAMM HMMA 867.

B. Interior Doors: Face sheets fabricated of commercial quality cold rolled steel that complies with ASTM A 1008/A 1008M. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:

1. Design: Flush panel.

    a. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.

2. Level/Model: Level 2 and Physical Performance Level B (Heavy Duty), Minimum 18 gauge (0.042-inch - 1.0-mm) thick steel, Model 2.

3. Vertical Edges: Vertical edges to have the face sheets spot welded and filled full height with an epoxy filler. Welds are to be ground, filled and dressed smooth. Beveled Lock Edge, 1/8 inch in 2 inches (3 mm in 50 mm).
4. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet.
5. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9" or minimum 14 gauge continuous channel with pierced holes, drilled and tapped.
6. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

C. Manufacturers Basis of Design:

1. Curries Company (CU) - Polystyrene Core - 707 Series.

D. Exterior Doors: Heavy-Duty doors and frames; ANSI/SDI A250.8, Level 2; ANSI/SDI A250.4, Level B.

1. Type: As indicated in the Door Schedule.
2. Thickness: 1-3/4 inches.
3. Face: Metallic-coated steel sheet, minimum thickness of 0.042 inch (1.0 mm), with minimum A60 (ZF180) coating.
4. Edge Construction: Model 2, Seamless.
5. Edge Bevel: Provide manufacturer's standard beveled or square edges.
6. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
7. Bottom Edges: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
8. Core: Polystyrene Vertical steel stiffener.
9. Fire-Rated Core: Manufacturer's standard vertical steel stiffener with insulation core for fire-rated doors.

2.04 HOLLOW METAL FRAMES

A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.

B. Interior Frames: Fabricated from cold-rolled steel sheet that complies with ASTM A 1008/A 1008M.

1. Fabricate frames with mitered or coped corners. Profile as indicated on drawings.
2. Frames: Minimum 16 gauge (0.053-inch -1.3-mm) thick steel sheet.
3. Manufacturers Basis of Design:

    a. Curries Company (CU) - M Series.

C. Fire rated frames: Fabricate frames in accordance with NFPA 80, listed and labeled by a qualified testing agency, for fire-protection ratings indicated.

D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 Table 4 with reinforcement plates from same material as frames.

2.05 FRAME ANCHORS

A. Jamb Anchors:

1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, formed from A60 metallic coated material, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
2. Stud Wall Type: Designed to engage stud and not less than 0.042 inch thick.
3. Compression Type for Drywall Slip-on (Knock-Down) Frames: Adjustable compression anchors.

B. Floor Anchors: Floor anchors to be provided at each jamb, formed from A60 metallic coated material, not less than 0.042 inches thick.

C. Mortar Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.06 LOUVERS

A. Metal Louvers: Door manufacturer's standard metal louvers unless otherwise indicated.

1. Blade Type: Vision proof inverted V or inverted Y.
2. Metal and Finish: Galvanized steel, 0.040 inch thick, factory primed for paint finish with baked enamel or powder coated finish. Match pre-finished door paint color where applicable.

B. Louvers for Fire Rated Doors: Metal louvers with fusible link and closing device, listed and labeled for use in doors with fire protection rating of 1-1/2 hours and less.

1. Manufacturers: Subject to compliance with requirements, provide door manufacturers standard louver to meet rating indicated.
2. Metal and Finish: Galvanized steel, 0.040 inch thick, factory primed for paint finish with baked enamel or powder coated finish. Match pre-finished door paint color where applicable.

2.07 LIGHT OPENINGS AND GLAZING

A. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints at fabricator’s shop. Fixed and removable stops to allow multiple glazed lites each to be removed independently. Coordinate frame rabbet widths between fixed and removable stops with the type of glazing and installation indicated.

B. Moldings for Glazed Lites in Doors and Loose Stops for Glazed Lites in Frames: Minimum 20 gauge thick, fabricated from same material as door face sheet in which they are installed.

C. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch (16 mm) high unless otherwise indicated. Provide fixed frame moldings and stops on outside of exterior and on secure side of interior doors and frames.

D. Preformed Metal Frames for Light Openings: Manufacturer's standard frame formed of 0.048-inch-thick, cold rolled steel sheet; with baked enamel or powder coated finish; and approved for use in doors of fire protection rating indicated. Match pre-finished door paint color where applicable.

2.08 FABRICATION

A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. When shipping limitations so dictate, frames for large openings are to be fabricated in sections for splicing or splining in the field by others.

B. Tolerances: Fabricate hollow metal work to tolerances indicated in ANSI/SDI A250.8.

C. Hollow Metal Doors:

1. Glazed Lites: Factory cut openings in doors with applied trim or kits to fit. Factory install glazing where indicated.
2. Astragals: Provide overlapping astragals as noted in door hardware sets in Division 08 Section "Door Hardware" on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted.
3. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge strap for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".

D. Hollow Metal Frames:

1. Shipping Limitations: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
2. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.

    a. Welded frames are to be provided with two steel spreaders temporarily attached to the bottom of both jambs to serve as a brace during shipping and handling. Spreader bars are for bracing only and are not to be used to size the frame opening.

3. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
4. High Frequency Hinge Reinforcement: Provide high frequency hinge reinforcements at door openings 48-inches and wider with mortise butt type hinges at top hinge locations.

5. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge straps for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".
6. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated for removable stops.
7. Mortar Guards: Provide guard boxes at back of hardware mortises in frames at all hinges and strike preps regardless of grouting requirements.
8. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
9. Jamb Anchors: Provide number and spacing of anchors as follows:

    a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

        1) Two anchors per jamb up to 60 inches high.
        2) Three anchors per jamb from 60 to 90 inches high.
        3) Four anchors per jamb from 90 to 120 inches high.
        4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.

    b. Stud Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

        1) Three anchors per jamb up to 60 inches high.
        2) Four anchors per jamb from 60 to 90 inches high.
        3) Five anchors per jamb from 90 to 96 inches high.
        4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
        5) Two anchors per head for frames above 42 inches wide and mounted in metal stud partitions.
10. Door Silencers: Except on weatherstripped or gasketed doors, drill stops to receive door silencers. Silencers to be supplied by frame manufacturer regardless if specified in Division 08 Section "Door Hardware".

E. Hardware Preparation: Factory prepare hollow metal work to receive template mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."

1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
2. Reinforce doors and frames to receive non-template, mortised and surface mounted door hardware.
3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.

2.09 STEEL FINISHES

A. Prime Finishes: Doors and frames to be cleaned, and chemically treated to insure maximum finish paint adhesion. Surfaces of the door and frame exposed to view to receive a factory applied coat of rust inhibiting shop primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead and chromate free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; and compatible with substrate and field-applied coatings.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. General Contractor to verify the accuracy of dimensions given to the steel door and frame manufacturer for existing openings or existing frames (strike height, hinge spacing, hinge back set, etc.).

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Remove welded in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Prior to installation, adjust and securely brace welded hollow metal frames for square, level, twist, and plumb condition.

C. Tolerances shall comply with SDI-117 "Manufacturing Tolerances Standard Steel Doors and Frames."

D. Drill and tap doors and frames to receive non-template, mortised, and surface-mounted door hardware.

3.03 INSTALLATION

A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11 and NFPA 80 at fire rated openings.

1. Set frames accurately in position, plumbed, leveled, aligned, and braced securely until permanent anchors are set. After wall construction is complete and frames

properly set and secured, remove temporary braces, leaving surfaces smooth and undamaged. Shim as necessary to comply with installation tolerances.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.
3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with mortar.
4. Grout Requirements: Do not grout head of frames unless reinforcing has been installed in head of frame. Do not grout vertical or horizontal closed mullion members.

C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Standard Steel Doors:

   a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
   b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
   c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
   d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

D. Field Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with hollow metal manufacturer's written instructions.

3.04 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow metal work immediately after installation.

C. Prime-Coat and Painted Finish Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat, or painted finishes, and apply touchup of compatible air drying, rust-inhibitive primer, zinc rich primer (galvanized openings) or finish paint.

END OF SECTION

SECTION 08 51 13

ALUMINUM WINDOWS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Standard Provisions and Special Provisions apply to this Section.

1.02 SUMMARY

A. Section includes aluminum windows for exterior locations.

1.03 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review and discuss the finishing of aluminum windows that is required to be coordinated with the finishing of other aluminum work for color and finish matching.
3. Review, discuss, and coordinate the interrelationship of aluminum windows with other exterior wall components. Include provisions for anchoring, flashing, weeping, sealing perimeters, and protecting finishes.
4. Review and discuss the sequence of work required to construct a watertight and weathertight exterior building envelope.
5. Inspect and discuss the condition of substrate and other preparatory work performed by other trades.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, glazing and fabrication methods, dimensions of individual components and profiles, hardware, and finishes for aluminum windows.

B. Shop Drawings: For aluminum windows.

1. Include plans, elevations, sections, hardware, accessories, insect screens, operational clearances, and details of installation, including anchor, flashing, and sealant installation.

C. Product Schedule: For aluminum windows. Use same designations indicated on Drawings.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and Installer.

B. Product Test Reports: For each type of aluminum window, for tests performed by a qualified testing agency.

C. Field quality-control reports.

D. Sample Warranties: For manufacturer's warranties.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer capable of fabricating aluminum windows that meet or exceed performance requirements indicated and of documenting this performance by test reports and calculations.

B. Installer Qualifications: An installer acceptable to aluminum window manufacturer for installation of units required for this Project.

C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockup of typical wall area as shown on Drawings.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.07 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Failure to meet performance requirements.
   b. Structural failures including excessive deflection, water leakage, condensation, and air infiltration.
   c. Faulty operation of movable sash and hardware.
   d. Deterioration of materials and finishes beyond normal weathering.
   e. Failure of insulating glass.

2. Warranty Period:

   a. Window: 10 years from date of Substantial Completion.
   b. Glazing Units: 10 years from date of Substantial Completion.
   c. Aluminum Finish: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Source Limitations: Obtain aluminum windows from single source from single manufacturer.

2.02 WINDOW PERFORMANCE REQUIREMENTS

A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.

1. Window Certification: AAMA certified with label attached to each window.

B. Performance Class and Grade: AAMA/WDMA/CSA 101/I.S.2/A440 as follows:

1. Minimum Performance Class: LC.
2. Minimum Performance Grade: 25.

C. Thermal Transmittance: NFRC 100 maximum whole-window U-factor of 0.30 Btu/sq. ft. x h x deg F (1.71 W/sq. m x K).

D. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum whole-window SHGC of 0.23.

E. Condensation-Resistance Factor (CRF): Provide aluminum windows tested for thermal performance according to AAMA 1503, showing a CRF of 45.

F. Thermal Movements: Provide aluminum windows, including anchorage, that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change: 120 deg F (67 deg C) ambient; 180 deg F (100 deg C) material surfaces.

2.03 ALUMINUM WINDOWS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. All Seasons Window & Door Mfg.; All Seasons Commercial Division, Inc.
2. All Weather Architectural Aluminum.
3. Alumatherm.
4. Arcadia, Inc.
5. EFCO Corporation.
6. Oldcastle Building Envelope.

7. TRACO.
8. Wausau Window and Wall Systems; Apogee Wausau Group, Inc.
9. Winco Manufacturing Co.
10. YKK AP America Inc.

B. Types: Provide the following types in locations indicated on Drawings:

1. Fixed.

C. Frames and Sashes: Aluminum extrusions complying with AAMA/WDMA/CSA 101/I.S.2/A440.

1. Thermally Improved Construction: Fabricate frames, sashes, and muntins with an integral, concealed, low-conductance thermal barrier located between exterior materials and window members exposed on interior side in a manner that eliminates direct metal-to-metal contact.

D. Glass: Refer to Section 08 80 00 “Glazing”.

E. Glazing System: Manufacturer's standard factory-glazing system that produces weathertight seal. Refer to Section 08 80 00 “Glazing”.

1. Dual Glazing System:

a. Interior Lite: Glass.
b. Exterior Lite: Glass.

F. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.

1. Exposed Fasteners: Do not use exposed fasteners to greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.

2.04 ACCESSORIES

A. Subsills: Thermally broken, extruded-aluminum subsills in configurations indicated on Drawings.

2.05 FABRICATION

A. Fabricate aluminum windows in sizes indicated. Include a complete system for assembling components and anchoring windows.

B. Glaze aluminum windows in the factory.

C. Weather strip each operable sash to provide weathertight installation.

D. Weep Holes: Provide weep holes and internal passages to conduct infiltrating water to exterior.

E. Provide water-shed members above side-hinged sashes and similar lines of natural water penetration.

F. Mullions: Provide mullions and cover plates, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections. Provide mullions and cover plates capable of withstanding design wind loads of window units.

G. Complete fabrication, assembly, finishing, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation.

2.06 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.07 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Anodic Finish: As selected by Architect from manufacturer’s standard finishes.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Verify rough opening dimensions, levelness of sill plate, and operational clearances.

C. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure weathertight window installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E2112.

B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weathertight construction.

C. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.

D. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

3.03 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

1. Testing and inspecting agency will interpret tests and state in each report whether tested work complies with or deviates from requirements.

B. Testing Services: Testing and inspecting of installed windows shall take place as follows:

1. Testing Methodology: Testing of windows for air infiltration and water resistance shall be performed according to AAMA 502.
2. Air-Infiltration Testing:

    a. Test Pressure: That required to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440 performance class indicated.
    b. Allowable Air-Leakage Rate: 1.5 times the applicable AAMA/WDMA/CSA 101/I.S.2/A440 rate for product type and performance class rounded down to one decimal place.

3. Water-Resistance Testing:

    a. Test Pressure: Two-thirds times test pressure required to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440 performance grade indicated.
    b. Allowable Water Infiltration: No water penetration.

4. Testing Extent: One window of each type as selected by Architect and a qualified independent testing and inspecting agency. Windows shall be tested after perimeter sealants have cured.
5. Test Reports: Prepared according to AAMA 502.

C. Windows will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.04 ADJUSTING, CLEANING, AND PROTECTION

A. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation and weathertight closure.

B. Clean exposed surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.

1. Keep protective films and coverings in place until final cleaning.

C. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

D. Protect window surfaces from contact with contaminating substances resulting from construction operations. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written instructions.

END OF SECTION

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SECTION 08 71 00

FINISH HARDWARE

PART 1 -- GENERAL

1.01 SCOPE OF WORK

A. Drawings and general provisions of the Contract, including Standard Provisions and Special Provisions apply to this Section.

B. Section includes:

1. Mechanical door hardware for the following:

a. Swinging doors.

1.02 SUBMITTALS

A. All submittals shall be in accordance with the Standard Provisions.

B. Product Data: For each type of product indicated. Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.

C. Other Submittals:

1. Door Hardware Schedule fabrication and assembly of door hardware, as well as installation procedures and diagrams. Coordinate final door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

a. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.

b. Content: Include the following information:

1) Identification number, location, hand, fire rating, size, and material of each door and frame.

2) Locations of each door hardware set, cross-referenced to the Drawings on floor plans and to door and frame schedule.

3) Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.

4) Fastenings and other pertinent information.

5) Explanation of abbreviations, symbols, and codes contained in schedule.

6) Mounting locations for door hardware.

7) List of related door devices specified in other Sections for each door and frame.

2. Keying Schedule: Prepared by or under the supervision of Installer, detailing District's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with the Contract Documents.

D. Qualification Data: For Installer.

E. Product Test Reports: For compliance with accessibility requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for door hardware on doors located in accessible routes.

F. Maintenance Data: For each type of door hardware to include in maintenance manuals. Include final hardware and keying schedule.

G. Warranty: Special warranty specified in this Section.

1.03 QUALITY ASSURANCE

A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and an Architectural Hardware Consultant who is available during the course of the Work to consult with Contractor and ENGINEER OF RECORD about door hardware and keying.

1. Scheduling Responsibility: Preparation of door hardware and keying schedules.

2. Engineering Responsibility: Preparation of data for electrified door hardware, including shop drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

B. Source Limitations: Obtain each type of door hardware from a single manufacturer.

C. Means of Egress Doors: Latches shall not require more than 15 lbf to release the latch. Locks shall not require use of a key, tool, or special knowledge for operation.

D. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines.

1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.

2. Comply with the following maximum opening-force requirements:

a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf applied perpendicular to door.

b. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.

3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch high.

4. Adjust door closer sweep periods so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the leading edge of the door.

E. Hardware and keying Conference: Conduct conference at Project site to coordinate hardware and keying. In addition to District, Contractor, and ENGINEER OF RECORD, conference participants shall also include S Installer's Architectural Hardware Consultant. Incorporate keying conference decisions into final access control system and keying schedule after reviewing door hardware and security system including, but not limited to, the following:

1. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.

2. Preliminary key system schematic diagram.

3. Requirements for key control system.

4. Address for delivery of keys.

F. Pre-installation Conference: Conduct conference at Project site.

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

2. Inspect and discuss preparatory work performed by other trades.

3. Review required testing, inspecting, and certifying procedures.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.

B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.

C. Deliver keys to CONSTRUCTION MANAGER at Project site.

1.05 COORDINATION

A. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check shop drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

B. Coordinate keying requirements with the CONSTRUCTION MANAGER and the District.

1.06 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fails in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including excessive deflection, cracking, or breakage.

b. Faulty operation of doors and door hardware.

c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

2. Warranty Period: Three years from date of Acceptance, unless otherwise indicated.

a. Manual Closers: 10 years from date of Acceptance.

1.07 MEASUREMENT AND PAYMENT

A. Work shall be considered incidental and compensation shall be included in the Contract prices paid for the various items of work and no additional time or compensation be allowed therefor.

B. Refer to Article 20.01 Schedule of Bid Items.

PART 2 -- PRODUCTS

2.01 SCHEDULED DOOR HARDWARE

A. Provide door hardware for each door as scheduled in Part 3 "Door Hardware Schedule" Article to comply with requirements in this Section.

1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated.

B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door Hardware Schedule" Article. Products are identified by using door hardware designations, as follows:

1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in Part 3 "Door Hardware Schedule" Article.

2.02 HINGES

A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Schedule or comparable product by one of the following:

    a. Hager Companies.

    b. Bommer Industries, Inc.

    c. McKinney Products Company.

    d. Or equal.

2.03 MECHANICAL LOCKS AND LATCHES

A. Lock Functions: As indicated in door hardware schedule.

B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:

1. Mortise Locks: Minimum 3/4-inch latchbolt throw.

2. Deadbolts: Minimum 1-inch bolt throw.

C. Lock Backset: 2-3/4 inches, unless otherwise indicated.

D. Lock Trim:

1. Description: As scheduled.

2. Levers: Cast

3. Escutcheons: Cast

4. Operating Device: Lever with escutcheons

E. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following.

3. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on the schedule or comparable product by one of the following:

    a. Schlage “L” Series locksets in accordance with the Santa Clara Valley Water District Standard.

F. Mortise Locks: BHMA A156.13; Operational Grade 1, Security Grade 1; stamped steel case with steel or brass parts; Series 1000.

2.04 LOCK CYLINDERS

A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver.

1. Manufacturer: District to verify cylinder manufacturer and keying system requirements.

B. Standard Lock Cylinders: BHMA A156.5; Grade 1; face finished to match lockset.

C. Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide 10 construction master keys.

2.05 KEYING

A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A. Incorporate decisions made in keying conference.

1. Grand Master Key System: Change keys, a master key, and a grand master key operate cylinders.

B. Keys:

1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:

a. Notation: Information to be furnished by District.

2. Quantity: In addition to one extra key blank for each lock, provide the following:

a. Cylinder Change Keys: Three.

b. Master Keys: Five.

c. Master Keys: Five.

2.06 OPERATING TRIM

A. Operating Trim: BHMA A156.6; Brass, bronze, or stainless steel, unless otherwise indicated.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Schedule or comparable product by one of the following or equal:

a. Hager Companies.

b. Trimco.

c. Rockwood Manufacturing Company.

d. Or equal.

2.07 SURFACE CLOSERS

A. Surface Closers: BHMA A156.4; cast iron closer body, rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:

2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following or equal:

   a. Hager Companies.

   b. DORMA Architectural Hardware.

   c. Norton Door Controls; an ASSA ABLOY Group company.

   d. Or equal.

2.08 MECHANICAL STOPS

A. Wall- and Floor-Mounted Stops: BHMA A156.16; polished cast brass, bronze, or stainless steel base metal.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:

2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following or equal:

   a. Hager Companies.

   b. Trimco.

   c. Rockwood Manufacturing Company.

   d. Or equal.

2.09 DOOR GASKETING

A. Door Gasketing: BHMA A156.22; air leakage not to exceed 0.50 cfm per foot of crack length for gasketing other than for smoke control, as tested according to ASTM E 283; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:

2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following or equal:

   a. Hager Companies.

   b. Pemko Manufacturing Co.

   c. Reese Enterprises, Inc.

   d. Or equal.

2.10 THRESHOLDS

A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:

2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following or equal:

   a. Hager Companies.

   b. Pemko Manufacturing Co.; an ASSA ABLOY Group company.

   c. Reese Enterprises, Inc.

   d. Or equal.

2.11 METAL PROTECTIVE TRIM UNITS

A. Metal Protective Trim Units: BHMA A156.6; fabricated from 0.050-inch- thick stainless steel; beveled 4 sides with manufacturer's standard machine or self-tapping screw fasteners.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:

2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following or equal:

   a. Hager Companies.

   b. Trimco.

   c. Rockwood Manufacturing Company.

   d. Or equal.

2.12 AUXILIARY DOOR HARDWARE

A. Auxiliary Hardware: BHMA A156.16.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Schedule or comparable product by one of the following or equal:

    a. Hager Companies.

    b. Trimco.

    c. Rockwood Manufacturing Company.

    d. Or equal.

2.13 FABRICATION

A. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.

B. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.

1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware

2. Fire-Rated Applications:

    a. Wood or Machine Screws: For the following:

        1) Hinges mortised to doors or frames.

        2) Strike plates to frames.

        3) Closers to doors and frames.

    b. Steel Through Bolts: The use of Through Bolts is not allowed. Hardware reinforcement mounts or wood blocking are to be provided at doors and frames.

    c. Gasketing Fasteners: Provide non-corrosive fasteners for exterior applications and elsewhere as indicated.

2.14 FINISHES

A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 -- EXECUTION

3.01 EXAMINATION

A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.

3.03 INSTALLATION

A. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.

2. Custom Steel Doors and Frames: HMMA 831.

B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 09 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.

2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

C. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

D. Lock Cylinders: Install construction keying to secure building and areas during construction period.

E. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.

F. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 07 92 00.

G. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.

H. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

I. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

J. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.04 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.

B. Occupancy Adjustment: Approximately 3 months prior to Project completion, Installer shall examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors, door hardware.

3.05 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items as necessary to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Project completion.

3.06 DEMONSTRATION

A. Engage a factory-authorized service representative to train District's maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes.

3.07 DOOR HARDWARE SCHEDULE

A. Note: Hardware to be provided as specified and in accordance with Santa Clara Valley Water District Standards and project requirements. Locks shall be Schlage (specified), or Corbin/Russwin or Best Access Systems six pin system, no other manufacturers allowed.

Hardware Group No. 1: Exterior Single Door

Electrified Lockset	L9080P-EU-RX-06L	630	SC
Hinges	BB1191 4-1/2”x4-1/2” NRP	630	HA
Closer	5100 HDCS	689	HA
Kick Plate	194S x 10” High	630	HA
Rain Drip	810S	628	HA
Door Sweep	770S B	628	HA
Threshold	417S x Slip Resistant Surface	SCA	HA
Weatherstrip	881S N	628	HA

Description of Operation:

1. Door is normally closed and secure.
2. Presentation of valid credential at wall reader unlocks the lockset for a predetermined time allowing entry by lever trim, then re-locking electrically.
3. Micro-switch positioned inside the lock case monitors the retractor crank, and is actuated when rotation of the inside or outside lever rotates the retractor hub. The switch signals the use of that opening to security systems, allowing a non-disruptive means of immediate egress. (Request to Exit “RX”)
4. Keyed cylinder at lockset trim for authorized entry by manual operation.
5. In the event of power loss or fire alarm condition the lockset trim is locked (Fail Secure).
6. Door position switch signals open or closed door status at monitor station.
7. Free and immediate egress at all times.

Hardware Group No. 2: Interior Single Door

Hinges	BB1191 4-1/2”x4-1/2” NRP	630	HA
Rim Cylinder	20-021	626	SC
Closer	5100 HDCS	689	HA
Kick Plate	194S x 10” High	630	HA
Silencers	307D	Grey	HA
Wall Stop	232W	630	HA

Description of Operation:

8. Door is normally closed and secure.
9. Keyed cylinder at exit for authorized entry by manual operation.
10. Free and immediate egress at all times.

END OF SECTION

SECTION 08 80 00

GLAZING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Standard Provisions and Special Provisions apply to this Section.

1.02 SUMMARY

A. Section includes:

1. Glass for doors and exterior windows.

1.03 PERFORMANCE REQUIREMENTS

A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

1.04 SUBMITTALS

A. Product Data: For each glass product and glazing material indicated.

B. Samples: 12-inch- square, for each type of glass product indicated, other than monolithic clear float glass.

C. Glazing Schedule: Use same designations indicated on Drawings.

1.05 QUALITY ASSURANCE

A. Glazing for Fire-Rated Door and Window Assemblies: Glazing for assemblies that comply with NFPA 80 and that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 257.

B. Safety Glazing Products: Comply with testing requirements in 16 CFR 1201 and, for wired glass, ANSI Z97.1.

C. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. GANA Publications: GANA's "Glazing Manual."
2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "Glazing Guidelines for Sealed Insulating Glass Units."

1.06 WARRANTY

A. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form, made out to Owner and signed by insulating-glass manufacturer agreeing to replace insulating-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

1. Warranty Period: 2 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers that may be incorporated into the Work include, but are not limited to, the following:

1. Guardian Industries Corp.
2. Pilkington North America.
3. PPG Industries, Inc.

2.02 GLASS PRODUCTS

A. Heat-Treated Float Glass: ASTM C 1048; Type I (transparent flat glass); Quality-Q3; of class, kind, and condition indicated.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed, unless otherwise indicated.
2. Provide Kind HS (heat-strengthened) float glass in place of annealed float glass where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with glass design requirements specified in Part 1 "Performance Requirements" Article.
3. For uncoated glass, comply with requirements for Condition A.
4. Provide Kind FT (fully tempered) float glass in place of annealed or Kind HS (heat-strengthened) float glass where safety glass is indicated.

B. Insulating-Glass Units, General: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, and complying with ASTM E 774 for Class CBA units and with requirements specified in this Article and in Part 2 "Insulating-Glass Units" Article.

1. Provide Kind HS (heat-strengthened) float glass in place of annealed glass where needed to resist thermal stresses induced by differential shading of

individual glass lites and to comply with glass design requirements specified in Part 1 "Performance Requirements" Article.

2. Overall Unit Thickness and Thickness of Each Lite: Dimensions indicated for insulating-glass units are nominal and the overall thicknesses of units are measured perpendicularly from outer surfaces of glass lites at unit's edge.
3. Sealing System: Dual seal.
4. Spacer Specifications: Manufacturer's standard spacer material and construction.

2.03 GLAZING GASKETS

A. Dense Compression Gaskets: Molded or extruded gaskets of material indicated below, complying with standards referenced with name of elastomer indicated below, and of profile and hardness required to maintain watertight seal:

1. Neoprene, ASTM C 864.

B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned gaskets of material indicated below; complying with ASTM C 509, Type II, black; and of profile and hardness required to maintain watertight seal:

1. Neoprene.

2.04 GLAZING SEALANTS

A. General: Provide products of type indicated, complying with the following requirements:

1. Compatibility: Select glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

2.05 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based elastomeric tape with a solids content of 100 percent; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; packaged on rolls with a release paper backing; and complying with ASTM C 1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.
2. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

2.06 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions with a Shore, Type A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.07 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

2.08 INSULATING-GLASS

A. Basis-of-Design Product: Subject to compliance with requirements, provide PPG Solarban 60 XL or a comparable product.

1. Overall Unit Thickness: 1 inch.
2. Thickness of Each Lite: 1/4 inch.
3. Interspace Content: Air.
4. Outdoor Lite: Class 1 clear float glass, Kind HS (heat strengthened) or annealed, as required by performance requirements.
5. Indoor Lite: Class 1 clear float glass, Kind HS (heat strengthened) or annealed, as required by performance requirements.
6. Low-E Coating: No. 2 surface.

PART 3 - EXECUTION

3.01 GLAZING

A. General: Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

1. Glazing channel dimensions, as indicated on Drawings, provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.
2. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
3. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.
4. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
5. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
6. Provide spacers for glass lites where length plus width is larger than 50 inches.
7. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

B. Tape Glazing: Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

1. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.
2. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
3. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

C. Gasket Glazing (Dry): Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

1. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

2. Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

3. Install gaskets so they protrude past face of glazing stops.

D. Sealant Glazing (Wet): Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

1. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

2. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.02 CLEANING AND PROTECTION

A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended by glass manufacturer.

B. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

END OF SECTION

SECTION 08 91 19

FIXED LOUVERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Standard Provisions and Special Provisions apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Fixed metal louvers.

B. Related Requirements:

1. Division 07 Section "Joint Sealants" for sealants installed in perimeter joints between fixed louver frames and adjoining construction.

2. Division 07 Section “Sheet Metal Flashing and Trim” for flashing.

3. Division 23 Sections for ductwork connected to louvers.

1.03 DEFINITIONS

A. Louver Terminology: Refer to AMCA Publication 501-85 for definitions of terms for metal louvers not otherwise defined in this section or referenced standards.

1.04 SYSTEM PERFORMANCE REQUIREMENTS

A. Structural Performance: Design, engineer, fabricate, and install fixed metal louvers to withstand the effects of loads and stresses from wind and normal thermal movement, without evidencing permanent deformation of louver components including blades, frames, and supports; noise or metal fatigue caused by louver blade rattle or flutter; and permanent damage to fasteners and anchors:

1. Wind Load: Uniform pressure (velocity pressure) of 35 psf acting inwards and 48 psf acting outwards.

2. Normal thermal movement is defined as that resulting from the following maximum change (range) in ambient temperature. Base design calculations on actual surface temperatures of metals due to both solar heat gain and night time sky heat loss.

a. Temperature Change (Range): 100 deg F (55.5 deg C).

B. Air Performance, Water Penetration, and Air Leakage Ratings: Provide louvers complying with performance requirements indicated as demonstrated by testing manufacturers stock units, of height and width indicated, according to Air Movement and Control Association (AMCA) Standard 500.

C. Airborne Sound Transmission Loss: Provide acoustical louvers complying with airborne sound transmission loss ratings indicated, as demonstrated by testing manufacturer's stock units according to ASTM E 90.

1.05 SUBMITTALS

A. Product data for each product indicated.

B. Shop drawings of fixed louver units and accessories. Include plans, elevations, sections, and details showing profiles, angles, spacing of louver blades; unit dimensions related to wall openings and construction; free areas for each size indicated; and profiles of frames at jambs, heads and sills.

1. Where installed products are indicated to comply with certain structural design loadings, include structural computations, material properties, and other information needed for structural analysis which has been prepared by, or under the supervision of, a qualified professional engineer.

C. Samples for verification purposes of each type of metal finish required, prepared on 6-inch square metal samples of same thickness and alloy indicated for final unit of Work. Where finishes involve normal color and texture variations, include sample sets showing full range of variations expected.

D. Product test reports evidencing compliance of units with performance requirements indicated.

E. Product certificates signed by fixed louver manufacturers certifying that their products which comply with Project requirements are licensed to bear AMCA Seal based on tests made in accordance with AMCA Standard 500 and complying with AMCA Certified Ratings Program.

F. Qualification data for firms and persons specified in "Quality Assurance" article to demonstrate their capabilities and experience.

1.06 QUALITY ASSURANCE

A. Single Source Responsibility: Obtain fixed louvers from a single source where alike in one or more respects with regard to type, design, and factory-applied color finish.

B. Qualify welding processes and welding operators in accordance with D1.2 "Structural Welding Code - Aluminum" and D1.3 "Structural Welding Code - Sheet Steel."

C. Certify that each welder employed in unit of Work of this section has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

1. Testing for recertification is Contractor's responsibility.

D. Engineer Qualifications: Professional engineer licensed to practice in the State of California and experienced in providing engineering services of the kind indicated which has resulted in the successful installation of fixed louvers similar in material, design, and extent to that indicated for this Project.

E. SMACNA Standard: Comply with SMACNA "Architectural Sheet Metal Manual" recommendations for fabrication, construction details, and installation procedures.

1.07 PROJECT CONDITIONS

A. Field Measurements: Check actual louver openings by accurate field measurements before fabrication; show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay of the Work.

1. Where field measurements cannot be made without delaying the Work, guarantee opening dimensions and proceed with fabrication of fixed louvers without field measurements. Coordinate wall construction to ensure that actual opening dimensions correspond to guaranteed dimensions.

PART 2 - PRODUCTS

2.01 FIXED LOUVERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Airolite Company, LLC.

2. Airstream Products, Division of Penn Ventilator Co., Inc.

3. American Warming and Ventilating, Inc.

4. Arrow United Industries, Division of Mestek, Inc.

5. Construction Specialties, Inc.

6. Industrial Louvers Inc.

7. Nystrom, Inc.

8. Ruskin Company.

2.02 MATERIALS

A. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer to produce required finish.

B. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5 or T-52.

C. Fasteners: Of same basic metal and alloy as fastened metal, unless otherwise indicated. Do not use metals which are corrosive or incompatible with materials joined.

1. Use types, gages, and lengths to suit unit installation conditions.

2. Use Phillips flat-head machine screws for exposed fasteners, unless otherwise indicated.

D. Anchors and Inserts: Of type, size, and material required for type of loading and installation indicated. Use nonferrous metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or expansion bolt devices for drilled-in-place anchors.

E. Bituminous Paint: SSPC-Paint 12 (cold-applied asphalt mastic).

2.03 FABRICATION

A. General: Fabricate fixed louvers to comply with requirements indicated for design, dimensions, materials, joinery, and performance.

B. Preassemble fixed louvers in shop to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

C. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.

D. Fabricate frames, including integral sills, to fit in openings of size indicated with allowances made for fabrication and installation tolerances of louvers, adjoining construction, and perimeter sealant joints.

E. Include supports, anchorages, and accessories required for complete assembly.

F. Provide vertical mullions of type and at spacing indicated but not further apart than recommended by manufacturer, or 72 inches o.c., whichever is less. At horizontal joints between fixed louver units provide horizontal mullions except where continuous vertical assemblies are indicated.

G. Provide sill extensions and loose sills made of same material as fixed louver, where indicated, or required for drainage to exterior and to prevent water penetrating to interior.

H. Join frame members to one another and to fixed louver blades as follows, unless otherwise indicated, or size of fixed louver assembly makes bolted connections between frame members necessary:

1. With fillet welds, concealed from view.

2.04 FIXED EXTRUDED ALUMINUM WALL LOUVERS

A. Horizontal Drainable Fixed Blade Louvers: Extruded aluminum frames and louver blades, complying with the following requirements:

1. Louver Depth: 4 inches.

2. Frame Type: Channel flange.

3. Frame Thickness: 0.081 inch.

4. Louver Blade Thickness: 0.081 inch.

5. Louver Blade Profile: Plain blade with no center baffle.

6. Louver Blade Angle: 37.5 degrees.

7. Louver Blade Spacing: 5 inches, nominal.

8. Performance Requirements: As follows, determined by testing units 48 inches wide by 48 inches high per AMCA Standard 500:

a. Louver Free Area: Not less than **[54 percent].**

b. Static Pressure Loss: Not more than 0.14 inch water gage at an airflow of 810 fpm free area intake velocity.

c. Water Penetration: Not more than 0.02 oz. per sq. ft. of free area at an airflow of 855 fpm free area velocity when tested for 15 minutes.

9. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.05 SCREENS

A. General: Provide each exterior fixed louver units with louver screens complying with the following requirements:

1. Screen Location: Interior face, unless otherwise indicated.

2. Screening Type: Bird screening, unless otherwise indicated.

B. Secure screens to fixed louver frames with stainless steel machine screws, spaced at each corner and at 12 inches o.c. between.

C. Fixed Louver Frames: Fabricate screen frames with mitered corners to louver sizes indicated and to comply with the following requirements:

1. Metal: Same kind and form of metal as indicated for fixed louver frames to which screens are attached.

a. Reinforce extruded aluminum screen frames at corners with clips.

1. Finish: Same finish as louver frames to which louver screens are attached.

2. Type: Non-rewireable U-shaped frames for permanently securing screen mesh.

D. Screening for Aluminum Fixed Louvers: Fit aluminum fixed louver frames with screening covering louver openings and complying with the following requirements:

1. Bird Screening: 1/2-inch square mesh formed with 0.063-inch diameter aluminum wire.

2.06 FINISHES, GENERAL

A. Comply with NAAMM "Metal Finishes Manual" for recommendations relative to application and designations of finishes.

B. Finish fixed louvers after assembly.

2.07 ALUMINUM FINISHES

A. Finish designations prefixed by "AA" conform to the system established by the Aluminum Association for designating aluminum finishes.

B. Baked-Enamel Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid chromate-fluoride-phosphate conversion coating. Apply baked enamel complying with paint manufacturer's specifications for cleaning, conversion coating, and painting.

1. Organic Coating: Thermosetting, modified-acrylic enamel system complying with AAMA 603.8 except with a minimum dry film thickness of 1.5 mils (0.04 mm), medium gloss.

a. Color: As selected from manufacturer’s standard range.

To ensure obtaining exact finish desired, insert product and manufacturers' names of coating system or systems.

PART 3 - EXECUTION

3.01 PREPARATION

A. Coordinate setting drawings, diagrams, templates, and instructions for installation of anchorages which are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.

3.02 INSTALLATION

A. Locate and place fixed louver units plumb, level, and in proper alignment with adjacent work.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

C. Form closely fitted joints with exposed connections accurately located and secured.

D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

E. Repair finishes damaged by cutting, welding, soldering, and grinding operations require for fitting and jointing. Restore finishes so there is no evidence of corrective work. Return items which cannot be refinished in field to shop, make required alterations and refinish entire unit, or provide new units.

F. Install concealed gaskets, flashings, joint fillers, and insulation, as fixed louver installation progresses where required to make louver joints weathertight. Comply with Division 07 Section "Joint Sealers" for sealants applied during installation of fixed louvers.

3.03 ADJUSTING AND PROTECTION

A. Protect fixed louvers from damage of any kind during construction period including use of temporary protective coverings where needed and approved by fixed louver manufacturer. Remove protective covering at time of Substantial Completion.

B. Restore fixed louvers damaged during installation and construction period, so that no evidence remains of correction work. If results of restoration are unsuccessful, as judged by Architect, remove damaged units and replace with new units.

1. Clean and touch-up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

3.04 CLEANING

A. Periodically clean exposed surfaces of fixed louvers which are not protected by temporary covering to remove fingerprints and soil during construction period; do not let soil accumulate until final cleaning.

B. Before final inspection, clean exposed surfaces with water and with a mild soap or detergent not harmful to finishes. Rinse thoroughly and dry surface.

END OF SECTION

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SECTION 09 29 00

GYPSUM BOARD

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Standard Provisions and Special Provisions apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Interior gypsum board.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Environmental Submittals: Manufacturers' product data for adhesives used to laminate gypsum board panels to substrates, including printed statement of VOC content.

1.04 QUALITY ASSURANCE

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 “Standard Test Methods for Fire Tests of Building Construction and Materials” by an independent testing agency.

PART 2 - PRODUCTS

2.01 INTERIOR GYPSUM BOARD

A. General: Complying with ASTM C 1396 “Standard Specification for Gypsum Board”, as applicable to type of gypsum board indicated.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following. Only North American manufactured gypsum board products are acceptable.

a. American Gypsum Company LLC.
b. CertainTeed Gypsum Inc.
c. Georgia-Pacific Gypsum.
d. Lafarge North America Inc.
e. National Gypsum Company.
f. PABCO Gypsum.

g. USG Corporation.

B. Type X:

1. Thickness: 5/8 inch.
2. Long Edges: Tapered and featured (rounded or beveled) for prefilling.

2.02 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047 “Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base”.

1. Material: Aluminum-coated steel sheet.
2. Shapes: Cornerbead, bullnose bead, LC-Bead: J-shaped; exposed long flange receives joint compound, and expansion (control) joint.

B. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following: Fry Reglet Corp., Gordon, Inc., Pittcon Industries or accepted equal.
2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221 “Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes, Alloy 6063-T5”.
3. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified, or clear Class II anodic finish, as indicated.

2.03 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475 “Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board”.

B. Joint Tape:

1. Interior Gypsum Wallboard: Paper.

C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.
3. Fill Coat: For second coat, use drying-type, all-purpose compound.
4. Finish Coat: For third coat, use drying-type, all-purpose compound.
5. Skim Coat: For final coat of Level 5 finish, use drying-type, all-purpose compound.

a. Contractor’s Option: Use high-build interior coating product designed for application by airless sprayer and to be used instead of skim coat to produce Level 5 finish.

b. Basis-of-Design Product: USG Corporation; Sheetrock Brand Tuff-Hide Primer-Surfacer.

2.04 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

1. Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Steel Drill Screws: ASTM C 1002 “Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs”, unless otherwise indicated.

1. Use screws complying with ASTM C 954 “Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness” for fastening panels to steel members from 0.033 to 0.112 inch thick.

PART 3 - EXECUTION

3.01 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840 “Standard Specification for Application and Finishing of Gypsum Board”.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- wide spaces at these locations, and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

3.02 APPLYING INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:

1. Type X: Throughout, unless otherwise indicated.

3.03 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.

C. Interior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners, unless otherwise indicated.
2. Bullnose Bead: Use at outside corners where indicated.
3. LC-Bead: Use at exposed panel edges.

D. Aluminum Trim: Install in locations indicated on Drawings.

3.04 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints, rounded or beveled edges, and damaged surface areas.

C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 4: At panel surfaces that will be exposed to view, unless otherwise indicated.

    a. Primer and its application to surfaces are specified in other Division 09 Sections.

3.05 PROTECTION

A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

B. Remove and replace panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

SECTION 09 67 00

FLUID APPLIED FLOORING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Standard Provisions and Special Provisions apply to this Section.

1.02 SUMMARY

A. Work Included: Provide concrete hardener and dustproofer sealer.

1.03 SUBMITTALS

A. Product Data: Manufacturer's specifications, details of flashings, treatment of joints and cracks in substrate, and penetrations through coating, material safety data sheets, data, and installation instructions.

1.04 QUALITY ASSURANCE

A. Single-source Responsibility: Obtain all components of the composition elastomeric coating system from a single manufacturer.

B. Special Requirements: Regulatory Agencies: Use materials for Work of this Section which comply with volatile organic compound limitations and other regulations of local Air Quality Management District and other local, state, and federal agencies having jurisdiction.

1.05 PROJECT CONDITIONS

A. Environmental Requirements: Do not apply materials during adverse weather or when surface and ambient temperature is below 40 degrees F, unless otherwise recommended by coatings manufacturer.

PART 2 - PRODUCTS

2.01 FLUID-APPLIED FLOORING

A. General: Provide concrete hardener and dustproofer where indicated on Drawings.

1. Manufacturer: Subject to compliance with requirements, provide Sonocrete Lapidolith Concrete Hardener and Dustproofer, manufactured by Sonneborn, or equal.

PART 3 - EXECUTION

3.01 PREPARATION

A. Surface Preparation: Clean and prepare substrate per fluid-applied flooring manufacturer's written recommendations. Substrates must be dry, smooth and free from dust and foreign matter, deleterious and excess materials, and projections.

1. Fill Holes, joints, honeycomb, cracks or cavities and finish flush with cement mortar.
2. Clean surfaces according to fluid-applied flooring manufacturer's written instructions.

3.02 APPLICATION

A. Apply two applications of fluid-applied flooring. Apply per manufacturer’s instructions. Distribute evenly and mop up excess solution or puddles.

B. Allow cure time for temperature, humidity, and methods used, before permitting any traffic.

C. Protect adjacent surfaces during installation.

D. Provide and maintain conditions ensure coating system is without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 09 67 23

RESINOUS FLOORING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: Decorative resinous flooring systems.

1.02 REFERENCES (USE CURRENT EDITIONS)

A. ASTM C579 - Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing and Polymer Concretes.

B. ASTM D2240 - Test Method for Rubber Property-Durometer Hardness.

C. ASTM D695 - Standard Test Method for Compressive Properties of Rigid Plastics.

D. ASTM D638 - Standard Test Method for Tensile Strength of Plastics.

E. ASTM C307 - Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts and Monolithic Surfacings.

F. ASTM D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastic and Electrical Insulating Materials.

G. ASTM C580 - Test Method for Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings and Polymer Concretes.

H. ASTM D696 - Test Method for Coefficient of Thermal Expansion of Plastics Between –30 Degrees Celsius and 30 Degrees Celsius with Vitreous Silica Dilatometor.

I. ASTM C531 - Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes.

J. ASTM D4541 - Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.

K. ASTM D4226 - Test Method for Impact Resistance of Rigid Poly (Vinyl Chloride) (PVC) Building Products.

L. ASTM D570 - Test Method for Water Absorption of Plastics.

M. ASTM D648 - Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position.

N. ASTM E84 - Test Method for Burning Characteristics of Building Materials.

O. ASTM C501 - Test Method for Relative Resistance to Wear of Unglazed Ceramic Tile by Taber Abraser.

P. ASTM D1044 - Test Method for Resistance of Transparent Plastics to Surface Abrasion.

Q. ASTM D2047 - Test Method for Static Coefficient of Friction of Polish-Coated Flooring Surfaces as Measured by the James Machine.

R. ASTM C905 - Test Method for Apparent Density of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes.

S. ASTM F1869 - Test Method for Measuring Moisture Vapor Emissions Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.

T. ADA Accessibility Guidelines for Buildings and Facilities (ADAAG).

1.03 SUBMITTALS

A. Product Data: For each type of product indicated. Include manufacturer's technical data, application instructions, and recommendations for each resinous flooring component required.

1. For adhesives, sealants, and chemical-bonding compounds include printed statement of VOC content.
2. For resinous flooring systems include printed statement of VOC content.

B. Samples: For each resinous flooring system required, 6 inches square or manufacturer's standard size, applied to a rigid backing by Installer for this Project.

C. Product Schedule: Use resinous flooring same designations indicated on Drawings.

D. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.

E. Material Certificates: For each resinous flooring component, signed by manufacturer.

F. Maintenance Data: For resinous flooring to include in maintenance manuals.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer (applicator) who is experienced in applying resinous flooring systems similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance, and who is acceptable to resinous flooring manufacturer.

B. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, through one source from a single manufacturer. Provide secondary materials, including patching and fill material,

joint sealant, and repair materials, of type and from source recommended by manufacturer of primary materials.

C. Mockups: Apply mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Apply full-thickness mockups on 48-inch- square floor area selected by Architect.

2. Include 48-inch length of integral cove base with inside and outside corner.

3. Simulate finished lighting conditions for Architect's review of mockups.

4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

D. Preinstallation Conference: Conduct conference at Project site.

E. Federal Agency Approvals: Where indicated, provide resinous flooring systems approved by the USDA for use indicated.

F. Resinous flooring must be formaldehyde free and low VOC requirement.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer’s labels indicating brand name and directions for storage and mixing with other components.

B. Store materials to prevent deterioration from moisture, heat, cold, direct sunlight, or other detrimental effects.

1.06 PROJECT CONDITIONS

A. Environmental Limitations: Comply with resinous flooring manufacturer’s written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.

B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.

C. Close spaces to traffic during resinous flooring application and for not less than 24 hours after application, unless manufacturer recommends a longer period.

PART 2 PRODUCTS

2.01 RESINOUS FLOORING

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Crossfield Products Corp.; Dex-O-Tex line of products.

B. System Characteristics:

1. Color and Pattern: As selected from manufacturer's full range.

2. Wearing Surface: Manufacturer's standard orange-peel texture.

3. Integral Cove Base: 4 inches height.

4. Overall System Thickness: 1/4 inch.

5. VOC Content: 100 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

C. System Components: Manufacturer's standard components that are compatible with each other and as follows:

1. Body Coat(s):

a. Resin: Dex-O-Tex Décor **[Flor Troweled].**

b. Formulation Description: 100 percent solids.

c. Application Method: Troweled or screeded.

1) Thickness of Coats: 1/4 inch.

2) Number of Coats: One.

d. Aggregates: Manufacturer's standard for color DFS-B-12.

2. Primer and Waterproofing Membrane: Dex-O-Tex Vapor Control Primer 200.

a. Formulation Description: 100 percent solids.

3. Topcoat: Chemical-resistant finish coat.

a. Basis-of-Design Product: Dex-O-Tex [**Quik-Glaze**].

b. Resin: Polyuria.

c. Formulation Description: 95 percent solids.

d. Type: Non-pigmented.

e. Finish: High gloss.

f. Number of Coats: One.

g. Color: Clear.

D. System Physical Properties: Provide resinous flooring system with the following minimum physical property requirements when tested according to test methods indicated:

2.02 ACCESSORY MATERIALS

A. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated.

B. Joint Sealant: Type recommended or produced by resinous flooring manufacturer for type of service and joint condition indicated.

1. Use sealants that have a VOC content of 150 grams/liter or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 EXECUTION

3.01 PREPARATION

A. General: Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry, and neutral Ph substrate for resinous flooring application.

B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.

1. Cure concrete for a minimum of 28 days.

2. Roughen concrete substrates as follows:

a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.

3. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written recommendations.

4. Verify that concrete substrates are dry.

a. Perform anhydrous calcium chloride test, ASTM F1869. Proceed with application only after substrates have maximum moisture-vapor-emission rate of 3 pounds of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) of slab in 24 hours.

b. Perform plastic sheet test, ASTM D4263. Proceed with application only after testing indicates absence of moisture in substrates

c. Perform additional moisture tests recommended by manufacturer. Proceed with application only after substrates pass testing.

5. Alkalinity and Adhesion Testing: Verify that concrete substrates have neutral Ph and that resinous flooring will adhere to them. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.

C. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.

D. Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.

E. Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written recommendations.

3.02 APPLICATION

A. General: Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.

1. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.

2. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.

3. At substrate expansion and isolation joints, provide joint in resinous flooring to comply with resinous flooring manufacturer's written recommendations.

a. Apply joint sealant to comply with manufacturer's written recommendations.

B. Apply primer over prepared substrate at manufacturer's recommended spreading rate.

C. Apply waterproofing membrane, where indicated, in manufacturer's recommended thickness.

1. Apply waterproofing membrane to integral cove base substrates.

D. Apply reinforcing membrane to substrate cracks.

E. Integral Cove Base: Apply cove base mix to wall surfaces before applying flooring. Apply according to manufacturer's written instructions and details including those for taping, mixing, priming, troweling, sanding, and topcoating of cove base. Round internal and external corners.

1. Integral Cove Base: 4 inches high.

F. Apply self-leveling slurry body coats in thickness indicated for flooring system.

1. Broadcast aggregates at rate recommended by manufacturer and, after resin is cured, remove excess aggregates to provide surface texture indicated.

G. Apply troweled or screeded body coat(s) in thickness indicated for flooring system. Hand or power trowel and grout to fill voids. When cured, sand to remove trowel marks and roughness.

H. Apply grout coat, of type recommended by resinous flooring manufacturer to fill voids in surface of final body coat and to produce wearing surface indicated.

I. Apply topcoat(s) in number of coats indicated for flooring system and at spreading rates recommended in writing by manufacturer.

3.03 FIELD QUALITY CONTROL

A. Core Sampling: At the direction of Owner and at locations designated by the Owner, take one core sample per 1000 square feet of resinous flooring, or portion of, to verify thickness. For each sample that fails to comply with requirements, take two additional samples. Repair damage caused by coring and correct deficiencies.

B. Material Sampling: Owner may at any time and any number of times during resinous flooring application require material samples for testing for compliance with requirements.

1. Owner will engage an independent testing agency to take samples of materials being used. Material samples will be taken, identified, sealed, and certified in presence of Contractor.

2. Testing agency will test samples for compliance with requirements, using applicable referenced testing procedures or, if not referenced, using testing procedures listed in manufacturer's product data.

3. If test results show applied materials do not comply with specified requirements, pay for testing, remove noncomplying materials, prepare surfaces coated with unacceptable materials, and reapply flooring materials to comply with requirements.

3.04 CLEANING AND PROTECTION

A. Protect resinous flooring from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by resinous flooring manufacturer.

END OF SECTION

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SECTION 09 91 13

EXTERIOR PAINTING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Standard Provisions and Special Provisions apply to this Section.

1.02 SUMMARY

A. This Section includes surface preparation and the application of paint systems on the following exterior substrates:

1. Steel.
2. Galvanized metal.

B. Scope of Work Under this Section:

1. Paint exposed surfaces, except where indicated that a surface or material is not to be painted or is to remain natural.

C. Surfaces not to be painted:

1. Do not paint prefinished items which include the items listed below:

a. Finished mechanical and electrical equipment.
b. Light fixtures.
c. Other items specified to be finished by manufacturer.

2. Do not paint finished metal surfaces which include the following:

a. Anodized or solid color coated aluminum.
b. Factory painted metal roof panels.

3. Do not paint over Underwriters Laboratories (UL), Factory Mutual (FM), or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

1.03 DEFINITIONS

A. General: Standard coating terms defined in ASTM D 16 apply to this Section.

1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.
2. Eggshell refers to low-sheen finish with a gloss range between 5 and 20 when measured at a 60-degree meter.

3. Satin refers to low-sheen finish with a gloss range between 15 and 35 when measured at a 60-degree meter.
4. Semi-gloss refers to medium-sheen finish with a gloss range between 30 and 65 when measured at a 60-degree meter.
5. Full gloss refers to high-sheen finish with a gloss range more than 65 when measured at a 60-degree meter.

1.04 REFERENCED STANDARDS

A. ASTM International

1. ASTM D16-07 Standard Terminology for Paint, Related Coatings, Materials, and Applications

B. Code of Federal Regulations

1. 40 CFR, Part 59, Subpart D-2001: National Volatile Organic Compound Emission Standards for Architectural Coatings

C. Master Painters Institute

1. MPI Approved Products List, current edition.
2. MPI Architectural Painting Specification Manual, current edition.

D. California Air Resources Board Regulations.

1.05 SUBMITTALS

A. General: Comply with Standard Provisions Section 7 “Submittal Management”.

B. Product Data: For each type of product indicated.

C. Samples for Verification: For each type of paint system and each color and gloss of topcoat indicated.

1. Submit Samples on rigid backing, 8 inches square.
2. Step coats on Samples to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

D. Product List: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.

1.06 QUALITY ASSURANCE

A. MPI Standards: Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 degrees F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.08 PROJECT CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 degrees F and as recommended by paint manufacturer.

B. Do not apply paints in rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 degrees F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."

B. Manufacturers: Subject to compliance with requirements, available manufacturers that may be incorporated into the Work include, but are not limited to the following.

1. Kelly Moore.
2. PPG.
3. Sherwin Williams Company.
4. Benjamin Moore & Company.
5. Frazee Paint Company.
6. Valspar.

2.02 PAINT, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. Colors: As selected by Architect.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with conditions affecting performance of work.

B. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

C. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.02 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.

C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.

D. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer, but not less than the following:

1. SSPC-SP 2 for removing loose rust, mill scale, and paint for painted steel.
2. SSPC-SP 3 for removing loose rust, mill scale, and paint.

E. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

F. Aluminum Substrates: Remove surface oxidation.

3.03 APPLICATION

A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.

3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

C. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.04 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.
2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.05 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.06 EXTERIOR PAINTING SCHEDULE

A. Paint Finish Galvanized Metal (Semi-gloss): Hollow metal doors and frames, flashing and miscellaneous galvanized metal.

1. Prime Coat PITT TECH PLUS PRIMER 90-912.
2. Prime Coat PITT TECH PLUS PRIMER 90-912.
3. Second Coat PITT TECH PLUS SEMI GLOSS 90-1210.
4. Finish Coat PITT TECH PLUS SEMI GLOSS 90-1210.
5. NOTE: Prepare existing surfaces per SSPS SP1 and SP2.

B. Paint Finish on Existing Aluminum (Semi-gloss): Gutters and sownspouts.

1.	Prime Coat	PPG Coraflon ADS 510 Series Epoxy PVDF Bonding Primer.
2.	Barrier Coat	PPG Coraflon ADS 564 Barrier. or PPG Coraflon Clear ADS.
3.	Finish Coat	PPG Coraflon ADS Metallic.

END OF SECTION

SECTION 09 91 23

INTERIOR PAINTING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Standard Provisions and Special Provisions apply to this Section.

1.02 SUMMARY

A. This Section includes surface preparation and the application of paint systems on the following interior substrates:

1. Steel.
2. Gypsum board.
3. Concrete masonry units (CMUs).

B. Scope of Work Under this Section:

1. Paint exposed surfaces, except where the paint schedules indicate that a surface or material is not to be painted or is to remain natural.

    a. If the paint schedules do not specifically mention an item or a surface, paint the item or surface the same as similar adjacent materials or surfaces whether or not schedules indicate colors.
    b. If the schedules do not indicate color or finish, the Architect will select from standard colors and finishes available.
    c. Where the section specifying the item indicates that the item of work is to be primed and painted at the shop or place of fabrication.

2. Where patching occurs in a painted surface or material, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface, from corner to corner and floor to ceiling, containing the patch.
3. Painting includes field painting of exposed bare and covered pipes and ducts (including color-coding), hangers, exposed steel and ironwork, and primed metal surfaces of mechanical and electrical equipment.

C. Surfaces not to be painted:

1. Do not paint prefinished items which include the items listed below:

    a. Plastic toilet enclosures.
    b. Distribution cabinets.
    c. Finished mechanical and electrical equipment.
    d. Light fixtures.
    e. Other items specified to be finished by manufacturer.

2. Do not paint concealed surfaces which include walls or ceilings in the following generally inaccessible spaces:

    a. Foundation spaces.
    b. Utility tunnels.
    c. Furred areas.
    d. Ceiling plenums.
    e. Pipe spaces.
    f. Duct shafts.

3. Do not paint finished metal surfaces which include the following:

    a. Anodized or solid color coated aluminum.
    b. Factory painted metal roof panels.
    c. Stainless steel.
    d. Chromium plate.
    e. Copper.
    f. Bronze and brass.

4. Do not paint operating parts which include moving parts of operating equipment and the following:

    a. Valve and damper operators.
    b. Linkages.
    c. Sensing devices.
    d. Motor and fan shafts.

5. Do not paint over Underwriters Laboratories (UL), Factory Mutual (FM), or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.
6. Do not paint structural steel scheduled to receive cementitious fireproofing or to be encased in concrete.

1.03 DEFINITIONS

A. General: Standard coating terms defined in ASTM D 16 apply to this Section.

1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.
2. Eggshell refers to low-sheen finish with a gloss range between 5 and 20 when measured at a 60-degree meter.
3. Satin refers to low-sheen finish with a gloss range between 15 and 35 when measured at a 60-degree meter.
4. Semi-gloss refers to medium-sheen finish with a gloss range between 30 and 65 when measured at a 60-degree meter.
5. Full gloss refers to high-sheen finish with a gloss range more than 65 when measured at a 60-degree meter.

1.04 REFERENCED STANDARDS

A. ASTM International

1. ASTM D16-07 Standard Terminology for Paint, Related Coatings, Materials, and Applications

B. Code of Federal Regulations

1. 40 CFR, Part 59, Subpart D-2001: National Volatile Organic Compound Emission Standards for Architectural Coatings

C. Master Painters Institute

1. MPI Approved Products List, January 2004.
2. MPI Architectural Painting Specification Manual, 2004.

D. California Air Resources Board Regulations.

1.05 SUBMITTALS

A. Product Data: For each type of product indicated, including printed statement of VOC content and chemical components. Include block fillers and primers.

1. For paints, including printed statement of VOC content and chemical components.

B. Samples for Verification: For each type of paint system and in each color and gloss of topcoat indicated. Include block fillers and primers.

1. Submit Samples on rigid backing, 8 inches square.
2. Step coats on Samples to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

C. Product List: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.

1.06 QUALITY ASSURANCE

A. MPI Standards: Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.

B. Source Limitations: Obtain block fillers and primers for each coating system from the same manufacturer as the finish coats.

C. Mockups: Apply benchmark samples of each paint system indicated and each color and finish selected to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.

a. Wall and Ceiling Surfaces: Provide samples of at least 100 sq. ft.

b. Other Items: Architect will designate items or areas required.

2. Apply benchmark samples after permanent lighting and other environmental services have been activated.
3. Final approval of color selections will be based on benchmark samples.

a. If preliminary color selections are not approved, apply additional benchmark samples of additional colors selected by Architect at no added cost to Owner.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.08 PROJECT CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

1.09 EXTRA MATERIALS

A. Furnish paint formulas to Owner of all paint used on the project

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. PPG
2. Kelly Moore Paints
3. ICI Dulux Paints.
4. Sherwin Williams Co.

2.02 PAINT MATERIALS, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.

2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. VOC Content of Field-Applied Interior Paints and Coatings: Provide products that comply with the following limits for VOC content, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24); these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:

1. Flat Paints, Coatings, and Primers: VOC content of not more than 50 g/L.
2. Nonflat Paints, Coatings, and Primers: VOC content of not more than 150 g/L.
3. Anti-Corrosive & Anti-Rust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
4. Floor Coatings: VOC not more than 100 g/L.
5. Dry-Fog Coatings: VOC content of not more than 400 g/L.
6. Zinc-Rich Industrial Maintenance Primers: VOC content of not more than 340 g/L.
7. Pre-Treatment Wash Primers: VOC content of not more than 420 g/L.

C. Chemical Components of Field-Applied Interior Paints and Coatings: Provide topcoat paints and anti-corrosive and anti-rust paints applied to ferrous metals that comply with the following chemical restrictions; these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:

1. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
2. Restricted Components: Paints and coatings shall not contain any of the following:

a. Acrolein; Acrylonitrile; Antimony
b. Benzene; Butyl benzyl phthalate.
c. Cadmium.
d. Di (2-ethylhexyl) phthalate; Di-n-butyl phthalate; Di-n-octyl phthalate; 1,2-dichlorobenzene; Diethyl phthalate; Dimethyl phthalate.
e. Ethylbenzene; Formaldehyde.
f. Hexavalent chromium.
g. Isophorone.
h. Lead.
i. Mercury; Methyl ethyl ketone; Methyl isobutyl ketone; Methylene chloride.
j. Naphthalene.
k. Toluene (methylbenzene); 1,1,1-trichloroethane.
l. Vinyl chloride.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Gypsum Board: 12 percent.
2. Masonry (Clay and CMUs): 12 percent.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.02 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

B. Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.

D. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.

E. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.

F. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods and as recommended by manufacturer to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

3.03 APPLICATION

A. Apply paints according to manufacturer's written instructions.

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.

3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.

B. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

C. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.04 FIELD QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when paints are being applied:

1. Owner will engage the services of a qualified testing agency to sample paint materials being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying-paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

3.05 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

4.01 INTERIOR PAINTING SCHEDULE

A. Paint Finish on Gypsum Wallboard (Eggshell):

1. Prime Coat : PPG Paints Speedhide Zero Interior Zero VOC Latex Sealer 6-4900XI.
2. Second Coat: PPG Paints *Pure Performance 9-300XI Zero VOC 100% Acrylic Interior Eggshell.

3. Finish Coat: PPG Paints *Pure Performance 9-300XI Zero VOC 100% Acrylic Interior Eggshell.

B. Concrete Unit Masonry (Semi-Gloss): Provide the following paint finish system over interior non-faced interior concrete unit masonry wall substrates:

1. Concrete Unit Masonry Block Filler: Factory-formulated high-performance latex block fillers.

   a. Benjamin Moore; Moorcraft Super Craft Latex Block Filler No. 285: Applied at a dry film thickness of not less than 8.1 mils.
   b. Glidden; Bloxfil 4000-1000 Interior/Exterior Heavy Duty Acrylic Block Filler: Applied at a dry film thickness of not less than 7.0 to 14.5 mils.
   c. Sherwin-Williams; PrepRite Interior/Exterior Block Filler B25W25: Applied at a dry film thickness of not less than 8.0 mils.

2. Finish Coats: Two finish Interior semi-gloss acrylic enamel.

C. Paint Finish on Metal (Semi-Gloss): Typical, unless otherwise noted.

1. Prime Coat: PPG Paints Pitt-Tech Plus Primer 90-912.
2. NOTE: Prepare galvanized metal per Paragraph 3.02.F of this Section. Prepare existing metal surfaces per SSPS SP1 and SP2.
3. Second Coat PPG Paints Pitt-Tech Plus Semi-gloss 90-1210.
4. Finish Coat: PPG Paints Pitt-Tech Semi-gloss 90-1210.

END OF SECTION

SECTION 09 96 00

PROTECTIVE COATING

PART 1 -- GENERAL

1.01 THE SUMMARY

A. The CONTRACTOR shall provide protective coatings, complete and in place, in accordance with the Contract Documents.

B. Definitions

1. The term "paint," "coatings," or "finishes" as used herein, shall include surface treatments, emulsions, enamels, paints, epoxy resins, and other protective coatings, excepting galvanizing or anodizing, whether used as a pretreatment, primer, intermediate coat, or finish coat.

2. The term "DFT" means minimum dry film thickness, without any negative tolerance.

C. The following surfaces shall not be coated:

1. Concrete, unless required by items on the concrete coating schedule below or the Drawings.

2. Stainless steel

3. Machined surfaces

4. Grease fittings

5. Glass

6. Equipment nameplates

7. Platform gratings, stair treads, door thresholds, and other walk surfaces, unless specifically indicated to be coated.

8. Platform gratings, stair treads, door thresholds, and other walk surfaces, unless specifically indicated to be coated.

D. The coating system schedules summarize the surfaces to be coated, the required surface preparation, and the coating systems to be applied. Coating notes on the Drawings are used to show or extend the limits of coating schedules, to show exceptions to the schedules, or to clarify or show details for application of the coating systems.

E. Where protective coatings are to be performed by a Subcontractor, the Subcontractor shall possess a valid state license as required for performance of the painting and coating WORK called for in this specification and shall provide 5 references which show that the Subcontractor has previous successful experience with the indicated or comparable

coating systems. Include the name, address, and the telephone number for the owner of each installation for which the Subcontractor provided the protective coating.

1.02 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 - Contractor Submittals.

B. Submittals shall include the following information and be submitted at least 30 Days prior to commencing protective coating WORK:

1. Materials List: Eight copies of a coating materials list showing the manufacturer and the product number, keyed to the coating systems herein. The list shall be submitted prior to or at the time of submitting samples.

2. Manufacturer's Information: For each coating system to be used, the following data:

a. Manufacturer's data sheet for each product proposed, including statements on the suitability of the material for the intended use.

b. Technical and performance information that demonstrates compliance with the system performance and material requirements.

c. Paint manufacturer's instructions and recommendations on surface preparation and application.

d. Colors available for each product (where applicable).

e. Compatibility of shop and field applied coatings (where applicable).

f. Material Safety Data Sheet for each product proposed.

C. Samples

1. Samples of paint, finishes, and other coating materials shall be submitted on 8-1/2 inch by 11-inch sheet metal. Each sheet shall be completely coated over its entire surface with one protective coating material, type, and color.

2. Two sets of color samples to match each color selected by the ENGINEER OF RECORD from the manufacturer's standard color sheets. If custom mixed colors are indicated, the color samples shall be made using color formulations prepared to match the color samples furnished by the ENGINEER OF RECORD. The color formula shall be shown on the back of each color sample.

3. One 5 pound sample of each abrasive proposed to be used for surface preparation for submerged and severe service coating systems.

D. Experience Requirements of the Field Applicator:

1. Three references which verify that the coating CONTRACTOR has demonstrated successful application of the specified coating system in the past 3 years. Provide the size (area of coating), time of completion, name, the owner’s address and telephone

number for each installation referenced.

2. A written statement from the CONTRACTOR stating that they are qualified and experienced in the application of the specified coating systems. The letter shall state the manufacturer and model number of mixing, heating, and pumping equipment to be used to apply the specified coating systems.

3. A written statement from the manufacturer certifying that the coating CONTRACTOR's onsite foreman and each applicator performing WORK on the project has been trained and approved to apply the selected coating system.

4. CONTRACTOR shall provide SSPC QP 1 Certification or the manufacturer's certification of the applicator for the specified coating system.

E. Experience Requirements of the Shop Applicator

1. NACE Coating Inspector Program certification documents for the person responsible for Quality Assurance/Quality Control at the facility. This person will be responsible for submitting inspection reports to the OWNER.

2. A copy of a typical Quality Assurance/Quality Control inspection report containing items listed in 3.18 of this Specification.

3. Three references which verify that the shop painting facility has demonstrated successful application of the specified coating systems in the past 3 years. Provide the structure name and size (area of coating), time of completion, the owner's name, address, and telephone number for each installation referenced.

4. The manufacturer shall provide written certification that the shop painting facility's supervisor and each applicator performing Work on the project have been trained and approved by the manufacturer to apply the selected coating system.

5. The manufacturer shall state whether or not it has verified that the CONTRACTOR is going to use the proper mixing, coating application, heating, and environmental control equipment for the specified coating products. Only heated plural component equipment shall be used for the 100% solids coating application. Equipment shall be capable of performing a ratio test.

6. The Shop Coating Applicator shall provide SSPC QP 3 Certification or the coating manufacturer's certification of the applicator for selected coating system.

1.03 SPECIAL CORRECTION OF DEFECTS REQUIREMENTS

A. Inspection: An inspection may be conducted during the eleventh month following completion of coating WORK. The CONTRACTOR and a representative of the coating material manufacturer shall attend this inspection. Defective WORK shall be repaired in accordance with these specifications and to the satisfaction of the OWNER. The OWNER may, by written notice to the CONTRACTOR, reschedule the inspection to another date within the one year correction period or may cancel the inspection altogether. The CONTRACTOR is not relieved of its responsibilities to correct defects, whether or not the inspection is conducted.

PART 2 -- PRODUCTS

2.01 GENERAL

A. Suitability: The CONTRACTOR shall use suitable coating materials as recommended by the manufacturer. Materials shall comply with Volatile Organic Compound (VOC) limits applicable at the Site.

B. Material Sources: Where manufacturers and product numbers are listed, it is to show the type and quality of coatings that are required. If a named product does not comply with VOC limits in effect at the time of Bid opening, that product will not be accepted, and the CONTRACTOR shall propose a substitution product of equal quality that does comply. Proposed substitute materials will be considered as indicated below. Coating materials shall be materials that have a record of satisfactory performance in industrial plants, manufacturing facilities, and water and wastewater treatment plants.

C. Compatibility: In any coating system only compatible materials from a single manufacturer shall be used in the WORK. Particular attention shall be directed to compatibility of primers and finish coats. If necessary, a barrier coat shall be applied between existing prime coat and subsequent field coats to ensure compatibility.

D. Containers: Coating materials shall be sealed in containers that plainly show the designated name, formula or specification number, batch number, color, date of manufacture, and name of manufacturer, all of which shall be plainly legible at the time of use.

E. Colors: Colors and shades of colors of coatings shall be as indicated or selected by the ENGINEER OF RECORD. Each coat shall be of a slightly different shade to facilitate inspection of surface coverage of each coat. Finish colors shall be as selected from the manufacturer's standard color samples by the ENGINEER OF RECORD.

F. Substitute or "Or-Equal" Products

1. To establish equality under Section 01 60 00 - Products, Materials, Equipment and Substitutions, the CONTRACTOR shall furnish satisfactory documentation from the manufacturer of the proposed substitute or "or-equal" product that the material meets the indicated requirements and is equivalent or better in the following properties:

    a. Minimum and maximum recoat times

    b. Minimum and maximum cure time for immersion

    c. Abrasion resistance per ASTM D4060 using CS17 Wheel

    d. Maximum and minimum dry film thickness per coat

    e. Compatibility with other coatings

    f. Suitability for the intended service

    g. Resistance to chemical attack

h. Temperature limitations during application and in service

i. Type and quality of recommended undercoats and topcoats

j. Ease of application

k. Ease of repairing damaged areas

l. Stability of colors

2. Protective coating materials shall be standard products produced by recognized manufacturers who are regularly engaged in production of such materials for essentially identical service conditions. When requested, the CONTRACTOR shall provide the ENGINEER OF RECORD with the names of not less than 10 successful applications of the proposed manufacturer's products that comply with these requirements.

3. If a proposed substitution requires changes in the WORK, the CONTRACTOR shall bear such costs involved as part of the WORK.

2.02 INDUSTRIAL COATING SYSTEMS

A. System 1 - Alkyd Enamel

1. Materials

Primer	Manufacturer's recommendation
Finish Coat	1 component alkyd enamel
Type	high quality alkyd, medium long enamel
Demonstrated suitable for	ferrous and nonferrous surfaces in industrial exposure, producing high gloss surface that is resistant to mild corrosion and chemical fumes, has good color and gloss retention, good weathering, and sunlight resistance
VOC Content, max	420 grams per liter

2. Application and manufacturers

Prime Coat (DFT = 2 to 4 mils)	Finish Coat (DFT = 2 to 4 mils)	Total System DFT
PPG Amercoat 5105	**Amercoat 5450**	4 to 8 mils
Tnemec Series L69	**Tnemec Series 2H**	
Devoe Devprime 1401	**Devoe Devlac 1431**	
Carboline Carbocoat 150	**Carbocoat 45**	

Sherwin Williams Kem Bond HS	**S-W Industrial Enamel HS**	

B. System 2 - Not Used

C. System 3 - Aluminum Silicone

1. Material

Type	High heat silicone with aluminum
Demonstrated suitable for	Ferrous surfaces, continuous temperatures of 1000 deg F
VOC Content, max	637 grams per liter

2. Application and manufacturers

Total System DFT = 3 mils
Carboline Thermaline 4700 - Aluminum, 2 coats
International Intertherm 50, 2-3 coats
Sherwin William Hi-Temp Coatings 1000V, 2 coats.

D. System 3 (VOC-Limited) - Aluminum Silicone

1. Material

Type	High heat silicone containing aluminum
Demonstrated suitable for	Ferrous surfaces with continuous temperatures at 1000 deg F and peaks of 1200 deg F
VOC Content, max	420 grams per liter

2. Application and manufacturers

Total System DFT = 3 mils
PPG- Amercoat 872 followed by **PPG- Amercoat 873**
Carboline Thermaline 4700 VOC Aluminum, 2 coats.
Sherwin Williams Hi-Temp Coatings 1000V, 2 coats.
International Intertherm 1202 UPC (1 coat – 4 mils)

E. System 4 (VOC-Limited) - Epoxy/Polyurethane

1. Materials

Primer type	rust-inhibitive, 2 component epoxy
VOC Content, max	250 g/L
Finish type	2 component aliphatic polyurethane
VOC Content	250 g/L, max
Demonstrated suitable for	Superior color and gloss retention, resistance to weathering, chemical fumes and splash

2. Application and manufacturers

Prime Coat (DFT = 3 - 5 mils)	Finish Coat (DFT = 3 -4 mils)	TOTAL SYSTEM DFT
Carboline 893	**Carboline 134 VOC**	6 - 9 MILS
Devoe Devran 224V	**Devoe 379H**	
Tnemec Hi-Build Epoxoline II Series L69	**Tnemec Series 750UVX**	
PPG Amerlock 400/2	**Amershield VOC**	
Sherwin Williams Macropoxy 646	**S W Hi-Solids Polyurethane 100**	

F. System 5 (VOC-Limited) - Inorganic Zinc/Epoxy/Polyurethane

1. Materials

Prime Coat	Inorganic zinc silicate, water-based, 2 component
zinc content in dry film	79 percent, minimum
VOC content, max	0 grams per liter
Demonstrated suitable for	Ferrous metal, providing superior corrosion, chemical, and abrasion resistance, recommended for use as primer under epoxy

Intermediate Coat	2 component epoxy, high build, recommended by manufacturer for application over inorganic zinc primer
Demonstrated suitable for	Outstanding chemical, corrosion, and abrasion resistance
VOC content, max	250 grams per liter
Finish Coat	2 component aliphatic or acrylic polyurethane
Demonstrated suitable for	Superior color and gloss retention, resistance to chemical fumes, severe weathering, and abrasion
VOC content, max	250 grams per liter

2. Application and manufacturers

Surface preparation for primer	SSPC SP 10
Anchor profile for primer	per manufacturer

Prime Coat (DFT = 3 - 4 mils)	Intermediate Coat (DFT = 4 - 6 mils)	Finish Coat (DFT = 3 - 4 mils)	Total System DFT
PPG- Dimetcote 21-5	**Amerlock 400/2**	**Amershield VOC**	10 - 14 mils
Carboline Carbozinc 11WB	**Carboguard 893**	**Carbothane 134VOC**	
Tnemec Tneme-Zinc 94H20	**Tnemec Series L69**	**Tnemec Series 750 UVX**	
Sherwin Williams Zinc Clad XI	**S W Macropoxy 646**	**S-W Hi-Solids Polyurethane 250**	
Devoe Cathacote 305	**Devoe Devran 224V**	**Devoe Devthane 379H**	

G. System 6 - Inorganic Zinc, Water Based

1. Material

Type	water based zinc silicate, 2 component
Percent Zinc in dry film	83, min

VOC Content, max	0 grams per liter
Demonstrated suitable for	Severe weathering and moderate chemical fumes, continuous temperatures of 750 deg F

2. Application and manufacturers

Product (2 coats at 2 - 4 mils each)	Total System DFT
PPG- Dimetcote 21-5	4 - 8 mils
Devoe Cathacoat 305	
Carboline Carbozinc 11 WB	
Sherwin Williams Zinc Clad XI	

H. System 7 - Acrylic Latex

1. Material

Primer	Product, surface preparation, and DFT as recommended by manufacturer for the surface
Finish Type	Single component, water based acrylic latex, with fungicide
VOC Content, max	180 grams per gallon
Demonstrated suitable for	PVC piping, weather and mild chemical resistance, excellent color and gloss retention

2. Application and manufacturers

Finish (at least 2 coats required)	Total System DFT
PPG- Amercoat 220	primer plus 6 mils
Carboline Carbocrylic 3359	
Tnemec Series 1028 Enduratone	
Sherwin Williams Metalatex	
Devoe Devcryl 530	

I. System 8 (VOC-Limited) - Epoxy, Equipment

1. Materials

Primer Type	2 component epoxy, recoatable up to one year
Demonstrated suitable for	Rust inhibitive, outstanding chemical, abrasion, and weathering resistance, resistance to splash, washdown, and condensation. Immersion capability is not required
VOC content, max	250
Finish Type	2 component epoxy, available in many colors
Demonstrated suitable for	Outstanding chemical, abrasion, and weathering resistance, resistance to splash, washdown, and condensation. Immersion capability is not required
VOC content, max	250

2. Application and manufacturers

Prime Coat (DFT = 4 - 5 mils)	Finish Coat (DFT = 4 - 5 MILS)	Total System DFT
Devoe Bar-Rust 231	**Devoe 224V**	8 - 10 mils
PPG- Amerlock 400/2	**Amerlock 400/2**	
Tnemec Series L69	**Tnemec Series L69**	
Carboguard 60	**Carboguard 60**	
Sherwin Williams Macropoxy 646	**S W Macropoxy 646**	

J. System 9 (VOC-Limited) - Inorganic Zinc/Epoxy, Equipment

1. Materials

Primer type	Water-based inorganic, self-curing zinc silicate
Zinc content in dry film	83 percent, min

Demonstrated suitable for	Superior corrosion, chemical and abrasion resistance, recommended as primer under epoxy
Finish type	2 component polyamide epoxy
VOC Content, max	215 g/L
Demonstrated suitable for	Good resistance to chemical attack, weathering, splash, washdown, and condensation, available in many colors

2. Application and manufacturers

Prime Coat (DFT = 3 to 5 mils)	Finish Coats (2 or more) (DFT = 4 to 6 mils each)	Total System DFT
Devoe Cathacote 305	**Devran 224V**	11 to 17 mils
Carboline Carbozinc 11WB	**Carboguard 890**	
PPG- Dimetcote 21-5	**Amerlock 400/2**	
Sherwin Williams Zinc Clad XI	**S-W Macropoxy 646**	

K. System 10 - Acrylic, Concrete

1. Materials

Filler-Sealer Type	Epoxy or acrylic masonry sealer, for concrete and CMU, for wet and dry conditions
Primer	as recommended by manufacturer
VOC Content, g/L, max	75
Finish Type	single component waterborne acrylic, industrial grade, high molecular weight
VOC Content, g/L, max	180
Demonstrated suitable for	concrete under mild to moderate exposure conditions, splash but not immersion

2. Application and manufacturers

Prime Coat	Finish Coat	Total System DFT

(Filler-Sealer)	(DFT = 5 - 7 mils) (2 or more coats)	
Tnemec EnviroFill 130	**Tneme-Crete 180 Series**	5 - 7 mils plus primer
PPG- Amerlock 400BF and Amercoat 114A	**Amercoat 220P**	
Carboline Sanitile 500	**Carbocrylic 3359DTM**	
Sherwin Williams Cement Plex 875 (acrylic) and Kem Cati Coat (epoxy)	**S W Metalatex**	
Devoe Tru-Glaze 4015	**Devoe Devcryl 1449**	

L. System 11 - Not Used

M. System 12 (VOC-Limited) - Polyurethane, Fiber Glass

1. Materials

Primer Type	as recommended by manufacturer
Finish Type	2 component aliphatic polyurethane
Demonstrated suitable for	Fiberglass, superior color and gloss retention, resistance to acid and alkali splash, fumes, and severe weathering, no immersion
VOC content, max	250 g/L

2. Application

Prime Coat (3 to 4 mils)	Finish Coats (4 to 6 mils)	TOTAL SYSTEM DFT
Devoe Bar-Rust 231	**DEVTHANE 379H (2 coats)**	7 to 10 mils
Carboline Carbocrylic 120 (2 coats)	**Carbothane 134 VOC (2 coats)**	
PPG Amerlock 400	**Amershield VOC**	
Tnemec Epoxoline Series L69	**Tnemec Series 750 UVX**	

Sherwin Williams Macropoxy 646	**S-W Hi-Solids Polyurethane 250**	

2.03 SUBMERGED AND SEVERE SERVICE COATING SYSTEMS

A. System 100 - Amine Cured Epoxy

1. Material

Type	high build, amine cure epoxy
VOC content, g/L max	220
Demonstrated suitable for	steel, long term immersion in water and wastewater, resistant to corrosion, chemical fumes, good color retention
Certification	NSF 61 if in contact with potable water

2. Application and manufacturers

Products (3 coats or more)	**Total System DFT**
PPG- Amercoat 133	15 to 17 mils For non-submerged valves and other equipment, DFT = 10 to 12 mils
Carboline Carboguard 891HS	
International Bar-Rust 233H	
Tnemec Epoxoline Series L69	
Sherwin Williams Macropoxy 646 PW	

B. System 101 - (Not used)

C. System 102 (VOC-Limited) - Polyamide Epoxy

1. Materials

Type	high build polyamide cure epoxy
VOC content, max, g/L	250
Demonstrated suitable	long term immersion in water and

for	wastewater, resistant to corrosion and chemical fumes, good color retention
Certification	NSF 61 if in contact with potable water

2. Application and manufacturers

Products (3 coats or more)	**Total System DFT**
Devoe Bar-Rust 233H	12 - 18 mils
Tnemec L140F	
PPG- Amerlock 400/2	
Carboguard 61	
Sherwin Williams Macropoxy 646 PW for water and Dura-Plate 235 for wastewater	

D. System 103 - Not Used

E. System 104 - Not Used

F. System 105 – Not Used

G. System 106 - Fusion Bonded Epoxy

1. Material

Type	100 percent solids fusion bond epoxy
Demonstrated suitable for	fluidized bed or electrostatic spray application, recommended for pumps, valves, pipe appurtenances, tanks, pipe hangers, flow meters, and hydrants
Certification requirement	NSF 61

2. Application in accordance with AWWA C213 and the following:

Product	Surface and DFT
3M Scotchkote 134 or 206N	Valves 12-mils
	All others 16-mils

H. System 107 – Not Used

I. System 108 - Polyurethane, Concrete

1. Materials

Filler-sealer type	epoxy material with portland cement and aggregate
Primer type	Phenolicamine or polyamidoamine epoxy
VOC content, g/L max	250
Finish type	aromatic elastomeric polyurethane
Demonstrated suitable for	concrete and concrete block masonry, long term immersion in water and wastewater and service where subject to splash and spill of water and wastewater treatment chemicals
VOC content, g/L max	250
Certification requirement, where coating will be in contact with potable water	NSF 61

2. Application and manufacturers

Filler-Sealer	**Primer** DFT = 3 - 7-mils	**Finish Coat** DFT = 100 - 125-mils, 75 mils for potable water
Tnemec MortarClad 218	**Tnemec Pota-Pox L140** (potable water) **Epoxoprime 201** (wastewater)	**Elasto-Shield 406 (max 75 mils for potable water)**
PPG-Amerlock 400/BF	**Amerlock 400/2**	**Amerlock 490**
Sherwin Williams Steel Seam FT 910	**S-W Dura-Plate 235**	**S-W Sherflex (Max 100 mils for potable water)**
International Ceilcote 400 Corocrete	**Polibrid 670-S**	**Polybrid 705**

J. System 109 - Epoxy, Concrete

1. Materials

Filler-sealer type	Epoxy material with portland cement and aggregate
Primer type	100% solids epoxy
VOC content, g/L max	100
Finish type	Amine cure epoxy/aggregate-filled epoxy
Demonstrated suitable for	Sewer manhole & wastewater facility, long term immersion in wastewater service where subject to chemical and bacteriological attack found in municipal sanitary sewer system
VOC content, g/L max	100

2. Application and manufacturers

Filler-Sealer	**Primer** DFT = 5 – 10 mils	**Finish Coat** DFT = 125 – 150 mils
RLS Raven 210	**RLS Raven 155**	**Raven 405 FS**
Sauereisen Filler Compound 209 or 209FS	**Per Sauereisen**	**SewerGard 210**
		Warren Environmental

K. System 110 - Not Used

L. System 111 - Vinyl Ester, Concrete

1. Topcoat Material

Type	Vinyl ester, with aggregate or flake fill
Demonstrated suitable for	72 hour immersion in 30 percent sulfuric or hydrochloric acid, sodium hydroxide, sodium hypochlorite, alum, aqueous ammonia, ferric chloride, hydrogen peroxide, sodium chloride, cationic or

	anionic polymer

2. Application and manufacturers

Filler-Sealer 1/16-inch	**Primer** DFT = mils	**Finish Coat** DFT = -mils
Tnemec MortarClad 218	**Vinester Primer 120-5002 1 coat, 15 - 18 mils**	**Vinester Finish 120-5001 1 coat, 15 - 18 mils**
Sherwin Williams Corobond VE Primer	**S-W Cor Cote VEN FF or GF**	**S-W Cor Cote VEN FF or GF**
Carboguard 510 or 510SG	**Semstone 800, 8 - 10 mils**	**Semstone 870, 30 mils**
International Ceilcote 380M Primer 4-5 mils	**International Ceilcote 242 Flakeline, 1 coat 15-25 mils**	**International Ceilcote 242 Flakeline, 1 coat 15-25 mils**

2.04 SPECIAL COATING SYSTEMS

A. **System 200 - PVC Tape:** Prior to wrapping the pipe with PVC tape, the pipe and fittings first shall be primed using a primer recommended by the PVC tape manufacturer. After being primed, the pipe shall be wrapped with a 20-mil adhesive PVC tape, half-lapped, to a total thickness of 40 mils.

B. **System 201 - Rich Portland Cement Mortar:** Rich portland cement mortar coating shall have a minimum thickness of 1/8-inch, followed by enclosure in an 8-mil thick polyethylene sheet with all joints and edges lapped and sealed with tape.

C. System 202 - (Not used)

D. System 203 - Epoxy Surfacing on Concrete Floors

1. Material

Type	2 component epoxy floor surfacing
Demonstrated suitable for	concrete, resistance to abrasion and many acids and alkalis such as liquid alum, sodium hydroxide, and sulfuric acid
VOC Content, g/L, max	250

2. Application and manufacturers

Primer/Sealer	Finish Coat (1/4-inch thick)
PPG- Amerlock Sealer	**PPG- Megaseal HDSL**
Tnemec Power-Tread 237	**Tnemec Power-Tread 237**
Carboline Semstone 110	**Carboline Semstone 145 SL**
International Ceilcote 680(M)*	**International Ceilcote 625 Ceilflor Series**
Sherwin Williams General Polymers TPM 12	**S-W General Polymers TPM 12**

E. System 204 - Water Retardant, Concrete

Type	silane-modified siloxane
Demonstrated suitable for	repelling water from vertical concrete and masonry surfaces
VOC Content, g/L, max	250
Products, or equal	**Sherwin Williams H&C Super V (315 g/l) or Loxon 7% Siloxane Water Repellent (0 VOC**
	Tnemec Series 633 Prime A Pell H2O

F. **System 205 - Polyethylene Encasement:** Application of polyethylene encasement shall be in accordance with ANSI/AWWA C105 using Method C.

G. **System 206 - Cement Mortar Coating:** A 1-1/2-inch minimum thickness mortar coating reinforced with 3/4-inch galvanized welded wire fabric shall be provided. The cement mortar shall contain no less than one part Type V cement to 3 parts sand. The cement mortar shall be cured by a curing compound meeting the requirements of "Liquid Membrane Forming Compounds for Curing Concrete," ASTM C 309, Type II, white pigmented, or by enclosure in an 8-mil thick polyethylene sheet with all edges and joints lapped by at least 6-inches.

H. System 207 - Not Used

I. System 208 - Aluminum Metal Isolation

1. Material

Type	high build polyamide epoxy with chemical and abrasion resistance

Demonstrated suitable for	concrete and aluminum substrates, to isolate aluminum from contact with concrete and the resulting chemical degradation
VOC content, max	250

2. Application and manufacturers

Coating (DFT = 16 - 20 mils)
PPG- Sigma, Novoguard 840
Sherwin Williams Macropoxy 646
Tnemec Epoxoline Series L69
Carboline 890
Devoe Bar-Rust 231

J. System 209 - Not Used

K. System 210 – Not Used

PART 3 -- EXECUTION

3.01 MANUFACTURER'S SERVICES

A. The CONTRACTOR shall require the protective coating manufacturer to furnish a qualified technical representative to visit the Site for technical support as may be necessary to resolve field problems.

3.02 WORKMANSHIP

A. Skilled craftsmen and experienced supervision shall be used on coating WORK.

B. Coating shall be done in a workmanlike manner so as to produce an even film of uniform thickness. Edges, corners, crevices, and joints shall receive special attention to insure thorough surface preparation. The finished surfaces shall be free from runs, drops, ridges, waves, laps, brush marks, and variations in color, texture, and finish. The hiding shall be so complete that the addition of another coat would not increase the hiding. Special attention shall be given so that edges, corners, crevices, welds, and similar areas receive a film thickness equivalent to adjacent areas, and installations shall be protected by the use of drop cloths or other precautionary measures.

C. Damage to other surfaces resulting from the WORK shall be cleaned, repaired, and refinished to original condition.

3.03 STORAGE, MIXING, AND THINNING OF MATERIALS

A. Manufacturer's Recommendations**:** Unless otherwise indicated, the coating manufacturer's printed recommendations and instructions for thinning, mixing, handling, applying, and protecting its coating materials, for preparation of surfaces for coating, and for other procedures relative to coating shall be strictly observed.

B. Coating materials shall be used within the manufacturer's recommended shelf life.

C. Storage and Mixing: Coating materials shall be stored under the conditions recommended by the Product Data Sheets, and shall be thoroughly stirred, strained, and kept at a uniform consistency during application. Coatings from different manufacturers shall not be mixed together.

3.04 PREPARATION FOR COATING

A. General: Surfaces to receive protective coatings shall be prepared as indicated prior to application of coatings. The CONTRACTOR shall examine surfaces to be coated and shall correct surface defects before application of any coating material. Marred or abraded spots on shop-primed and on factory-finished surfaces shall receive touch-up restoration prior to any field coating application. Surfaces to be coated shall be dry and free of visible dust.

B. Protection of Surfaces Not to be Coated: Surfaces that are not to receive protective coatings shall be protected during surface preparation, cleaning, and coating operations.

C. Hardware, lighting fixtures, switch plates, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not to be painted shall be removed, masked, or otherwise protected. Drop cloths shall be provided to prevent coating materials from falling on or marring adjacent surfaces. The working parts of mechanical and electrical equipment shall be protected from damage during surface preparation and coating operations. Openings in motors shall be masked to prevent entry of coating or other materials.

D. Care shall be exercised not to damage adjacent WORK during blasting operations. Spraying shall be conducted under carefully controlled conditions. The CONTRACTOR shall be fully responsible for and shall promptly repair any and all damage to adjacent WORK or adjoining property occurring from blasting or coating operations.

E. Protection of Painted Surfaces: Cleaning and coating shall be coordinated so that dust and other contaminants from the preparation process will not fall on wet, newly-coated surfaces.

3.05 ENVIRONMENTAL REQUIREMENTS

A. No coating work shall be performed under the following conditions:

1. Surface or ambient temperatures exceed the manufacturer’s recommended maximum or minimum allowable.

2. Dust or smoke laden atmosphere.

3. Damp or humid conditions, where the relative humidity is above the manufacturer’s

maximum allowable.

4. Substrate and ambient temperatures are less than 5°F above the dew point and are decreasing. Dew point shall be measured by use of an instrument such as a Sling Psychrometer in conjunction with U.S. Department of Commerce, Weather Bureau psychrometric tables. Elcometer 319 Dew Point meter or equal may also be used.

5. Ambient temperature that is expected to drop below 50°F or less than 5°F above the dew point within 8 hours after application of coating.

3.06 SURFACE PREPARATION STANDARDS

A. The following referenced surface preparation specifications of the Steel Structures Painting Council shall form a part of this specification:

1. Solvent Cleaning (SSPC SP 1): Removal of oil, grease, soil, salts, and other soluble contaminants by cleaning with solvent, vapor, alkali, emulsion, or steam.

2. Hand Tool Cleaning (SSPC SP 2): Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, by hand chipping, scraping, sanding, and wire brushing.

3. Power Tool Cleaning (SSPC SP 3): Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, by power tool chipping, descaling, sanding, wire brushing, and grinding.

4. White Metal Blast Cleaning (SSPC SP 5/NACE 1): Removal of all visible rust, oil, grease, soil, dust, mill scale, paint, oxides, corrosion products and foreign matter by blast cleaning.

5. Commercial Blast Cleaning (SSPC SP 6/NACE 3): Removal of all visible oil, grease, soil, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except that staining shall be limited to no more than 33 percent of each square inch of surface area.

6. Brush-Off Blast Cleaning (SSPC SP 7/NACE 4): Removal of all visible oil, grease, soil, dust, loose mill scale, loose rust, and loose paint.

7. Near-White Blast Cleaning (SSPC SP 10/NACE 2): Removal of all visible oil, grease, soil, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except that staining shall be limited to no more than 5 percent of each square inch of surface area.

8. Power Tool Cleaning to Bare Metal (SSPC 11) When viewed without magnification, the surface shall be free of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter. Slight residues of rust and paint may be left in the lower portion of pits if the original surface is pitted. The surface profile shall not be less than 1 mil (25 microns).

9. Surface Preparation of Concrete (SSPC-SP 13/NACE 6): Removal of protrusions, laitance and efflorescence, existing coatings, form-release agents, and surface

contamination by detergent or steam cleaning, abrasive blasting, water jetting, or impact or power tool methods as appropriate for the condition of the surface and the requirements of the coating system.

3.07 FERROUS METAL SURFACE PREPARATION (UNGALVANIZED)

A. The minimum abrasive blasting surface preparation shall be as indicated in the coating system schedules included at the end of this Section. Where there is a conflict between these requirements and the coating manufacturer's printed recommendations for the intended service, the higher degree of cleaning shall apply.

B. The Shop Painting Facility shall use a minimum blast material mixture of 75% grit and 25% shot material to achieve the proper surface profile.

C. The Field Coating Applicator shall abrasive blast the shop coated surfaces per SSPC SP 7/NACE 4. The previously shop-painted surfaces shall be abraded prior to the application of the final coats. Special attention shall be given to uncoated steel weld joints, coating holdbacks, and bare metal.

D. Grease, oil, and welding fluxes shall be removed by wiping with MEK or naphtha cleaning or with trisodium phosphate detergent per SSPC SP 1.

E. All sharp edges shall be rounded or chamfered and all burrs, rust, scale, welding slag, and spatter shall be removed and the surface prepared by SSPC SP 2 hand tool cleaning, and SSPC SP 3 power tool cleaning.

F. The Contractor shall test the surfaces for soluble salts with the use of Chlor*Test as manufactured by Chlor*Rid International or approved equivalent. Any blasted surfaces shall be tested and shall have a maximum concentration of 5 micrograms per square centimeter ($\mu g/cm^2$). A test shall be conducted for every 100 square feet (ft2) of surface area to be coated at locations determined by the Inspector.

G. If the soluble salt test indicates chloride concentrations greater than those outlined in these Specifications, the Contractor shall use Chlor*Rid, as manufactured by Chlor*Rid International, in the water source during Water Cleaning to remove the salts from the substrate. A substrate’s surface preparation will be accepted once the soluble salt concentration is below the amounts outlined in these Specifications.

H. The type and size of abrasive shall be selected to produce a surface profile that meets the coating manufacturer's recommendation for the particular coating and service conditions.Abrasive shall not be reused unless an automated blasting system is used for surfaces that will be in non-submerged service. For automated blasting systems, clean oil-free abrasives shall be maintained. The abrasive mix shall include at least 50 percent grit.

I. The CONTRACTOR shall comply with the applicable federal, state, and local air pollution control regulations for blast cleaning.

J. Compressed air for air blast cleaning shall be supplied at adequate pressure from well-

maintained compressors equipped with oil and moisture separators that remove at least 95 percent of the contaminants.

K. Surfaces shall be cleaned of dust and residual particles of the cleaning operation by dry air blast cleaning, vacuuming, or another approved method prior to painting.

L. Enclosed areas and other areas where dust settling is a problem shall be vacuum-cleaned and wiped with a tack cloth.

M. Damaged or defective coating shall be removed by the blast cleaning to meet the clean surface requirements before recoating.

N. If the required abrasive blast cleaning will damage adjacent WORK, the area to be cleaned is less than 100 square feet, and the coated surface will not be submerged in service, then SSPC SP 2 or SSPC SP 3 may be used.

O. Shop-applied coatings of unknown composition shall be completely removed before the indicated coatings are applied. Valves, castings, ductile or cast iron pipe, and fabricated pipe or equipment shall be examined for the presence of shop-applied temporary coatings. Temporary coatings shall be completely removed by solvent cleaning per SSPC SP 1 before the abrasive blast cleaning has been started.

P. Shop primed equipment shall be solvent-cleaned in the field before finish coats are applied.

3.08 FERROUS METAL SURFACE PREPARATION (GALVANIZED)

A. Galvanized ferrous metal shall be alkaline cleaned per SSPC SP 1 to remove oil, grease, and other contaminants detrimental to adhesion of the protective coating system, followed by brush off blast cleaning per SSPC SP 7/NACE 4.

B. Any high spots, sharp protrusions, and rough edges, such as the metal drip line, shall be smoothed to avoid paint film gaps in the areas of the high spots. Surfaces shall be hand tool cleaned per SSPC SP 2 and power tool cleaned per SSPC SP 3.

C. Pretreatment coatings of surfaces shall be in accordance with the printed recommendations of the coating manufacturer. Galvanized metals may be cleaned with suitable organic solvent such as a rust inhibitor or aqueous alkaline solution per ASTM D6386.

D. The surfaces of galvanized steel exposed to chemical splashing or within a wastewater head space shall be abraded per SSPC SP 11 or SP 7 prior to coating.

3.09 SURFACE PREPARATION OF FERROUS SURFACES WITH EXISTING COATINGS, EXCLUDING STEEL RESERVOIR INTERIORS

A. General: Grease, oil, heavy chalk, dirt, or other contaminants shall be removed by solvent

or detergent cleaning prior to abrasive blast cleaning. The generic type of the existing coatings shall be determined by laboratory testing.

B. Abrasive Blast Cleaning: The CONTRACTOR shall provide the degree of cleaning indicated in the coating system schedule for the entire surface to be coated. If the degree of cleaning is not indicated in the schedule, deteriorated coatings shall be removed by abrasive blast cleaning to SSPC SP 6/NACE 3. Areas of tightly adhering coatings shall be cleaned to SSPC SP 7/NACE 4, with the remaining thickness of existing coating not to exceed 3-mils.

C. Incompatible Coatings: If coatings to be applied are not compatible with existing coatings the CONTRACTOR shall apply intermediate coatings per the manufacturer's recommendation for the indicated coating system or shall completely remove the existing coating prior to abrasive blast cleaning. A small trial application shall be conducted for compatibility prior to painting large areas.

D. Unknown Coatings: Coatings of unknown composition shall be completely removed prior to application of new coatings.

E. Water Abrasive or Wet Abrasive Blast Cleaning: Where indicated or where Site conditions do not permit dry abrasive blasting for industrial coating systems due to dust or air pollution considerations, water abrasive blasting or wet abrasive blasting may be used. In both methods, paint-compatible corrosion inhibitors shall be used, and coating application shall begin as soon as the surfaces are dry. Water abrasive blasting shall be done using high pressure water with sand injection. In both methods, the equipment used shall be commercially produced equipment with a successful service record. Wet blasting methods shall not be used for submerged or severe service coating systems unless indicated.

3.10 CONCRETE AND CONCRETE BLOCK MASONRY SURFACE PREPARATION

A. Surface preparation shall not begin until at least 30 Days after the concrete or masonry has been placed.

B. At the discretion of the Inspector, the Contractor shall test the surfaces for soluble salts with the use of Chlor*Test as manufactured by Chlor*Rid International or approved equivalent. Any surfaces shall be tested and shall have a maximum concentration of 5 micrograms per square centimeter (µg/cm2). A test shall be conducted for every 100 square feet (ft2) of surface area to be coated at locations determined by the Inspector.

C. If the soluble salt test indicates chloride concentrations greater than those outlined in these Specifications, the Contractor shall use Chlor*Rid, as manufactured by Chlor*Rid International, in the water source during Water Cleaning to remove the salts from the substrate. A substrate’s surface preparation will be accepted once the soluble salt concentration is below the amounts outlined in these Specifications.

D. In accordance with ASTM D4262, test to determine the pH of the concrete surface after the surface has been thoroughly blasted and cleaned. If the pH is outside the range recommended by the coating manufacturer, then the surface must be neutralized by removing concrete until the surface pH of 7 or greater is obtained prior to any coating application. One pH test shall be performed every 200 square feet, or less, and at locations

determined by the Inspector.

E. The Contractor shall test for capillary moisture in accordance with ASTM D4263. Moisture tests shall be taken every 200 square feet or less and at locations determined by the Inspector. If capillary moisture is present, the coating manufacturer shall be consulted to determine primer requirements and special coating application criteria.

F. For below grade structures with surface areas greater than 2,000 square feet, the Contractor shall install three anhydrous calcium chloride test kits on bare concrete to measure the Moisture Vapor Transmission Rate (MVTR) on a flat horizontal surface. Testing and calculations shall be performed according to ASTM F1869. The MVTR shall be less than 3 lbs per 1,000 square feet per 24 hours. If the MVTR is greater than 3 lbs per 1,000 square feet per 24 hours, the Contractor shall apply a concrete sealant to reduce the MVTR through the concrete. The test kits shall be undisturbed for a minimum of 60 hours.

G. Surface Voids: Bugholes, honeycomb, or other surface voids greater than 1/4 inch in depth or 1/4 inch in diameter shall be filled in with a resurfacing mortar prior to the application of any primer or finish coat.

H. Holes or other joint defects in masonry shall be filled with mortar and repainted. All voids and cracks shall be repaired as specified. Loose or spatter mortar shall be removed by scraping and chipping. Masonry surfaces shall be cleaned with clear water by washing and scrubbing to remove foreign and deleterious substances. Muriatic acid shall not be used. After cleaning, masonry surfaces shall be sealed or filled with a sealer or block filler compatible with the specified primer.

I. Coating Pipe Penetrations: A 1/4-inch wide by 3/8-inch deep saw cut shall be made around the circumference of the pipe as it penetrates the concrete. Prior to the coating application, the saw cut shall be dried and vacuumed to remove all dust and residue.

J. Coating Floor/Wall Joints: A 1/4-inch wide by 3/8-inch deep saw cut shall be made on the vertical and horizontal concrete surfaces around the perimeter of the floor. The saw cut shall be 2 inches from the joint on both sides. Prior to the coating application, the saw cut shall be dried and vacuumed to remove all dust and residue.

K. All oil, grease, and form release and curing compounds shall be removed by detergent cleaning per SSPC-SP 1 before abrasive blast cleaning.

L. New concrete, concrete block masonry surfaces and deteriorated concrete surfaces to be coated shall be abrasive blast cleaned to remove existing coatings, laitance, and deteriorated concrete, and to roughen the surface equivalent to 80 Grit sandpaper or ICRI No. 310.2 Guideline for Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays Concrete Surface Profile No. 4.

M. Surfaces shall be clean and as recommended by the coating manufacturer before coating is started.

3.11 PLASTIC, FIBER GLASS AND NONFERROUS METALS SURFACE PREPARATION

A. Plastic and fiber glass surfaces shall be sanded or brush off blast cleaned prior to solvent

cleaning with a chemical compatible with the coating system primer.

B. Non-ferrous metal surfaces shall be solvent-cleaned SSPC SP 1 followed by sanding or brush-off blast cleaning SSPC SP 7/NACE 4.

C. Surfaces shall be clean and dry prior to coating application.

3.12 ARCHITECTURAL CONCRETE BLOCK MASONRY SURFACE PREPARATION

A. The mortar surfaces shall be cured at least 14 Days before surface preparation WORK is started.

B. Dust, dirt, grease, and other foreign matter shall be removed prior to abrasive blasting.

C. The masonry surfaces shall be prepared in accordance with the material manufacturer's printed instructions.

3.13 SHOP COATING REQUIREMENTS

A. Unless otherwise indicated, items of equipment or parts of equipment which are not submerged in service shall be shop-primed and then finish-coated in the field after installation with the indicated or selected color. The methods, materials, application equipment, and other details of shop painting shall comply with this Section. If the shop primer requires top coating within a specific period of time, the equipment shall be finish-coated in the shop and then be touched up after installation.

B. Items of equipment or parts and surfaces of equipment which are submerged or inside an enclosed hydraulic structure when in service, with the exception of pumps and valves, shall have surface preparation and coating performed in the field.

C. Shop primed surfaces which are to be incorporated in the work shall be prepared in the field by cleaning all surfaces as necessary in accordance with SSPC SP 1 and SP 2. Damaged shop coating shall be cleaned in accordance with SSPC SP 3, Power Tool Cleaning, and recoated with the primer specified.

D. For every 500 square feet, or less, of steel surface blasted, the surface profile shall be tested with the use of Press-o-Film as manufactured by Testex, or other RP0287 approved equal, at locations to be determined by the Inspector. The replica tape thickness shall be measured using a dial micrometer manufactured by Testex, or other ASTM D4417 Type C approved equal. For each test area, one replica tape test shall be performed. For each test area, the three replica tape thickness values shall be recorded and must be within 10% of the coating manufacturer’s recommended profile. If the surface profile does not meet the manufacturer’s recommended profile, two additional tests will be performed within a 12-inch diameter of the initial test. If the values are not satisfactory, the Contractor shall reblast the affected areas.

E. The interior surfaces of steel water reservoirs, except for Paragraph A surfaces, shall have surface preparation and coating WORK performed in the field.

F. For certain pieces of equipment it may be undesirable or impractical to apply finish coatings in the field. Such equipment may include engine generator sets, equipment such

as electrical control panels, switchgear or main control boards, submerged parts of pumps, ferrous metal passages in valves, or other items where it is not possible to obtain the indicated quality in the field. Such equipment shall be primed and finish-coated in the shop and touched up in the field with the identical material after installation. The CONTRACTOR shall require the manufacturer of each such piece of equipment to certify as part of its Shop Drawings that the surface preparation is in accordance with these specifications. The coating material data sheet shall be submitted with the Shop Drawings for the equipment.

G. For certain small pieces of equipment the manufacturer may have a standard coating system that is suitable for the intended service conditions. In such cases, the final determination of suitability will be made during review of the Shop Drawing submittals. Equipment of this type generally includes only indoor equipment such as instruments, small compressors, and chemical metering pumps.

H. Shop-painted surfaces shall be protected during shipment and handling by suitable provisions including padding, blocking, and the use of canvas or nylon slings. Primed surfaces shall not be exposed to the weather for more than 2 months before being top coated or less time if recommended by the coating manufacturer.

I. Damage to shop-applied coatings shall be repaired in accordance with this Section and the coating manufacturer's printed instructions.

J. The CONTRACTOR shall make certain that the shop primers and field topcoats are compatible and meet the requirements of this Section. Copies of applicable coating manufacturer's data sheets shall be submitted with equipment Shop Drawings.

3.14 APPLICATION OF COATINGS

A. The application of protective coatings to steel substrates shall be in accordance with SSPC PA1 - Paint Application Specification No. 1.

B. Cleaned surfaces and each coat shall be inspected prior to applying each succeeding coat. The CONTRACTOR shall schedule such inspection with the CONSTRUCTION MANAGER in advance.

C. Blast cleaned ferrous metal surfaces shall be painted before any rusting or other deterioration of the surface occurs. Blast cleaning shall be limited to only those surfaces that can be coated in the same day.

D. Coatings shall be applied in accordance with the manufacturer's instructions and recommendations and this Section, whichever has the most stringent requirements.

E. Special attention shall be given to edges, angles, weld seams, flanges, nuts and bolts, and other places where insufficient film thicknesses are likely to be present. CONTRACTOR shall use an independent stripe coat per SSPC PA Guide 11 for these areas. Particular care shall be used to ensure that the specified coverage is secured on the edges and corners of all surfaces.

F. Special attention shall be given to materials that will be joined so closely that proper surface preparation and application are not possible. Such contact surfaces shall be

coated prior to assembly or installation.

G. Finish coats, including touch-up and damage repair coats shall be applied in a manner that will present a uniform texture and color matched appearance.

H. Coatings shall not be applied under the following conditions:

1. Temperatures exceeding the manufacturer's recommended maximum and minimum allowable.

2. Concrete surfaces will be in direct sunlight during application or within 3 hours after application.

3. Dust or smoke laden atmosphere.

4. Damp or humid weather.

5. Substrate or air temperature is less than 5 degrees F above the dew point.

6. Air temperature is expected to drop below 40 degrees F or less than 5 degrees F above the dew point within 8 hours after application of coating.

7. Wind conditions are not calm.

I. Dew point shall be determined by use of a sling psychrometer in conjunction with U.S. Dept. of Commerce, Weather Bureau psychometric tables.

J. Unburied steel piping shall be abrasive blast cleaned and primed before installation.

K. Finish coats shall be applied after concrete, masonry, and equipment installation is complete, and the working areas are clean and dust free.

3.15 CURING OF COATINGS

A. The CONTRACTOR shall maintain curing conditions in accordance with the conditions recommended by the coating material manufacturer or by this Section, whichever is the most stringent, prior to placing the completed coating system into service.

B. In the case of enclosed areas, forced air ventilation, using heated air if necessary, may be required until the coatings have fully cured.

3.16 IDENTIFICATION OF PIPING

A. Identification of piping shall be in accordance with Section 431051 - Piping Identification Systems.

B. Every valve or connection, where it may be possible for a worker to be exposed to a hazardous substance, shall be labeled per General Industry Safety Orders, Articles 112 and 5194.

C. Unburied chemical pipes, including chemical pipes in structures and chemical pipe trenches, shall be color-code painted. Colors shall be as selected by the ENGINEER OF RECORD or as indicated.

3.17 SHOP AND FIELD INSPECTION AND TESTING

A. General: The CONTRACTOR shall give the CONSTRUCTION MANAGER a minimum of 3 Days advance notice of the start of any field surface preparation or coating application, and a minimum of 7 Days advance notice of the start of any surface preparation activity in the shop.

B. Such WORK shall be performed only in the presence of the CONSTRUCTION MANAGER, unless the CONSTRUCTION MANAGER has granted prior approval to perform such WORK in its absence.

C. Inspection by the CONSTRUCTION MANAGER, or the waiver of inspection of any particular portion of the WORK, shall not relieve the CONTRACTOR of its responsibility to perform the WORK in accordance with these Specifications.

D. Scaffolding shall be erected and moved to locations where requested by the CONSTRUCTION MANAGER to facilitate inspection. Additional illumination shall be furnished on areas to be inspected.

E. Inspection Devices: The CONTRACTOR shall furnish inspection devices in good working condition for the detection of holidays and measurement of dry film thicknesses of coatings. Dry-film thickness gauges shall be made available for the CONSTRUCTION MANAGER's use while coating is being done, until final acceptance of such coatings. The CONTRACTOR shall furnish the services of a trained operator of the holiday detection devices until the final acceptance of such coatings. Holiday detection devices shall be operated only in the presence of the CONSTRUCTION MANAGER.

F. Holiday Testing: The CONTRACTOR shall test for continuity all coated ferrous surfaces inside a steel reservoir, other surfaces that will be submerged in water or other liquids, surfaces that are enclosed in a vapor space in such structures, and surfaces coated with any of the submerged and severe service coating systems. Areas that contain discontinuities shall be marked and repaired or recoated in accordance with the coating manufacturer's printed instructions and then be retested.

1. Coatings with thickness exceeding 20-mils total DFT: Pulse-type holiday detector such as **Tinker & Rasor Model AP-W, D.E. Stearns Co. Model 14/20,** or equal shall be used. The unit shall be adjusted to operate at the voltage required to cause a spark jump across an air gap equal to twice the required coating thickness.

2. Coatings with thickness of 20-mils or less total DFT: **Tinker & Rasor Model M1** non-destructive type holiday detector, **K-D Bird Dog,** or equal shall be used. The unit shall operate at less than 75 volts. For thicknesses between 10- and 20-mils, a non-sudsing type wetting agent, such as **Kodak Photo-Flo** or equal, shall be added to the water prior to wetting the detector sponge.

G. Film Thickness Testing: On ferrous metals, the dry film coating thickness shall be measured in accordance with the SSPC Paint Application Specification No. 2 using a magnetic type dry film thickness gauge such as **Mikrotest Model FM, Elcometer Model 111/1EZ,** or equal. Each coat shall be tested for the correct thickness. No measurements shall be made until at least 8 hours after application of the coating. On non-ferrous metals and other substrates, the coating thicknesses shall be measured at the time of application using a wet film gauge.

H. Surface Preparation: Confirm proper surface profile with Testex Press-O-Film replica tape in accordance with NACE RP0287-02.

3.18 Coating System Schedule, Ferrous Metal - Not Galvanized

	Item	Surface Prep.	System No.
FM-1	All surfaces outdoors, exposed or covered, except those included below.	Commercial blast cleaning SSPC SP 6/NACE 3	(4) (VOC-Limited) epoxy/ polyurethane
FM-2	All surfaces, indoors except those included below	Commercial blast cleaning SSPC SP 6/NACE 3	(8) eqiupment epoxy
FM-3	Surfaces of equipment and ferrous surfaces submerged or intermittently submerged in potable water, utility water, and wastewater including all surfaces lower than 2 feet above high water level in hydraulic structures, and all surfaces inside enclosed hydraulic structures and vents (excluding shop-coated valves, couplings, pumps).	White metal blast cleaning SSPC SP 5/NACE 1	(100) amine cure epoxy
FM-4	Buried small steel pipe.	Removal of dirt, grease, oil	(200) PVC tape
FM-5	Where indicated, ferrous surfaces in water passages and submerged surfaces of all pumps which have discharge size of 4 inches or larger.	White metal blast cleaning SSPC SP 5/NACE 1	(100) amine cure epoxy
FM-6	Ferrous surfaces of sleeve couplings.	Solvent cleaning SSPC SP 1, followed by white metal blast cleaning SSPC-SP 10/NACE 2	(106) fusion bond epoxy
FM-7	Buried surfaces that are not	Near white metal blast	(100) amine cure epoxy

	indicated to be coated elsewhere.	cleaning SSPC SP 10/NACE 2	

FM-18	Buried pipe couplings, valves, fittings, and flanged joints (where piping is plastic).	Removal of dirt, grease, oil	(201) rich portland cement mortar
FM-19	Buried pipe couplings, valves, and flanged joints (where piping is ductile or cast iron, not tape-coated), including factory-coated surfaces.	As specified by reference specification	(205) polyethylene encasement
FM-20	Buried pipe couplings, valves, and flanged joints (where piping is mortar-coated steel or reinforced concrete), including factory-coated surfaces.	Removal of dirt, grease, oil	(206) cement mortar coating

A. Coating System Schedule, Ferrous Metal - Galvanized: Pretreatment coatings, barrier coatings, or washes shall be applied as recommended by the coating manufacturer. All galvanized surfaces shall be coated except for the following items which shall be coated only if required by other Sections: (1) Floor gratings and frames, (2) Handrails, (3) Stair treads, (4) Chain link fencing and appurtenances.

	Item	**Surface Prep.**	**System No.**
FMG-1	All exposed surfaces indoors and outdoors, except those included below.	Solvent cleaning SSPC SP 1	(4) (VOC-Limited) epoxy/ polyurethane
FMG-2	Surfaces in chlorinator room, chlorine storage room.	Solvent cleaning SSPC SP 1	(100) amine cure epoxy
FMG-3	Buried small steel pipe.	Removal of dirt, grease, oil	(200) PVC tape
FMG-4	Surfaces buried or submerged in water or wastewater, including all surfaces lower than two feet above high water level and all surfaces inside enclosed hydraulic structures and vents.	Solvent cleaning SSPC SP 1 followed by brush-off grade blast cleaning SSPC SP 7/NACE 4	(100) amine cure epoxy

3.19 COATING SYSTEM SCHEDULE, NON-FERROUS METAL, PLASTIC, FIBER GLASS

A. Where isolated non-ferrous parts are associated with equipment or piping, the CONTRACTOR shall use the coating system for the adjacent connected surfaces. Do not coat handrails, gratings, frames or hatches. Only primers recommended by the coating manufacturer shall be used.

	Item	Surface Prep.	System No.
NFS-1	All exposed surfaces, indoors and outdoors, except those included below.	Solvent cleaned SSPC SP 1	(4) (VOC-Limited) epoxy/polyurethane
NFS-2	Aluminum surfaces in contact with concrete, or with any other metal except galvanized ferrous metal.	Solvent cleaned SSPC	(208) aluminum metal isolation
NFS-3	Polyvinyl chloride plastic piping, indoors and outdoors, or in structures, not submerged.	Solvent cleaned SSPC	(7) acrylic latex
NFS-4	Fiber glass surfaces.	Per paragraph 3.10	(12) (VOC-Limited) polyurethane, fiber glass
NFS-5	Buried non-ferrous metal pipe.	Removal of dirt, grease, oil	(200) PVC tape

3.20 COATING SYSTEM SCHEDULE-CONCRETE

	Item	Surface Prep.	System No.
C-1	Floor slab and walls, exposure to chemicals, where indicated.	Per paragraph 3.9	(108) polyurethane, concrete
C-2	Interior surfaces of sewer manholes, including sidewalls, bottom, and metal appurtenances, for manholes	Per paragraph 3.9	(111) vinyl ester, concrete

	indicated.		
C-3	Interior surfaces of sewer manholes, including sidewalls, bottom, and metal appurtenances, for manholes indicated.	Per paragraph 3.9	(109) epoxy, concrete

END OF SECTION

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SECTION 10 44 13

FIRE PROTECTION CABINETS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Special Provisions Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Fire-protection cabinets for the following:

a. Portable fire extinguishers.

B. Related Requirements:

1. Section 10 44 16 "Fire Extinguishers."

1.03 PREINSTALLATION CONFERENCE

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to fire-protection cabinets including, but not limited to, the following:

a. Schedules and coordination requirements.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product. Show door hardware, cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing surface-mounting method and relationships of box and trim to surrounding construction.

B. Shop Drawings: For fire-protection cabinets. Include plans, elevations, sections, details, and attachments to other work.

C. Samples: For each type of exposed finish required.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples 6 by 6 inches (150 by 150 mm) square.

E. Product Schedule: For fire-protection cabinets. Indicate whether recessed, semirecessed, or surface mounted. Coordinate final fire-protection cabinet schedule

with fire-extinguisher schedule to ensure proper fit and function. Use same designations indicated on Drawings.

1.05 CLOSEOUT SUBMITTALS

A. Maintenance Data: For fire-protection cabinets to include in maintenance manuals.

1.06 COORDINATION

A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

1.07 SEQUENCING

A. Apply decals on field-painted fire-protection cabinets after painting is complete.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.02 FIRE-PROTECTION CABINET

A. Cabinet Type: Surface mounted, suitable for fire extinguisher.

1. Basis-of-Design Product: Subject to compliance with requirements, provide **J.L. Industries, Inc. Ambassador Series Model 1816F10** or comparable product by one of the following:

    a. Babcock-Davis.
    b. Fire-End & Croker Corporation.
    c. GMR International Equipment Corporation.
    d. Guardian Fire Equipment, Inc.
    e. JL Industries, Inc.; a division of the Activar Construction Products Group.
    f. Larsens Manufacturing Company.
    g. Modern Metal Products, Division of Technico Inc.
    h. MOON American.
    i. Nystrom, Inc.
    j. Potter Roemer LLC.
    k. Strike First Corporation of America (The).

B. Cabinet Construction: Nonrated.

C. Cabinet Material: Cold-rolled steel sheet.

D. Cabinet Trim Material: Same material and finish as door.

E. Door Material: Steel sheet.

F. Door Style: Fully glazed panel with frame.

G. Door Glazing: Tempered float glass (clear).

H. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

1. Provide projecting lever handle with cam-action latch.

2. Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.

I. Accessories:

1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
2. Break-Glass Strike: Manufacturer's standard metal strike, complete with chain and mounting clip, secured to cabinet.
3. Lettered Door Handle: One-piece, cast-iron door handle with the word "FIRE" embossed into face.
4. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle.
5. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated or as directed by Architect.

a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."

1) Location: Applied to cabinet door.

2) Application Process: Silk-screened.

3) Lettering Color: Comply with authorities having jurisdiction.

4) Orientation: Vertical , or as indicated on Drawings.

J. Materials:

1. Cold-Rolled Steel: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.

a. Finish: Baked enamel or powder coat.

b. Color: As selected by Architect from full range of industry colors and color densities.

2. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

2.03 FABRICATION

A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

1. Weld joints and grind smooth.
2. Provide factory-drilled mounting holes.
3. Prepare doors and frames to receive locks.
4. Install door locks at factory.

B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles.

1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch (13 mm) thick.
2. Fabricate door frames of one-piece construction with edges flanged.
3. Miter and weld perimeter door frames.

C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.04 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's AMP 500, "Metal Finishes Manual for Architectural and Metal Products," for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces of fire-protection cabinets from damage by applying a strippable, temporary protective covering before shipping.

C. Finish fire-protection cabinets after assembly.

D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. General: Install fire-protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights indicated below: or, if not indicated, at heights acceptable to authorities having jurisdiction.

1. Fire-Protection Cabinets: 54 inches (1372 mm) above finished floor to top of cabinet.

B. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.

1. Provide inside latch and lock for break-glass panels.

2. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.

C. Identification: Apply decals at locations indicated.

3.03 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as fire-protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet and mounting bracket manufacturers.

E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

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SECTION 10 44 16

FIRE EXTINGUISHERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Special Provisions Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

B. Related Requirements:

1. Section 10 44 13 "Fire Protection Cabinets."

1.03 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to fire extinguishers including, but not limited to, the following:

a. Schedules and coordination requirements.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.

B. Product Schedule: For fire extinguishers. Coordinate final fire-extinguisher schedule with fire-protection cabinet schedule to ensure proper fit and function. Use same designations indicated on Drawings.

1.05 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.07 COORDINATION

A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.08 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Failure of hydrostatic test according to NFPA 10.
   b. Faulty operation of valves or release levers.

2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

1. Provide fire extinguishers approved, listed, and labeled by FM Global.

2.02 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

C. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Amerex Corporation.
   b. Ansul Incorporated; Tyco International.
   c. Badger Fire Protection.

d. Buckeye Fire Equipment Company.
e. Fire End & Croker Corporation.
f. Guardian Fire Equipment, Inc.
g. JL Industries, Inc.; a division of the Activar Construction Products Group.
h. Kidde Residential and Commercial Division.
i. Larsens Manufacturing Company.
j. MOON American.
k. Nystrom, Inc.
l. Oval Fire Products Corporation.
m. Potter Roemer LLC.
n. Pyro-Chem; Tyco Fire Suppression & Building Products.
o. Strike First Corporation of America (The).

2. Valves: Manufacturer's standard.

3. Handles and Levers: Manufacturer's standard.

4. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B, and bar coding for documenting fire-extinguisher location, inspections, maintenance, and recharging.

D. Multipurpose Dry-Chemical Type ABC: UL-rated 2A-10B:C, 5-lb nominal capacity; dimensions: 15.25-inches high x 7.5-inches wide x 4.25-inches deep, with monoammonium phosphate-based dry chemical in manufacturer's standard enameled steel container.

E. Wet Chemical Type K: Badger #WC250, UL Rating of 1A-10B:C, 5-lb nominal capacity; dimensions: 24.5-inches high x 8.75-inches wide x 7-inches deep.

2.03 MOUNTING BRACKETS

F. Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish. Color: As selected by Architect from manufacturer's full range.

1. Provide only for fire extinguishers shown to be wall mounted and not installed within fire extinguisher cabinets.

2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Amerex Corporation.
b. Ansul Incorporated; Tyco International.
c. Babcock-Davis.
d. Badger Fire Protection.
e. Buckeye Fire Equipment Company.
f. Fire End & Croker Corporation.
g. Guardian Fire Equipment, Inc.

h. JL Industries, Inc.; a division of the Activar Construction Products Group.
i. Kidde Residential and Commercial Division.
j. Larsens Manufacturing Company.
k. Nystrom, Inc.
l. Potter Roemer LLC.
m. Pyro-Chem; Tyco Fire Suppression & Building Products.
n. Strike First Corporation of America (The).

G. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.

1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.

a. Orientation: Vertical.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged fire extinguishers.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

C. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.

1. Mounting Brackets: 54 inches (1372 mm) above finished floor to top of fire extinguisher.

D. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION

SECTION 13 34 21

PRE-ENGINEERED METAL CANOPIES

PART 1 -- GENERAL

1.01 THE SUMMARY

A. The CONTRACTOR shall provide pre-engineered metal canopie(s) and appurtenant WORK, complete and in place, with operational components, in accordance with the Contract Documents.

B. The CONTRACTOR shall furnish professional design and engineering services as required for pre-engineered metal canopie(s) and appurtenances as indicated herein.

1. Professional design and engineering services may be provided by the manufacturer or by an independent licensed structural engineer retained by the CONTRACTOR, either of which shall comply with the requirements indicated.

C. The CONTRACTOR shall coordinate color samples with other Sections through the submittal process.

1.02 REFERENCES

A. Where reference is made to any of the below, the revision in effect at the time of bid opening shall apply.

B. American Institute of Steel Construction (AISC)

AISC Steel Construction Manual, Thirteenth Edition

C. American Iron and Steel Institute (AISI)

AISI Specification for the Design of Cold Formed Steel Structural Members

AISI Design of Light Gage Steel Diaphragms

D. American Society for Testing and Materials (ASTM)

ASTM A 36 Specification for Carbon Structural Steel

ASTM A 307 Specification for Carbon Steel Bolts and Studs, 60,000 PSI Ultimate Tensile Strength

ASTM A 325 Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Ultimate Tensile Strength

ASTM A 529 Specification for High-Strength Carbon-Manganese Steel of Structural Quality

ASTM A 572 Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel

ASTM A 653	Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 1008	Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
ASTM A 1011	Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength

E. American Welding Society

AWS D1.1	Structural Welding Code-Steel

F. Metal Building Manufacturer's Association (MBMA)

Metal Building Systems Manual.

G. Architectural Aluminum Manufacturers Association (AAMA).

H. Building Code: Refer to the Drawings and Special Provisions to determine which building code applies. The applicable building code, defined by the Drawings, is referenced herein as "the CODE."

1.03 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 7 of Standard Provisions – Submittal Management.

B. Literature: Manufacturer's specifications, technical data, installation methods, and maintenance instructions, and the following:

1. Complete operation instructions for operable components.

2. Manufacturer's full-range color charts, indicating custom color availability for color selection by the OWNER.

3. Additional information for the canopy system, roof panels, accessories and components.

C. Warranty: Submit a copy of the warranty.

D. Certifications

1. Certification of compliance with the Structural Requirements of paragraph 2.1.A.

2. Certification of manufacturer qualifications demonstrating compliance with the qualifications requirements indicated. Include a list of 5 similar completed projects with addresses of the project location, date of project completion, manufacturer's

products, and contact information of the consultant firm of record, general contractor and owner.

3. Certification of installer qualifications demonstrating compliance with the qualifications requirements indicated. Include a list of 5 similar completed projects with addresses of the project location, date of project completion, and contact information of the consultant firm of record, general contractor and owner.

4. Certification from the manufacturer stating that galvanizing has been completed in accordance with these specifications.

5. Certification of welder qualifications in accordance with the American Welding Society Code for Building Construction.

6. When requested by the CONSTRUCTION MANAGER, furnish other certifications as may be required to demonstrate compliance with the Contract Documents.

E. Shop Drawings and Design Calculations: Complete Shop Drawings showing location and details of installation, and design calculations.

1. Shop Drawings and Design Calculations shall be prepared, signed, and stamped by a professional civil or structural engineer registered in the State where the project is located.

2. Shop Drawings shall be drawn to sufficient scale, showing fully-dimensioned layout, including plans, sections, elevations and details of construction, connections to the foundation, joints, penetration details, preformed metal closures, flashing, gutters, and downspouts, fastenings, system caulking, sealants, gaskets, appurtenances, locations of framed openings, special project specific conditions, location of custom-cut panels, provisions for expansion and contraction, connections, accessories, and trim.

a. Shop Drawings shall include material descriptions, finish, color, details of construction, installation, and accessories of each pre-engineered metal canopy and shall include, as a minimum:

1) Erection drawings with written procedures to clearly explain proper installation of fasteners, trim, gaskets, and sealants. Erection drawings shall also include a notation requiring the installer to coordinate with other trades.

2) Transverse cross sections.

3) Roof plans showing sizes and locations of structural panels and connections.

4) Design and detail penetrations to be weathertight. Coordinate locations of penetrations.

5) Manufacturer's standard details may be used in addition to the shop drawings listed above provided that the portions that apply are clearly marked and those parts that do not apply are clearly marked.

6) Foundation and floor slab drawings.

a) Foundation anchor bolt plan with anchor bolts, shear lugs (if required) and base plate details. A diagram shall be included showing the vertical and lateral loads applied on the foundation for each load combination.

b) Floor slab drawings shall show the location of all construction joints, blockouts and details of the interface between the foundation and floor slab.

3. Design Calculations

a. Design calculations shall include a complete stress and deflection analysis of all structural components and connections.

b. Design calculations shall include supporting information for the structural roof deck with ICC-ES/IAPMO approval substantiating the capacity of the deck to act as a roof diaphragm and provide lateral support for out-of-plane loading as necessary.

c. Design calculations shall substantiate a complete load path for the wind and seismic lateral force resisting system including design of drag, collector and bracing elements (including connections) required to transfer loading, including overstrength factors, to the foundation. The design calculations shall specifically address anchorage of the structural system to the foundation, including detailing of baseplates and anchor rods. Detailing shall consider edge distance and clearance requirements at slab edges, blockouts and curbs. The structural calculations shall also conform to Section 01 33 17 – Structural Design, Support and Anchorage.

4. Specifications for the painting system including paint manufacturer's name, product trade name, and preparation for shop and field coats.

F. Deferred Approval: The shop drawings and design calculations shall be submitted to the Building Official(s) having jurisdiction for review and approval prior to construction. The CONTRACTOR shall provide all engineering support as necessary during the review process with all Building Official(s) having jurisdiction, including providing responses to review comments, attendance at meetings, and submitting all requested documentation.

G. Samples: The CONTRACTOR shall submit 2 samples of each of the following. Unless otherwise indicated, samples shall be full size and shall show gauges, configuration, construction, finish and color proposed for the various components. Samples shall be clearly marked to show the manufacturer's name, product identification, finish and color. New samples shall be resubmitted of each, as required, until approved by the ENGINEER OF RECORD. Upon approval, the samples shall become the standard for acceptance for the project with regard to color, finish, and quality of each item. Approval of samples shall not relieve the CONTRACTOR from compliance with the Contract Documents.

1. Metal Roof Panels

a. Assembled half panels, with representative panel support framing, showing seam, and appurtenances; one-foot long, in color and finish indicated.

b. Three-inches (76 mm) by 4-inch (102 mm) color samples showing substrate, finish, and color.

2. Gutter and downspout: One-foot (.30 m) long section of each in material, profile, finish, and color indicated.

3. Finish trim, closure pieces, and sealant, one-foot long (.30 m) each.

4. Samples of each type fastener required, identified as to use.

1.04 QUALITY ASSURANCE

A. Single Source Responsibility: Pre-engineered metal canopies and components shall be provided by a single manufacturer.

B. Manufacturer Qualifications

1. Pre-engineered metal canopy manufacturer shall be a current member of the Metal Building Manufacturer's Association (MBMA).

2. Pre-engineered metal canopy manufacturer shall have a minimum of 20 years of Pre-engineered metal canopy manufacturing experience.

3. Pre-engineered metal canopy manufacturer shall have a minimum of 5 similar successful projects over the most recent 10 years, employing similar products, materials, applications, and performance requirements.

4. Manufacturers without these qualifications will not be accepted.

C. Installer Qualifications

1. Installer shall have a minimum of 5 years' experience in the successful completion of at least 5 projects of similar size and scope, employing similar products, materials, applications, and performance requirements.

2. Installer shall be trained, certified, and authorized by the manufacturer to install the manufacturer's product.

3. Installers without these qualifications will not be accepted.

1.05 SPECIAL WARRANTY PROVISIONS

A. For pre-engineered metal canopie(s) and appurtenances furnish manufacturer's 5-year written warranty to cover defects in materials, products, and manufacturing workmanship.

B. Installation Warranty: At the time of Substantial Completion, the manufacturer shall warrant that the installation is not defective in and conforms to the manufacturer's erection drawings, except for reasonable variances not impairing the usefulness thereof.

C. Finish Warranty: The manufacturer shall warrant against spalling, fading, chalking, peeling, cracking, checking, chipping, or erosion to base metal of the exterior roof panel finish, for a period of 10 years from the date of Substantial Completion. The finish shall not change color more than eight NBS units for a period of 10 years from the date of Substantial Completion.

D. Weathertight Warranty: Manufacturer shall provide a weathertight warranty against water penetration of the pre-engineered metal canopy system, including panel joints and trim conditions for a period of 20 years from date of Substantial Completion.

E. In the event that the pre-engineered metal canopy fails to meet the warranty standards above, the manufacturer shall, at the manufacturer's sole cost (including labor and materials), replace or repair the pre-engineered metal canopy, as agreeable to the OWNER throughout the term of the warranty.

F. The CONTRACTOR shall furnish separate, but concurrently running, 5-year written warranty to cover installation and associated labor.

G. The term of the warranties shall begin on the date of Substantial Completion, unless otherwise indicated.

PART 2 -- PRODUCTS

2.01 GENERAL

A. Structural Requirements

1. Pre-engineered metal canopies, including structural framing, accessories, related assemblies, components, appurtenances and attachment details shall comply with the CODE and shall be designed and installed for resistance to the structural design criteria indicated in the Contract Documents in accordance with the CODE. Where a conflict occurs between the requirements of this Section and the CODE, the more stringent shall apply.

    a. Refer to the Contract Drawings, Section 13.05.01 – Seismic Design Criteria and Section 13.05.02 Wind Design Criteria of the Special Provisions.

2. The CONTRACTOR shall provide additional non-standard bracing, reinforcements, anchors, and heavier gauge materials in order to conform to the structural design criteria indicated and to other performance requirements indicated.

3. Pre-engineered metal canopie(s) including related assemblies, components, and accessories shall be manufactured and installed to maintain the specified performance requirements, under the structural design criteria indicated, without defects, damage, or failure.

B. Thermal Movements: Pre-engineered metal canopie(s) and accessories shall be designed to provide for such expansion and contraction of component materials as will be caused by temperature changes without causing buckling, stresses or other cladding components, failure of joints, undue stress on structural elements, damaging loads on fasteners, reduction of performance, or other visual or technical detrimental effects.

C. Manufacturer and Product, or Equal

1. Subject to the requirements indicated, provide manufacturer and product listed below, or equal.

a. **Butler Manufacturing Company** - With additional options and custom features as specified herein.

D. Description

1. Pre-engineered metal canopies shall be provided complete, and shall include the structural framing, connections, anchor bolts, framed openings for roof penetrations, metal roofing, gutters and downspouts, pipe flashing, gable trim, flashing, closures, fasteners, sealants, and all other component parts for a complete weathertight, exterior envelope.

a. Dimensions: The dimensions shall be as indicated on the Contract Documents. The minimum clear height to the underside of the roof members at their lowest point (eave height) shall be as indicated on the Contract Documents. The roof slope shall be a minimum of ½ inch per foot and meet code requirements.

b. Structural System

1) The building's structural system shall be a clear span rigid frame system as determined by the manufacturer and in coordination with the Contract Documents.

2) The building’s structural system shall be selected such that it is compatible with the foundation system shown on the Contract Documents.

2.02 MATERIALS

A. Metals

1. Members fabricated from plate or bar stock: provide 42,000-psi minimum yield strength and comply with the requirements of ASTM A529, A1011, or A572.

2. Members fabricated by cold forming: ASTM A 1008, Grade 50.

3. Galvanized Steel Sheet: ASTM A 653 with G90 coating.

4. Bolts for Structural Framing: ASTM F3125.

5. Anchors into concrete: ASTM A307

6. Hot rolled structural shapes: ASTM A36, A570, or A992.

2.03 DESIGN CRITERIA

A. Design Loads

1. Roof live load, Wind load, and Seismic load shall be per the design criteria listed on the Structural General Notes Drawing GS-1.

2. Collateral loads shall include dead and live loads resulting from HVAC, piping, and other items suspended from the roof. This loading shall be coordinated with the drawings of all disciplines and manufacturer's shop drawings.

B. Design Requirements

1. Design roof panels and exterior covering materials for applicable loads and combinations of loads in accordance with the MBMA Metal Building Design Manual.

2. For design of light gage steel members, comply with AISI for design requirements and allowable stresses.

3. Welded connections shall comply with AWS.

4. Design framing to withstand stresses resulting from combinations of loads that produce the maximum allowable stresses in that member as prescribed in MBMA's Metal Building Design Manual.

2.04 FOUNDATION AND FLOOR SLAB

A. The foundation and floor slab shall be reinforced concrete conforming to the requirements of the CODE and shall be provided by the CONTRACTOR.

B. The pre-engineered metal canopy manufacturer shall design the anchorages for the pre-engineered metal canopy and make any recommendations for base plate revision based on actual loading. The CONTRACTOR shall coordinate the anchorage and base plate details with the foundation and pre-engineered metal canopy engineer.

C. The CONTRACTOR shall coordinate the details of anchorages of the pre-engineered metal canopy to its foundation. The CONTRACTOR shall provide the anchor bolts and layout templates and allow for any foundation revisions necessary to adapt or support the pre-engineered metal canopy during construction as accepted by the ENGINEER OF RECORD.

2.05 STRUCTURAL FRAMING

A. Manufacturer and Product, or Equal

1. Subject to the requirements indicated, provide manufacturer and product listed below, or equal.

a. **Butler Manufacturing Company**

B. Description

1. Design of the structural system for the pre-engineered metal canopy shall be clear span rigid frame with tapered columns, tapered roof beams, and gable roof.

2. Primary Framing

a. Rigid Frames

1) Frames shall consist of welded plate section columns and roof beams complete with necessary splice plates for bolted field assembly.

2) Welding shall be performed in accordance with the American Welding Society Code for Building Construction.

3) All base plates, cap plates, compression plates, and stiffener plates shall be factory-welded into place and have the connection holes shop fabricated.

4) All splice plates shall be shop fabricated complete with bolt connection holes.

5) Columns and roof beams shall be fabricated complete with holes in webs and flanges for the attachment of secondary structural members and bracing.

b. All bolts for field assembly of frame members shall be high strength bolts as indicated on erection drawings.

c. Endwall Structurals

1) Endwall frames shall consist of endwall corner posts, endwall roof beams, and endwall posts as required by design criteria.

a) All splice plates and connection clips shall be shop fabricated complete with bolt connection holes.

b) Beams and posts shall be shop fabricated complete with holes for the attachment of secondary structural members.

3. Secondary Structural Members

a. Purlins and Girts

1) Purlins and girts shall be 8-inch (203 mm) or 9-1/2-inch (241 mm) deep "Z" sections, precision roll formed.

2) Outer flange of all purlins and girts shall contain factory-punched holes for panel connections.

b. Eave Struts

1) Eave struts shall be 8-inch (203 mm) or 9-1/2-inch (241 mm) in deep "C" sections.

2) Outer flange of all eave struts shall contain factory-punched holes for panel connections.

c. Bracing

1) Diagonal bracing shall be designed by the canopy manufacturer and attached to columns and roof beams.

2) Flange braces, sag angles, etc., when required, shall be supplied by the building manufacturer.

3) All bracing locations shall be coordinated with ductwork, piping, door openings, and ventilation openings.

4. Structural Painting

a. Structural steel shall be shop prepared, shop primed, and field painted prior to erection. For additional requirements, see Section 09 96 00 - Protective Coating. Primer products shall be compatible with paint system specified in Section 09 96 00– Protective Coating.

1) Primary Frames - Clean all steel per SSPC-SP2. Apply one coat of water reducible alkyd primer by spray or dip method to a minimum coating thickness of 1.0 mil.

2) Secondary Structurals - Clean all steel per SSPC-SP8. Apply one coat of coil applied polyester primer to a minimum coating thickness of 0.5 mil (purlins and grits).

2.06 METAL ROOF PANELS

A. Manufacturer and Product, or Equal

1. Subject to the requirements indicated, provide manufacturer and product listed below, or equal.

a. **Butler Manufacturing Company**; MR-24

B. Description

1. Panels shall be roll formed to provide a width coverage of 24-inches (610 mm).

a. There shall be two major corrugations, 2-inches (51 mm), spaced 24-inches (610 mm) on center.

b. There shall be minor corrugations, spaced 6-inches (152 mm) on center between and perpendicular to the major corrugations.

2. The panel endlaps shall be 6-inches (152 mm).

a. Panels shall be of maximum length so as to minimize panel endlaps.

b. Endlaps shall be engineered to occur over and be fastened to a secondary structural member.

c. The upper end of all panels shall be marked for the proper location of endlap sealant.

3. Ridge assembly shall be designed to allow for expansion and contraction.

4. Eave panels shall extend beyond the building structural line.

5. Panels shall be factory pre-punched at panel ends to match pre-punched holes in the eave structural members. Panel end splices shall be factory pre-punched and pre-notched. Panel end splices shall allow for expansion and contraction of the panels.

6. Panel Material

a. Panel material shall be 24-gauge galvanized steel (80,000 psi yield) G90 coating conforming to ASTM Galvanized Specification A-525.

2.07 ROOF PANEL FINISH AND COLOR

A. Finish: Exterior panel surface shall be **Butler-Cote 500 FP** (70% Kynar 500 fluoropolymer), or equal.

1. Interior surface finish shall be manufacturer's standard polyester paint finish on reverse face.

B. Color shall be selected and approved by the OWNER from manufacturer's full color range including custom colors, and may be required to exactly match other building components, as determined by the OWNER, at no additional cost to the OWNER.

1. Tentative color selection: Color shall exactly match colors indicated below, as selected and approved by the OWNER.

Metal Roof Panels	
Exterior:	As Selected From Manufacturer’s Standard Colors
Interior:	As Selected From Manufacturer’s Standard Colors

2. The OWNER reserves the option of changing this tentative color selection during the submittal process.

3. Color shall be uniform with no variation in shade, and panels of different color batches will not be acceptable.

2.08 BUILDING ACCESSORIES

A. Accessories

1. Accessories shall be manufacturer's standard unless otherwise indicated. Location of standard accessories shall be indicated on the erection drawings.

    a. All miscellaneous trim and accessories shall match adjacent panels.

    b. Skylights shall be insulated lite panels as compatible with MR-24 roof panel systems.

        1) Lite panels shall be translucent cool white, fiberglass reinforced, insulated, plastic panel. The panel shall provide diffused natural light and maintain a weathertight roof system.

        2) Provide number of skylights in locations as shown on the drawings.

        3) Panels shall be nominal 2-feet 0 inches (61 cm) wide by 10-foot 6 inches (3.2 m) long.

        4) Load capacity shall equal or exceed that of roof panels.

        5) Interior and exterior faces of insulated panel shall be factory assembled and sealed, forming a 1-inch (25 mm) dead air space.

    c. Gutters, downspouts, and trim pieces shall be provided by the manufacturer.

    d. Trim materials shall be:

        1) Outside corner trim shall be of the same material and finish as the exterior of wall panel.

        2) Gutters, downspouts, eave trim and gable trim shall be prepainted galvanized steel.

B. Roof Fasteners

1. Insulation, bearing plates, and panel clips shall be fastened to structural members with fasteners as per manufacturer's erection drawings, using factory pre-punched holes in structural members.

2. All connections of panels to structural members except at eave shall be by clips with moveable tabs that are seamed into the standing seam sidelap.

3. Panel clips shall be fastened to structural members with fasteners as per manufacturer's erection drawing, using factory pre-punched holes in structural members.

C. Sealants

1. Factory applied side lap sealant shall be a one part, non-skinning, non-drying, synthetic butyl elastomer.

2. Field applied hidden sealant at side laps, end laps, and flashing details shall be gun grade non-skinning butyl elastomer or polymeric non-skinning butyl tape to ensure weather tightness.

3. Exposed sealant shall be as one-part moisture curing, gun grade polyurethane as recommended in writing by the Manufacturer. Color shall match adjacent panels as approved by ENGINEER OF RECORD. Provide custom color as required.

D. Flashing

1. Preformed metal closures, trim pieces, flashings, sheets, clips, and associated appurtenances shall be as indicated or as otherwise required for weather tightness or completeness, and shall be of the same material, color, and finish as the adjacent panels, unless otherwise indicated.

   a. The minimum face dimensions between flashing breaks shall be 12-inches (305 mm). Thermal expansion of exposed items more than 24-feet (7.3 m) in continuous length shall be accommodated and watertight expansion joints shall be provided at approved locations.

   b. Expansion joints shall be fabricated as approved of materials to match the flashing.

   c. Flashing and trim shall be minimum 20-gauge, formed, extruded metal fabricated with the same finish and color as the exterior face of the adjacent panels, unless otherwise indicated.

   d. WORK shall be coordinated as required to insure proper flashing and seals to adjoining construction.

   e. Flashing shall be provided for penetrations. Provide penetration enclosures, including hot pipe penetrations, to be weathertight. Coordinate locations of protruding pipes.

PART 3 -- EXECUTION

3.01 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Site in manufacturer's original, unopened packages, containers, or bundles with labels intact, which clearly identify contents.

1. Materials shall be delivered to Site in a dry and undamaged condition and unloaded per the manufacturer's instructions. The installer shall inspect materials for damage and stains upon arrival to the Site.

B. Store materials carefully in accordance with the manufacturer's written instructions, in an area that is protected from deleterious elements, and in a manner that will prevent damage to the products.

C. Verify that foundation, floor slab, mechanical and electrical utilities, and placed anchors are in correct position.

3.02 PRODUCT CONDITIONS

A. Comply with manufacturer's written instructions for environmental conditions before, during and after installation.

B. Protect surrounds WORK from damage that may result from operations under this Section.

3.03 INSPECTION

A. The CONTRACTOR shall be totally responsible for the proper performance and completion of the WORK under this Section.

B. The CONTRACTOR shall inspect materials for damage and shall confirm conformance with the specifications, erection drawings, and shop drawings prior to installation.

C. Systems and components shall be inspected before installation.

1. Damaged or defective items shall be rejected and marked as such and shall be removed from the Site.

2. Exposed surfaces that exhibit pitting, seam marks, roller marks, stains, discoloration, or other surface imperfections on the finished units shall be rejected.

D. The CONTRACTOR shall verify dimensions, tolerances, and method of attachment with adjacent WORK.

1. Examine substrates, areas, and conditions where metal roof and soffit panels, system support framing, and appurtenances will be installed for compliances with the requirements for installation, taking into account tolerances, and other conditions affecting performances of installed metal panels and appurtenances.

   a. Provide inserts, backing blocking, anchoring devices, and reinforcements that must be built into other WORK for the installation of metal roof and soffit panels, system support framing, and appurtenances. Coordinate delivery with other WORK to avoid delay.

   b. Prior to installing the pre-engineered metal canopy the CONTRACTOR and the pre-engineered metal canopy installer shall verify final alignment of the foundation, floor slab, mechanical and electrical utilities to be in compliance with these specifications with the Contract Documents, with the erection drawings, and with the shop drawings.

2. Notify the CONSTRUCTION MANAGER in writing of conditions detrimental to the proper and timely completion of the WORK. Do not proceed with the WORK until satisfactory conditions have been corrected in an acceptable manner.

3. Commencement of the installation by the CONTRACTOR shall indicate CONTRACTOR's acceptance of the substrate, areas, and conditions.

3.04 FABRICATION

A. The canopy shall be factory fabricated and erected to the manufacturer's written standards and shall be in accordance with AISC and MBMA standards.

B. The prefabricated canopy shall be completely fabricated and prepared for shipment including any necessary crating or bundling. All parts of the canopy shall be accurately made and true to dimension so that all parts will easily fit during installation.

3.05 PREPARATION

A. Sequence installation properly with the installation and protection of other WORK, so that neither will be damaged by the installation of the other.

3.06 INSTALLATION

A. General

1. Installation shall comply with the requirements of the Contract Documents, with applicable references, with AISC, AISI, MBMA, with the requirements of the CODE, and with manufacturer's written instructions. Where a conflict occurs among these requirements, the more stringent shall apply, as directed by the CONSTRUCTION MANAGER.

2. The CONTRACTOR shall provide corrosion resistant fasteners, anchors, and shims required for a complete installation, and shall be secure, plumb, level, straight, and true to line, allowing for required movement, including expansion and contraction.

3. The CONTRACTOR shall provide separation of dissimilar materials to ensure no galvanic action occurs.

4. Horizontal lines shall be level, and vertical lines shall be plumb.

5. WORK shall be coordinated as required to insure proper flashing and seals to adjoining construction.

B. Installation and Erection: Installation and erection of the canopy shall be in accordance with the manufacturer's standards and shall be workmanship of the highest quality. No field cutting of structural parts will be permitted. Field cutting and patching of roof panels and accessories will not be permitted unless authorized by the CONSTRUCTION MANAGER. Such field modifications, when authorized, shall be performed in a manner which will not impair the appearance, weather tightness, or structural quality of the material. Erection shall be accomplished in sufficient time to meet the schedule specified.

3.07 ROOF PANELS

A. General: Apply panels and associated items for neat and weather tight enclosure. Avoid "panel creep" or application not true to line. Protect factory finishes from damage.

1. Flash and seal roof panels at eave and rake with rubber, neoprene or other closures to exclude weather.

B. Roof Panel Application

1. Panels shall be factory cut-to-length according to the erection drawings as furnished by the manufacturer.

2. Panels shall be positioned and aligned to hold the 24-inch (610 mm) module throughout the building length.

3. Pre-punched panels shall be positioned and aligned by matching the pre-punched holes in the panel with the pre-punched roof structural.

4. Panel sidelaps shall be field seamed; all sidelap sealant shall be factory applied.

5. Endlaps will be at least 6-inches (152 mm) and fastened together over and to structural members.

6. Panel sidelaps and endlaps shall be sealed with weather sealing compound to prevent the entry of capillary moisture.

7. Fasteners shall be installed with proper tools, in a workmanlike manner according to the recommendations of the Manufacturer.

3.08 CLEANING, FINISHING, AND PROTECTION

A. Adhesive papers used for masking which become firmly bonded when exposed to heat and/or light shall not be used.

1. Remove masking film and temporary labels as soon as possible after installation. Films and labels left in place after installation shall be the responsibility of the CONTRACTOR.

2. Residue shall not be left on any surfaces.

B. Upon completion of the installation of pre-engineered metal canopy and appurtenances shall be cleaned of dirt and other foreign matter to the satisfaction of the CONSTRUCTION MANAGER.

C. Cleaning shall be performed again immediately prior to acceptance of the WORK, as determined by the CONSTRUCTION MANAGER.

1. Cleaning shall be performed in accordance with the manufacturer's written instructions.

2. Pre-engineered metal canopy shall be protected from damage from subsequent construction operations.

D. The CONTRACTOR shall make adjustments required until accepted.

E. The CONTRACTOR shall remove scratches and blemishes to the satisfaction of the CONSTRUCTION MANAGER.

F. Damaged or defective items shall be removed and replaced at the direction of the CONSTRUCTION MANAGER.

G. When pre-engineered metal canopy WORK is completed, remove unused materials, containers, and equipment, and clean the Site of debris.

END OF SECTION

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SECTION 22 33 00

ELECTRIC, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Thermostat-control, electric, tankless, domestic-water heaters.

2. Domestic-water heater accessories.

1.02 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Commercial domestic-water heaters shall withstand the effects of earthquake motions determined according to **ASCE/SEI 7**.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified.

1.03 ACTION SUBMITTALS

A. Product Data: For each type and size of domestic-water heater indicated.

B. LEED Submittals:

1. Product Data for Prerequisite EA 2: Documentation indicating that units comply with applicable requirements in ASHRAE/IESNA 90.1, Section 7, "Service Water Heating."

C. Shop Drawings:

1. Wiring Diagrams: For power, signal, and control wiring.

1.04 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For commercial domestic-water heaters, accessories, and components, from manufacturer.

B. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.

C. Source quality-control reports.

D. Field quality-control reports.

E. Warranty: Sample of special warranty.

1.05 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.06 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

C. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 Annex, "Drinking Water System Components - Health Effects."

1.07 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric, domestic-water heaters that fail in materials or workmanship within specified warranty period.

1. Warranty Periods: From date of Substantial Completion.

a. Electric, Tankless, Domestic-Water Heaters: **Five** year(s).

PART 2 - PRODUCTS

2.01 ELECTRIC, TANKLESS, DOMESTIC-WATER HEATERS

A. Thermostat-Control, Electric, Tankless, Domestic-Water Heaters:

1. EEMAX or equal

2. Standard: UL 499 for electric, tankless, (domestic-water heater) heating appliance.

3. Construction: Copper piping or tubing complying with NSF 61 Annex barrier materials for potable water, without storage capacity.

a. Connections: ASME B1.20.1 pipe thread.

b. Pressure Rating: 150 psig (1035 kPa).
c. Heating Element: Resistance heating system.

d. Temperature Control: Thermostat.

e. Safety Control: High-temperature-limit cutoff device or system.

f. Jacket: Aluminum or steel with enameled finish or plastic.

4. Support: Bracket for wall mounting.

5. Capacity and Characteristics:

a. Flow Rate: 0.5 gpm (L/s) at 28 deg F (56 deg C)] temperature rise.

b. Temperature Setting: 125 deg F (52 deg C)

2.02 DOMESTIC-WATER HEATER ACCESSORIES

A. Drain Pans: Corrosion-resistant metal with raised edge. Comply with ANSI/CSA LC 3. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than NPS 3/4 (DN 20) with ASME B1.20.1 pipe threads or with ASME B1.20.7 garden-hose threads.

B. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1

C. Heat-Trap Fittings: ASHRAE 90.2.

D. Pressure-Reducing Valves: ASSE 1003 for water. Set at 25-psig- (172.5-kPa-) maximum outlet pressure unless otherwise indicated.

E. Combination Temperature-and-Pressure Relief Valves: ASME rated and stamped. Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.

F. Pressure Relief Valves: ASME rated and stamped. Include pressure setting less than domestic-water heater working-pressure rating.

G. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4.

H. Shock Absorbers: ASSE 1010 or PDI-WH 201, Size A water hammer arrester.

I. Domestic-Water Heater Stands: Manufacturer's factory-fabricated steel stand for floor mounting, capable of supporting domestic-water heater and water. Include dimension that will support bottom of domestic-water heater a minimum of 18 inches (457 mm) above the floor.

J. Domestic-Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting domestic-water heater and water.

2.03 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect domestic-water heaters specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.

B. Hydrostatically testdomestic-water heaters to minimum of one and one-half times pressure rating before shipment.

C. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.01 DOMESTIC-WATER HEATER INSTALLATION

A. Electric, Tankless, Domestic-Water Heater Mounting: Install electric, tankless, domestic-water heaters **at least 18 inches (457 mm) above floor** on wall bracket.

1. Maintain manufacturer's recommended clearances.

2. Arrange units so controls and devices that require servicing are accessible.

3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

4. Install anchor bolts to elevations required for proper attachment to supported equipment.

5. Anchor domestic-water heaters to substrate.

B. Install electric, domestic-water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping,"

C. Install commercial, electric, domestic-water heaters with seismic-restraint devices. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

D. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend

commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

E. Install pressure relief valves in water piping for electric, domestic-water heaters without storage. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

F. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for electric, domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 221119 "Domestic Water Piping Specialties."

G. Install thermometers on outlet piping of electric, domestic-water heaters. Comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."

H. Install pressure-reducing valve with integral bypass relief valve in electric, domestic-water booster-heater inlet piping and water hammer arrester in booster-heater outlet piping. Set pressure-reducing valve for outlet pressure of 25 psig (172 kPa). Comply with requirements for pressure-reducing valves and water hammer arresters specified in Section 221119 "Domestic Water Piping Specialties."

I. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps.

J. Fill electric, domestic-water heaters with water.

K. Charge domestic-water compression tanks with air.

3.02 CONNECTIONS

A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.03 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.04 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.

4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.

C. Prepare test and inspection reports.

END OF SECTION

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Balancing Air Systems:
    a. Constant-volume air systems.
2. Balancing steam systems.
3. Testing, Adjusting, and Balancing Equipment:
    a. Motors.
4. Sound tests.
5. Vibration tests.
6. Duct leakage tests.
7. Control system verification.

1.03 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. BAS: Building automation systems.

C. NEBB: National Environmental Balancing Bureau.

D. TAB: Testing, adjusting, and balancing.

E. TABB: Testing, Adjusting, and Balancing Bureau.

F. TAB Specialist: An independent entity meeting qualifications to perform TAB work.

G. TDH: Total dynamic head.

1.04 PREINSTALLATION MEETINGS

A. TAB Conference: If requested by the Owner, conduct a TAB conference after approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Provide a minimum of 14 days' advance notice of scheduled meeting time and location.

1. Minimum Agenda Items:

a. The Contract Documents examination report.

b. The TAB plan.

c. Needs for coordination and cooperation of trades and subcontractors.

d. Proposed procedures for documentation and communication flow.

1.05 ACTION SUBMITTALS

A. LEED Submittals:

1. Air-Balance Report for Prerequisite IEQ 1: Documentation indicating that work complies with ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
2. TAB Report for Prerequisite EA 2: Documentation indicating that work complies with ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

1.06 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.

C. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

D. System Readiness Checklists: Within 30 days of Contractor's Notice to Proceed, submit system readiness checklists as specified in "Preparation" Article.

E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.

F. Certified TAB reports.

G. Sample report forms.

H. Instrument calibration reports, to include the following:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.07 QUALITY ASSURANCE

A. TAB Specialists Qualifications: Certified by AABC.

1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC.
2. TAB Technician: Employee of the TAB specialist and certified by AABC as a TAB technician.

B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

1.08 FIELD CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.

B. Examine installed systems for balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual

volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine equipment performance data including fan and pump curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

F. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

G. Examine test reports specified in individual system and equipment Sections.

H. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.

I. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.02 PREPARATION

A. Prepare a TAB plan that includes the following:

1. Equipment and systems to be tested.
2. Strategies and step-by-step procedures for balancing the systems.
3. Instrumentation to be used.
4. Sample forms with specific identification for all equipment.

B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:

1. Airside:

a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.

b. Duct systems are complete with terminals installed.

c. Volume, smoke, and fire dampers are open and functional.

d. Clean filters are installed.

e. Fans are operating, free of vibration, and rotating in correct direction.

f. Variable-frequency controllers' startup is complete and safeties are verified.

g. Automatic temperature-control systems are operational.

h. Ceilings are installed.

i. Windows and doors are installed.

j. Suitable access to balancing devices and equipment is provided.

3.03 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in **SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing** and in this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.

2. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 233300 "Air Duct Accessories."

3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713 "Duct Insulation," Section 230716 "HVAC Equipment Insulation," and Section 230719 "HVAC Piping Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in **inch-pound (IP)** units.

3.04 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross-check the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling-unit components.

L. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."

3.05 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.

c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.

d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.

2. Measure fan static pressures as follows:

   a. Measure static pressure directly at the fan outlet or through the flexible connection.

   b. Measure static pressure directly at the fan inlet or through the flexible connection.

   c. Measure static pressure across each component that makes up the air-handling system.

   d. Report artificial loading of filters at the time static pressures are measured.

3. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.

4. Obtain approval from **Owner**for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.

5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.

1. Measure airflow of submain and branch ducts.

2. Adjust submain and branch duct volume dampers for specified airflow.

3. Re-measure each submain and branch duct after all have been adjusted.

C. Adjust air inlets and outlets for each space to indicated airflows.

1. Set airflow patterns of adjustable outlets for proper distribution without drafts.

2. Measure inlets and outlets airflow.

3. Adjust each inlet and outlet for specified airflow.

4. Re-measure each inlet and outlet after they have been adjusted.

D. Verify final system conditions.

1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.

2. Re-measure and confirm that total airflow is within design.

3. Re-measure all final fan operating data, rpms, volts, amps, and static profile.

4. Mark all final settings.

5. Test system in economizer mode. Verify proper operation and adjust if necessary.

6. Measure and record all operating data.

7. Record final fan-performance data.

3.06 VIBRATION TESTS

A. After systems are balanced and construction is Substantially Complete, measure and record vibration levels on equipment having motor horsepower equal to or greater than **10**.

B. Instrumentation:

1. Use portable, battery-operated, and microprocessor-controlled vibration meter with or without a built-in printer.

2. The meter shall automatically identify engineering units, filter bandwidth, amplitude, and frequency scale values.

3. The meter shall be able to measure machine vibration displacement in mils of deflection, velocity in inches per second, and acceleration in inches per second squared.

4. Verify calibration date is current for vibration meter before taking readings.

C. Test Procedures:

1. To ensure accurate readings, verify that accelerometer has a clean, flat surface and is mounted properly.
2. With the unit running, set up vibration meter in a safe, secure location. Connect transducer to meter with proper cables. Hold magnetic tip of transducer on top of the bearing, and measure unit in mils of deflection. Record measurement, then move transducer to the side of the bearing and record in mils of deflection. Record an axial reading in mils of deflection by holding nonmagnetic, pointed transducer tip on end of shaft.

3. Change vibration meter to velocity (inches per second) measurements. Repeat and record above measurements.

4. Record CPM or rpm.

5. Read each bearing on motor, fan, and pump as required. Track and record vibration levels from rotating component through casing to base.

D. Reporting:

1. Report shall record location and the system tested.

2. Include horizontal-vertical-axial measurements for tests.

3. Verify that vibration limits follow Specifications, or, if not specified, follow the General Machinery Vibration Severity Chart or Vibration Acceleration General Severity Chart from the AABC National Standards. Acceptable levels of vibration are normally "smooth" to "good."

4. Include in report General Machinery Vibration Severity Chart, with conditions plotted.

3.07 DUCT LEAKAGE TESTS

A. Witness the duct pressure testing performed by Installer.

B. Verify that proper test methods are used and that leakage rates are within specified tolerances.

C. Report deficiencies observed.

3.08 CONTROLS VERIFICATION

A. In conjunction with system balancing, perform the following:

1. Verify temperature control system is operating within the design limitations.

2. Confirm that the sequences of operation are in compliance with Contract Documents.

3. Verify that controllers are calibrated and function as intended.

4. Verify that controller set points are as indicated.

5. Verify the operation of lockout or interlock systems.

6. Verify the operation of valve and damper actuators.

7. Verify that controlled devices are properly installed and connected to correct controller.

8. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.

9. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.

B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions.

3.09 TOLERANCES

A. Set HVAC system's airflow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: **Plus or minus 10 percent**.

2. Air Outlets and Inlets: **Plus or minus 10 percent**

B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.10 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.

2. Include a list of instruments used for procedures, along with proof of calibration.

3. Certify validity and accuracy of field data.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Pump curves.

2. Fan curves.

3. Manufacturers' test data.

4. Field test reports prepared by system and equipment installers.

5. Other information relative to equipment performance; do not include Shop Drawings and Product Data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.

2. Name and address of the TAB specialist.

3. Project name.

4. Project location.

5. Architect's name and address.

6. Engineer's name and address.

7. Contractor's name and address.

8. Report date.

9. Signature of TAB supervisor who certifies the report.

10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.

11. Summary of contents including the following:

    a. Indicated versus final performance.

    b. Notable characteristics of systems.

    c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.

13. Data for terminal units, including manufacturer's name, type, size, and fittings.

14. Notes to explain why certain final data in the body of reports vary from indicated values.

15. Test conditions for fans and pump performance forms including the following:

    a. Settings for outdoor-, return-, and exhaust-air dampers.

    b. Conditions of filters.

    c. Cooling coil, wet- and dry-bulb conditions.

    d. Face and bypass damper settings at coils.

    e. Fan drive settings including settings and percentage of maximum pitch diameter.

    f. Inlet vane settings for variable-air-volume systems.

    g. Settings for supply-air, static-pressure controller.

    h. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows.

2. Water and steam flow rates.

3. Duct, outlet, and inlet sizes.

4. Pipe and valve sizes and locations.

5. Terminal units.

6. Balancing stations.

7. Position of balancing devices.

E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data:

a. Unit identification.

b. Location.

c. Make and type.

d. Model number and unit size.

e. Manufacturer's serial number.

f. Unit arrangement and class.

g. Discharge arrangement.

h. Sheave make, size in inches (mm), and bore.

i. Center-to-center dimensions of sheave and amount of adjustments in inches (mm).

j. Number, make, and size of belts.

k. Number, type, and size of filters.

2. Motor Data:

a. Motor make, and frame type and size.

b. Horsepower and rpm.

c. Volts, phase, and hertz.

d. Full-load amperage and service factor.

e. Sheave make, size in inches (mm), and bore.

f. Center-to-center dimensions of sheave and amount of adjustments in inches (mm).

3. Test Data (Indicated and Actual Values):

    a. Total airflow rate in cfm (L/s).

    b. Total system static pressure in inches wg (Pa).

    c. Fan rpm.

    d. Discharge static pressure in inches wg (Pa).

    e. Filter static-pressure differential in inches wg (Pa).

    f. Preheat-coil static-pressure differential in inches wg (Pa).

    g. Cooling-coil static-pressure differential in inches wg (Pa).

    h. Heating-coil static-pressure differential in inches wg (Pa).

    i. Outdoor airflow in cfm (L/s).

    j. Return airflow in cfm (L/s).

    k. Outdoor-air damper position.

    l. Return-air damper position.

    m. Vortex damper position.

F. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:

    a. System and air-handling-unit number.

    b. Location and zone.

    c. Traverse air temperature in deg F (deg C).

    d. Duct static pressure in inches wg (Pa).

    e. Duct size in inches (mm).

    f. Duct area in sq. ft. (sq. m).

    g. Indicated airflow rate in cfm (L/s).

    h. Indicated velocity in fpm (m/s).

    i. Actual airflow rate in cfm (L/s).

j. Actual average velocity in fpm (m/s).

k. Barometric pressure in psig (Pa).

G. Air-Terminal-Device Reports:

1. Unit Data:

a. System and air-handling unit identification.

b. Location and zone.

c. Apparatus used for test.

d. Area served.

e. Make.

f. Number from system diagram.

g. Type and model number.

h. Size.

i. Effective area in sq. ft. (sq. m).

2. Test Data (Indicated and Actual Values):

a. Airflow rate in cfm (L/s).

b. Air velocity in fpm (m/s).

c. Preliminary airflow rate as needed in cfm (L/s).

d. Preliminary velocity as needed in fpm (m/s).

e. Final airflow rate in cfm (L/s).

f. Final velocity in fpm (m/s).

g. Space temperature in deg F (deg C).

H. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.

b. Serial number.

c. Application.

d. Dates of use.

e. Dates of calibration.

3.11 VERIFICATION OF TAB REPORT

A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of **commissioning authority**.

B. **Commissioning authority** shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.

C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."

D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

E. If TAB work fails, proceed as follows:

1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
2. If the second final inspection also fails, Owner may contract the services of another TAB specialist to complete TAB work according to the Contract Documents and deduct the cost of the services from the original TAB specialist's final payment.

3. If the second verification also fails, **design professional** may contact AABC Headquarters regarding the AABC National Performance Guaranty.

F. Prepare test and inspection reports.

3.12 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION

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SECTION 23 31 13

METAL DUCTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Special Provisions Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Sheet metal materials.
3. Duct liner.
4. Sealants and gaskets.
5. Hangers and supports.
6. Seismic-restraint devices.

B. Related Sections:

1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section 233119 "HVAC Casings" for factory- and field-fabricated casings for mechanical equipment.
3. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.03 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"

1. Seismic Hazard Level A: Seismic force to weight ratio, 0.48.

2. Seismic Hazard Level B: Seismic force to weight ratio, 0.30.

3. Seismic Hazard Level C: Seismic force to weight ratio, 0.15.

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of the following products:

1. Liners and adhesives.

2. Sealants and gaskets.

3. Seismic-restraint devices.

B. LEED Submittals:

1. Product Data for Prerequisite IEQ 1: Documentation indicating that duct systems comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."

2. Product Data for Prerequisite EA 2: Documentation indicating that duct systems comply with ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."
3. Leakage Test Report for Prerequisite EA 2: Documentation of work performed for compliance with ASHRAE/IESNA 90.1, Section 6.4.4.2.2 - "Duct Leakage Tests."
4. Duct-Cleaning Test Report for Prerequisite IEQ 1: Documentation of work performed for compliance with ASHRAE 62.1, Section 7.2.4 - "Ventilation System Start-up."
5. Product Data for Credit IEQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content.
6. Laboratory Test Reports for Credit IEQ 4: For adhesives and sealants, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.

2. Factory- and shop-fabricated ducts and fittings.

3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.

4. Elevation of top of ducts.

5. Dimensions of main duct runs from building grid lines.

6. Fittings.
7. Reinforcement and spacing.

8. Seam and joint construction.

9. Penetrations through fire-rated and other partitions.

10. Equipment installation based on equipment being used on Project.

11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.

12. Hangers and supports, including methods for duct and building attachment vibration isolation.

D. Delegated-Design Submittal:

1. Sheet metal thicknesses.

2. Joint and seam construction and sealing.

3. Reinforcement details and spacing.

4. Materials, fabrication, assembly, and spacing of hangers and supports.
5. Design Calculations: Calculations for selecting hangers and supports

1.05 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.

2. Suspended ceiling components.

3. Structural members to which duct will be attached.

4. Size and location of initial access modules for acoustical tile.

5. Penetrations of smoke barriers and fire-rated construction.

6. Items penetrating finished ceiling including the following:

   a. Lighting fixtures.

   b. Air outlets and inlets.

   c. Speakers.

   d. Sprinklers.

   e. Access panels.

   f. Perimeter moldings.

B. Welding certificates.

C. Field quality-control reports.

1.06 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.

2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.

3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.01 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements,

materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

E. Inner Duct: Minimum 0.028-inch (0.7-mm)

2.02 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: [G60 (Z180)] [G90 (Z275)].

2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. PVC-Coated, Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: [G60 (Z180)] [G90 (Z275)].
2. Minimum Thickness for Factory-Applied PVC Coating: 4 mils (0.10 mm) thick[on sheet metal surface of ducts and fittings exposed to corrosive conditions, and minimum 1 mil (0.025 mm) thick on opposite surface].

3. Coating Materials: Acceptable to authorities having jurisdiction for use on ducts listed and labeled by an NRTL for compliance with UL 181, Class 1.

D. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.

E. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.

F. Aluminum Sheets: Comply with ASTM B 209 (ASTM B 209M) Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

G. Factory- or Shop-Applied Antimicrobial Coating:

1. Apply to the surface of sheet metal that will form the interior surface of the duct. An untreated clear coating shall be applied to the exterior surface.

2. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.

3. Coating containing the antimicrobial compound shall have a hardness of 2H, minimum, when tested according to ASTM D 3363.

4. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

5. Shop-Applied Coating Color: Black

6. Antimicrobial coating on sheet metal is not required for duct containing liner treated with antimicrobial coating.

H. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

I. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.03 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.

2. Tape Width: 3 inches (76 mm)

3. Sealant: Modified styrene acrylic.

4. Water resistant.

5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.

7. Service: Indoor and outdoor.

8. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).

9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
10. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
11. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.

2. Solids Content: Minimum 65 percent.

3. Shore A Hardness: Minimum 20.

4. Water resistant.

5. Mold and mildew resistant.

6. VOC: Maximum 75 g/L (less water).

7. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.

8. Service: Indoor or outdoor.

9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Solvent-Based Joint and Seam Sealant:

1. Application Method: Brush on.

2. Base: Synthetic rubber resin.

3. Solvent: Toluene and heptane.

4. Solids Content: Minimum 60 percent.

5. Shore A Hardness: Minimum 60.

6. Water resistant.

7. Mold and mildew resistant.
8. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

9. VOC: Maximum 395 g/L.
10. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

11. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive or negative.

12. Service: Indoor or outdoor.

13. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

E. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.

2. Type: S.

3. Grade: NS.

4. Class: 25.

5. Use: O.
6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

G. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg (0.14 L/s per sq. m at 250 Pa) and shall be rated for 10-inch wg (2500-Pa) static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.

3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.04 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

H. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.

3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

2.05 SEISMIC-RESTRAINT DEVICES

A. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

B. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.

C. Restraint Cables: ASTM A 603, galvanized cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for

restraining cable service; and with an automatic-locking and clamping device or double-cable clips.

D. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections hanger rod.

E. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.01 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install ducts with fewest possible joints.

D. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

E. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

G. Install ducts with a clearance of 1 inch (25 mm), plus allowance for insulation thickness.

H. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

I. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches (38 mm).

J. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers.

K. Protect duct interiors from moisture, construction debris and dust, and other foreign materials.[Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."]

3.02 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.03 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":

1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2. Outdoor, Supply-Air Ducts: Seal Class A.

3. Outdoor, Exhaust Ducts: Seal Class C.

4. Outdoor, Return-Air Ducts: Seal Class C.

5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg (500 Pa) and Lower: Seal Class B.

6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg (500 Pa): Seal Class A.

7. Unconditioned Space, Exhaust Ducts: Seal Class C.

8. Unconditioned Space, Return-Air Ducts: Seal Class B.

9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg (500 Pa) and Lower: Seal Class C.

10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg (500 Pa): Seal Class B.

11. Conditioned Space, Exhaust Ducts: Seal Class B.

12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.04 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.

2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.

3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches (100 mm) thick.

4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches (610 mm) of each elbow and within 48 inches (1200 mm) of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet (5 m).

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.05 SEISMIC-RESTRAINT-DEVICE INSTALLATION

A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with [SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."] [ASCE/SEI 7.]

1. Space lateral supports a maximum of 40 feet (12 m)o.c., and longitudinal supports a maximum of 80 feet (24 m) o.c.

2. Brace a change of direction longer than 12 feet (3.7 m).

B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install cable restraints on ducts that are suspended with vibration isolators.

E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction.

F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.

G. Drilling for and Setting Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.

2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.

4. Set anchors to manufacturer's recommended torque, using a torque wrench.

5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.06 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.07 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

3.08 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:

1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.

2. Test the following systems:

   a. Ducts with a Pressure Class Higher Than 3-Inch wg (750 Pa): Test representative duct sections totaling no less than 25 percent of total installed duct area for each designated pressure class.
   b. Exhaust Ducts with a Pressure Class of 2-Inch wg (500 Pa) or Higher: Test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure class.

3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.

4. Test for leaks before applying external insulation.

5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.

6. Give seven days' advance notice for testing.

C. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present.

2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."

a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.09 DUCT CLEANING

A. Clean new duct system(s) before testing, adjusting, and balancing.

B. Use service openings for entry and inspection.

1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 233300 "Air Duct Accessories" for access panels and doors.

2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.

3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.

2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

D. Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).

2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.

3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.

4. Coils and related components.

5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.

6. Supply-air ducts, dampers, actuators, and turning vanes.

7. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.

2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.

3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.

4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.

5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.

6. Provide drainage and cleanup for wash-down procedures.

7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.10 START UP

A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.11 DUCT SCHEDULE

A. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:

a. Pressure Class: Negative 2-inch wg (500 Pa)
b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.

c. SMACNA Leakage Class for Rectangular: 12

B. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

    a. Velocity 1000 fpm (5 m/s) or Lower:

        1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.

        2) Mitered Type RE 4 without vanes.

    b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s):

        1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.

        2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.

        3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

    c. Velocity 1500 fpm (7.6 m/s) or Higher:

        1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.

        2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.

        3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

    a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.

    b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.

    c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

C. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."

    a. Rectangular Main to Rectangular Branch: 45-degree entry.

b. Rectangular Main to Round Branch: Spin in.

END OF SECTION

SECTION 23 33 00

AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Manual volume dampers.

2. Flange connectors.

3. Turning vanes.

4. Flexible connectors.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.

B. LEED Submittals:

1. Product Data for Prerequisite IEQ 1: Documentation indicating that units comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."

2. Product Data for Prerequisite EA 2: Documentation indicating that duct insulation R-values comply with tables in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air Conditioning."

C. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:

a. Special fittings.

b. Manual volume damper installations.

c. Combination fire- and smoke-damper, and duct-mounted access doors.
d. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.

B. Source quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fusible Links: Furnish quantity equal to **10** percent of amount installed.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2 MATERIALS

A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: [G60 (Z180)] [G90 (Z275)].

2. Exposed-Surface Finish: Mill phosphatized.

B. Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

C. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.3 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

1. Standard leakage rating with linkage outside airstream.

2. Suitable for horizontal or vertical applications.

3. Frames:

   a. Frame: Hat-shaped, 0.094-inch- (2.4-mm-) thick, galvanized sheet steel

   b. Mitered and welded corners.

   c. Flanges for attaching to walls and flangeless frames for installing in ducts.

4. Blades:

   a. Multiple or single blade.

   b. Parallel- or opposed-blade design.

   c. Stiffen damper blades for stability.

   d. Galvanized steel, 0.064 inch (1.62 mm) thick.

5. Blade Axles: Galvanized steel

6. Bearings

7. Tie Bars and Brackets: Galvanized steel.

B. The damper motor shall be specifically listed and approved as fire/smoke damper actuator for the damper to which it is applied. Field installed actuators are not acceptable.

2.4 TURNING VANES

A. Both dimensions less than 48 inches: single vane or approved double thickness airfoil vanes.

B. Either dimension greater than 48 inches: double thickness airfoil vanes of approved pattern.

C. Rectangular smooth radius elbows: provide multiple splitter vanes.

2.5 FLEXIBLE CONNECTORS

A. Materials: 16oz airtight ventglass noncombustible fabric with fire retardant neoprene coating.

B. Attach to ductwork by lock seam.

C. Install not more than 6 inches long.

D. Provide where required or indicated.

2.6 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

1. Install steel volume dampers in steel ducts.

2. Install aluminum volume dampers in aluminum ducts.

D. Set dampers to fully open position before testing, adjusting, and balancing.

E. Install test holes at fan inlets and outlets and elsewhere as indicated.

F. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. At outdoor-air intakes and mixed-air plenums.

2. At drain pans and seals.

3. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.

4. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
5. At each change in direction and at maximum 50-foot (15-m) spacing.

6. Upstream turning vanes.

7. Control devices requiring inspection.

8. Elsewhere as indicated.

G. Install access doors with swing against duct static pressure.

H. Access Door Sizes:

1. One-Hand or Inspection Access: 8 by 5 inches (200 by 125 mm).

2. Two-Hand Access: 12 by 6 inches (300 by 150 mm).

3. Head and Hand Access: 18 by 10 inches (460 by 250 mm).

4. Head and Shoulders Access: 21 by 14 inches (530 by 355 mm).

5. Body Access: 25 by 14 inches (635 by 355 mm).

6. Body plus Ladder Access: 25 by 17 inches (635 by 430 mm).

I. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

J. Install flexible connectors to connect ducts to equipment.

K. For fans developing static pressures of 5-inch wg (1250 Pa) and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

L. Install duct test holes where required for testing and balancing purposes.

M. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch (6-mm) movement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.

2. Inspect locations of access doors and verify that purpose of access door can be performed.

3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.

4. Inspect turning vanes for proper and secure installation.

5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION

SECTION 23 34 16

CENTRIFUGAL HVAC FANS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Special Provisions Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes: For each product.

1. Backward-inclined centrifugal fans.

1.03 ACTION SUBMITTALS

A. Product Data:

1. Include rated capacities, furnished specialties, and accessories for each fan.

2. Certified fan performance curves with system operating conditions indicated.

3. Certified fan sound-power ratings.

4. Motor ratings and electrical characteristics, plus motor and electrical accessories.

5. Material thickness and finishes, including color charts.

6. Dampers, including housings, linkages, and operators.

B. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

3. Include diagrams for power, signal, and control wiring.

4. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.

5. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.

1.04 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show fan room layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate and certify field measurements.

B. Field quality-control reports.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For centrifugal fans to include in emergency, operation, and maintenance manuals.

1.06 MAINTENANCE MATERIAL SUBMITTALS

A. Belts: One set(s) for each belt-driven unit.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. AMCA Compliance:

1. Comply with AMCA performance requirements and bear the AMCA-Certified Ratings Seal.

2. Operating Limits: Classify according to AMCA 99.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Capacities and Characteristics:

1. Total Airflow: 3800 cfm (L/s)

2. External Static Pressure: 1.2 inches wg (Pa)

3. Class: I

4. Housing Material: Aluminum

5. Drive Type: Belt

6. Motor:

a. Motor Enclosure:Totally enclosed, nonventilated .
b. Enclosure Materials: Cast aluminum.

c. Efficiency: Premium efficient.

2.02 BACKWARD-INCLINED CENTRIFUGAL FANS

A. Description:

1. Factory-fabricated, -assembled, -tested, and -finished, belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor, drive assembly, and support structure.

2. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations.

3. Factory-installed and -wired disconnect switch.

B. Housings:

1. Formed panels to make curved-scroll housings with shaped cutoff.

2. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
3. Horizontally split, bolted-flange housing.

4. Spun inlet cone with flange.

5. Outlet flange.

C. Backward-Inclined Wheels:

1. Single-width-single-inlet and double-width-double-inlet construction with curved inlet flange, backplate, backward-inclined blades, and fastened to shaft with set screws.

2. Welded or riveted to flange and backplate; cast-iron or cast-steel hub riveted to backplate.

D. Shafts:

1. Statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with adjustable alignment and belt tensioning.

2. Turned, ground, and polished hot-rolled steel with keyway. Ship with protective coating of lubricating oil.

3. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.

E. Prelubricated and Sealed Shaft Bearings:

1. Self-aligning, pillow-block-type ball bearings.
2. Ball-Bearing Rating Life: ABMA 9, LI0 at 50,000 hours

3. Roller-Bearing Rating Life: ABMA 11, LI0 at 50,000 hours

F. Belt Drives:

1. Factory mounted, with adjustable alignment and belt tensioning.

2. Service Factor Based on Fan Motor Size: 1.5

3. Fan Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
4. Motor Pulleys: Adjustable pitch for use with motors through 5 fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.

5. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.

6. Belt Guards: Fabricate to comply with OSHA and SMACNA requirements of diamond-mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation. Include provisions for adjustment of belt tension, lubrication, and use of tachometer with guard in place.

7. Motor Mount: Adjustable for belt tensioning.

G. Accessories:

1. Access for Inspection, Cleaning, and Maintenance: Comply with requirements in ASHRAE 62.1.

2. Discharge Dampers: Assembly with opposed blades constructed of two plates formed around and to shaft, channel frame, and sealed ball bearings; with blades linked outside of airstream to single control lever of same material as housing.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install centrifugal fans level and plumb.

B. Disassemble and reassemble units, as required for moving to the final location, according to manufacturer's written instructions.

C. Lift and support units with manufacturer's designated lifting or supporting points.

D. Equipment Mounting:
1. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

2. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

E. Label fans according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

3.02 CONNECTIONS

A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 233300 "Air Duct Accessories."

B. Install ducts adjacent to fans to allow service and maintenance.

C. Install piping from scroll drain connection, with trap with seal equal to 1.5 times specified static pressure, to nearest floor drain with pipe sizes matching the drain connection.

3.03 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Verify that shipping, blocking, and bracing are removed.

2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.

3. Verify that cleaning and adjusting are complete.

4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.

5. Adjust belt tension.

6. Adjust damper linkages for proper damper operation.

7. Verify lubrication for bearings and other moving parts.

8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.

9. See Section 230593 "Testing, Adjusting, and Balancing For HVAC" for testing, adjusting, and balancing procedures.

10. Remove and replace malfunctioning units and retest as specified above.

D. Test and adjust controls and safeties. Controls and equipment will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.04 DEMONSTRATION

A. Owner's maintenance personnel to adjust, operate, and maintain centrifugal fans.

END OF SECTION

SECTION 23 37 13.23

AIR REGISTERS AND GRILLES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Special Provisions Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Fixed face grilles.

2. Linear bar grilles.

B. Related Requirements:

1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to registers and grilles.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.

2. Register and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

B. Samples: For each exposed product and for each color and texture specified. Smallest size register and grille indicated.

C. Samples for Initial Selection: For registers and grilles with factory-applied color finishes. Smallest size register and grille indicated.

D. Samples for Verification: For registers and grilles, in manufacturer's standard sizes to verify color selected. Smallest size register and grille indicated.

1.04 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Ceiling suspension assembly members.

2. Method of attaching hangers to building structure.

3. Size and location of initial access modules for acoustical tile.

4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

5. Duct access panels.

B. Source quality-control reports.

PART 2 - PRODUCTS

2.01 GRILLES

A. Fixed Face Grille
1. Material: Steel

2.02 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate registers and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas where registers and grilles are installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install registers and grilles level and plumb.

B. Outlets and Inlets Locations: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in

ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install registers and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.03 ADJUSTING

A. After installation, adjust registers and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

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SECTION 26 00 00

ELECTRICAL WORK, GENERAL

PART 1 -- GENERAL

1.01 THE SUMMARY

A. Section includes general requirements for electrical scope and related items including materials and methods. The work shall include furnishing, installing, testing, and documentation of the equipment, materials, and installation detailed in the following sections:

Section	Title
26 01 26	Electrical Tests
26 05 05	Demolition for Electrical
26 05 06	District Specific Electrical Design and Installation Requirements
26 05 10	Electric Motors
26 05 19	Wire and Cabling
26 05 26	Grounding
26 05 33	Electrical Raceway Systems
26 05 36	Wiring Devices
26 05 43	Underground Raceway Systems
26 05 73	Protective Device Studies
26 09 13	Electrical Power Monitoring
26 09 23	Lighting Control Devices
26 12 16	Panelboards and Dry Type Transformers
26 29 00	Low Voltage Motor Control Centers
26 29 13	Solid State Reduced Voltage Starting
26 29 23	Variable Frequency Drives
26 43 00	Surge Protective Devices
26 43 00	Uninterruptible Power Single Phase
26 50 00	Lighting

B. The work shall include but not be limited to the following:

1. Electrical and telecommunication service installation and/or modification which include coordination, making arrangements, and scheduling with the utility companies the application, inspection, and testing of incoming services.

2. Site work which includes excavation, trenching, raceway installations, backfill, and resurfacing for incoming services.

3. Installation of major electrical equipment such as generators, switchgears, switchboards, transformers, motor control centers, distribution panels, and lighting panels.

    a. Prior to installation of electrical equipment, mark equipment outline and clearance requirements per NEC. Obtain approval prior to installation.

4. Conduit, wire installation and termination to electrical equipment, wiring devices, light fixtures, motors, field devices, starters, controllers, drives, and control panels.

5. Installation of light fixtures, wiring devices, enclosures, terminal boxes, and junction boxes.

6. Installation and programming of various controllers ie. lighting, building automations, security, fire alarm, and similar systems.

7. Installation underground infrastructure which includes duct bank, manholes, handholes, and pullboxes to pull feeder cables between structures.

8. Conduit, wire, and terminations to instruments furnished under other sections including process instrumentation primary elements, transmitters, local indicators, remote and local control panels.

9. Conduit, wire, and field connections to equipment furnished under other sections including HVAC systems, landscaping controllers, plumbing controllers, fire alarm systems, fire suppression systems, evacuation system.

10. Power wiring for all heating, ventilating, and air conditioning equipment furnished under other sections. Refer to HVAC Drawings for the locations of power, controls and thermostats connections. Provide conduit and conductors as required.

11. Installation of complete raceway system for:

    a. Telemetry

    b. District Network

    c. SCADA Network

    d. Power Monitoring Network

12. Provision and installation of specialized electrical equipment such as harmonic filters, grounding transformers, power factor correction capacitors, lightning, rectifiers, inverters, solar arrays, and surge suppressors furnished and mounted under other related sections.

13. Installation of concrete housekeeping, light pole bases, and other site appurtenances.

14. Installation of a ground grid system or the development of a UFER ground.

C. Modification and Demolition work shall include but not be limited to the following:

1. Demolition work associated with the removal of equipment from the existing facilities, including disconnecting and removing all electrical, controls, and communication wiring and conduits to equipment being removed under other related sections.

2. Start of demolition means that Contractor assumes responsibility of existing systems and the requirements for maintaining specific equipment in service and the requirements for restoration work.

3. Electrical relocation work associated with the relocation of equipment for the existing and new facilities, including disconnecting all existing wiring and conduits and providing new wiring and conduit to the relocated equipment.

4. Modifications to existing systems as required to provide the new functions as shown on the Drawings.

5. Obtain approval from CONSTRUCTION MANAGER prior to start of demolition work.

D. Excavation, bedding material, forms, concrete and backfill for the installation of underground raceways and site restoration shall comply with Section 31 – Earthwork.

E. Floor mounted electrical equipment shall be mounted on concrete housekeeping pads. Refer to forms and concrete for electrical equipment furnished under Section 03 – Concrete.

F. Secure electrical equipment and systems to meet Seismic 4 requirements and Special Provisions.

G. Perform electrical studies as described in Section 26 05 73. At a minimum, perform the following studies:

1. Protective device short circuit study and coordination analysis.

2. Equipment arc flash analysis and attachment of arc flash hazard warning labels.

1.02 REFERENCES

A. Electric equipment, materials and installation shall comply with the latest edition of the National Electrical Code (NEC), and with the latest edition of the following codes and standards:

1. National Electrical Safety Code (NESC)

2. Occupational Safety and Health Administration (OSHA)

3. National Fire Protection Association (NFPA)

4. National Electrical Manufacturers Association (NEMA)

5. American National Standards Institute (ANSI)

6. Insulated Cable Engineers Association (ICEA)

7. Instrument Society of America (ISA)

8. Underwriters Laboratories (UL)

9. Factory Mutual (FM)

10. InterNational Electrical Testing Association (NETA)

11. California Building Code

12. American Society for Testing and Materials (ASTM)

13. Institute of Electrical and Electronics Engineers (IEEE)

14. Joint Industrial Council (JIC)

B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.03 SUBMITTALS

A. Submit, in accordance with the Article 19.02, shop drawings for all equipment, materials and other items furnished under Section 26.

B. Division 26 submittals shall be packaged by individual specification sections. Each submittal package shall be complete and include all equipment specified within the section. Partial section submittals will not be allowed. As an example, all Section 26 29 00 Low Voltage Motor Control Centers shall be submitted together, all Section 26 12 16 Panelboards shall be submitted together, etc.

C. Submit engineering anchorage and seismic calculations for mounting electrical equipment in conformance with the Special Provisions (Seismic Design Criteria and Wind Design Criteria).

D. Mark submittals to clearly identify proposed specific equipment including accessories, options, and features. Other equipment listed in the submittals that are not applicable to the project shall be clearly marked as being excluded or not part of the submittal.

E. The following list of submittal requirements in this Section applies to electrical equipment such as medium voltage equipment, switchgears, power transformers, switchboards, motor control centers, distribution panels, lighting panels, relay, pump, local control panels, adjustable speed drives, networking equipment related to power monitoring and SCADA, and other major electrical equipment.

1. Submit the following for review/approval prior to manufacturing:

a. The following information shall be submitted to the CONSTRUCTION MANAGER:

1) Master drawing index

2) Elevation Drawings (Top, Front, Rear, Sides, External, and Internal)

3) Floor Plan, Cross Sections, and Mimic Diagram

4) Bussing diagram

5) Three-line diagrams

6) Elementary diagrams

7) Nameplate schedule

8) AC and DC Wiring Diagram

9) Point to Point Wiring Diagram

10) Anchoring details

11) Component list

12) Conduit entry/exit locations

13) Assembly ratings including short-circuit rating, rated voltage, rated current, and BIL

14) Major component ratings including voltage, continuous current, interrupting ratings

15) Cable terminal sizes

16) Product data sheets

17) DC battery or backup system details

18) Feeder power monitoring equipment

19) Protective devices and transient voltage surge suppressor details

20) Networking equipment

21) Power monitoring equipment

2. Where applicable, the following additional information shall be submitted to the CONSTRUCTION MANAGER:

   a. Busway connection

   b. Connection details between close-coupled assemblies

   c. Composite floor plan of close-coupled assemblies

   d. Key interlock scheme drawing and sequence of operations

   e. Descriptive bulletins

3. Submit the following for review prior to shipping to site for installation:

    a. Factory Acceptance Test or Certified production test reports

    b. Shop Drawings and Installation Instructions

    c. Transport dimensions and weights

    d. Packaging and shipping splits

4. Submittals – after construction and installation

    The following information shall be submitted for record purposes:

    a. Final as-built drawings and information for items listed under submittal for review/approval incorporating all changes made during the manufacturing process and during site installation (actual installed condition). As built shall include point to point wiring between equipment.

    b. Site Acceptance Report including raw data obtain during electrical testing.

    c. Installation information including equipment anchorage provisions

F. Operation and Maintenance Manuals

1. Submit operations and maintenance manual for equipment furnished under this section. The manuals shall be prepared specifically for this installation and shall include catalog data sheets, drawings, equipment lists, descriptions, parts lists, etc, to instruct operating and maintenance personnel unfamiliar with such equipment.

2. Manuals shall include the following as a minimum:

    a. A comprehensive index.

    b. A complete “As-Built” set of approved shop drawings.

    c. A complete list of the equipment supplied, including serial numbers, ranges and pertinent data.

    d. A table listing of the “as left” settings for all adjustable protective, alarm and trip setpoints.

    e. System schematic drawings “As-Built,” illustrating all components, piping and electric connections of the systems supplied under this section.

    f. Detailed service, maintenance and operation instructions for each item supplied.

    g. Special maintenance requirements particular to this system shall be clearly defined, along with special calibration, test procedures, and frequency.

h. The operating instructions shall also incorporate a functional description of the entire system, with references to the systems schematic drawings and instructions.

i. Printout of programmed settings

j. Software and associated files required for programming and setting parameters

k. Complete spare parts list with stock numbers.

1.04 UTILITY SERVICES

A. For electrical service entrance installation or modification, the contractor shall coordinate with, and comply with, all PG&E requirements and the latest edition of the PG&E Greenbook.

B. For tele/communication service entrance installation or modification, the contractor shall coordinate with, and comply with, all AT&T, Verizon, Comcast, or designated tel/com provider's requirements.

C. Temporary and construction power shall be the responsibility of the contractor.

1.05 CODES, INSPECTION AND FEES

A. Equipment, materials and installation shall comply with the requirements of the local authority having jurisdiction.

B. Obtain all necessary permits and pay all fees required for permits and inspections.

1.06 INTERPRETATION OF DRAWINGS

A. Electrical drawings are diagrammatic. Unless specifically dimensioned, the electrical drawings are not intended to show the exact locations of equipment and wiring devices.

B. Conduit layout shown is the general routing of raceways. Coordinate the installation with other trades and the actual supplied equipment.

C. Verify the exact locations and mounting heights of lighting fixtures, switches and receptacles prior to installation.

D. Except where dimensions are shown, the locations of equipment, fixtures, outlets and similar devices shown on the Drawings are approximate only. Exact locations shall be determined by the contractor and approved by the ENGINEER OF RECORD during construction. Obtain information relevant to the placing of electrical work and in case of any interference with other work.

E. Circuit layouts are not intended to show the number of fittings, or other installation details. Furnish all labor and materials necessary to install and place in satisfactory operation all electrical, instrumentation, and control systems shown.

F. Redesign of electrical or mechanical work, which is required due to the contractor's use of an alternate item, arrangement of equipment and/or layout other than specified in these Specifications, shall be done by the contractor at his/her own expense. Redesign and detailed plans shall be submitted to the ENGINEER OF RECORD for approval. No additional compensation will be provided for changes in the work, either his/her own or others, caused by such redesign.

1.07 QUALIFICATIONS

A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.

B. The manufacturer of equipment listed in Section 36 shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the ENGINEER OF RECORD, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

1.08 MATERIALS AND EQUIPMENT

A. Materials and equipment shall be new, except where specifically identified on the Drawings to be re-used.

B. Equipment and materials shall be the products of reputable, recognized suppliers having adequate experience in the manufacture of these particular items. Similar items shall be by one manufacturer. All equipment shall be designed for the service intended and shall be of rugged construction of ample strength for all stresses which may occur during fabrication, transportation, erection, and during continuous or intermittent operation.

1. All equipment and materials shall be listed by UL, where applicable, unless otherwise specified or as approved by the ENGINEER OF RECORD.

2. All self-contained components of standard manufacture for which a listing service is provided shall be UL listed. Where special non-standard assemblies are fabricated by the contractor, subassemblies therein shall bear the UL label whenever possible.

3. All electrical equipment shall conform to or exceed the current standards of the ANSI, IEEE, and NEMA, where applicable.

C. Contractor shall take field measurements to ensure that product being provided will fit and have the necessary code required clearances when installed.

D. Provide quality control in accordance with the Special Provisions.

1.09 SUBSTITUTION

A. Electrical equipment, components, protective devices, wires, and conduits shown in the drawings have been designed using project basis design documents. The design of the electrical system shown are typically based on the vendor in the drawing or first-named manufacturer in the specifications. The equipment shown and rating meets the project minimum requirements. Physical dimensions, electrical ratings, system performance and mechanical properties shall be adjusted in case an equivalent product or equipment is proposed other than listed at the expense of the contractor. All additional costs

associated with acceptance of equivalent, or substituted project shall be at contractor's expense.

B. Engineering review time in excess of one (1) hour per equipment substitution per submittal shall be chargeable to the contractor.

C. There shall be no change in contract time allowed as a result of the substitution or substitution review process.

D. Refer to the Special Provisions regarding material and product substitution.

1.10 EQUIPMENT TRANSPORT AND STORAGE

A. Investigate each space in the structure through which equipment must pass to reach its final location. Coordinate shipping splits with the manufacturer to permit safe handling and passage through restricted areas in the structure.

B. The equipment shall be kept upright at all times during storage and handling. When equipment must be tilted for passage through restricted areas, brace the equipment to ensure that the tilting does not impair the functional integrity of the equipment.

C. Unless otherwise noted, storage of equipment or construction materials is not allowed on site. Designated construction areas may be pre-arranged or specified as part of the construction documents.

D. Damages to surfaces due to transportation of equipment shall be repaired at the contractor's expense.

1.11 HAZARDOUS AREAS (AS NEEDED)

A. Equipment, materials and installation in areas designated as hazardous on the Drawings shall comply with NEC Articles 500, 501, 502 and 503.

B. Equipment and materials installed in hazardous areas shall be UL listed for the appropriate hazardous area classification.

1.12 IDENTIFICATION

A. If not provided under each section, the following identification shall apply.

1.13 EQUIPMENT IDENTIFICATION

A. Identify all equipment furnished under this section with the name of the equipment it serves as detailed on the oneline drawings. Nameplate list shall be submitted for review and approval.

B. Nameplates shall be engraved, laminated plastic, not less than 1/16 inches thick by 3/4 inches high by 2 1/2 inches wide with 3/16 inches high white letters on a black background.

C. Nameplates shall be screw mounted to NEMA enclosures using stainless steel screws. Epoxy shall be applied to the backside of the nameplate to seal against moisture. Nameplates shall be bonded to all other enclosure types using an epoxy, or similar,

permanent waterproof adhesive. Two-sided foam adhesive tape is not acceptable. Where the equipment size does not have space for mounting a nameplate, the nameplate shall be permanently fastened to the adjacent mounting surface.

1.14 RACEWAY IDENTIFICATION

A. Junction boxes shall have unique identification. In addition, power and control circuits passing through the junction box shall also be identified on the inside cover of the junction box.

B. Conduits shall be labeled. Label shall indicate voltage, source equipment, service equipment, and system type.

1.15 SEISMIC RESTRAINTS

A. Refer to the Special Provisions for seismic restraint criteria.

B. Electrical equipment shall be securely fastened in placed. When electrical equipment over twenty pounds (20 lbs.) are suspended above ten (10) feet, additional seismic restraints shall be installed.

1.16 TESTING AND PROGRAMMING

A. Test electrical equipment, component, and materials furnished under this section. Test each equipment functionally as well as part a system wide functional test. Test under manual and automatic control.

B. Testing shall be performed as detailed in Section 26 01 26, Electrical Tests. Electrical equipment and controls furnished in other sections shall also be tested under Division 26.

C. Programmable equipment and systems shall be programmed and be functionally tested. Submit final settings and parameters as part of record documents.

D. Equipment, sensors, devices, or systems that are annunciated remotely through remote terminal, human machine interfaces, or web-client (pages) shall be brought into these various interfaces by updating software program, webscreens, or both.

1.17 RECORD DRAWINGS

A. As the work progresses, legibly record all field changes on a set of Project Contract Drawings as specified in these Specifications, to produce the “Record Drawings.”

B. Record Drawings shall accurately show the installed condition of the following items:

1. Oneline (Single Line) diagrams.

2. Raceways and pullboxes – show exact routing and location; homerun notations in record drawings are not acceptable

3. Conductor sizes and conduit fills.

4. Panel Schedules.

5. Control schematic diagrams.

6. Lighting Fixture Schedules.

7. Lighting fixture, receptacle and switch outlet locations.

8. Underground raceway and duct bank routing.

9. Plan view, sizes and locations of switchgear, distribution transformers, substations, motor control centers and panelboards. Indicated code required working clearances.

10. Fire alarm system components, wiring and routing of raceways.

11. Security system components, wiring and routing of raceways.

12. Communication system components, wiring and routing of raceways.

13. Power monitoring system.

14. Grounding system.

C. Submit a schedule of control wiring raceways and wire numbers, including the following information:

1. Circuit origin, destination and wire numbers.

2. Field wiring terminal strip names and numbers.

D. Submit directory of panel schedules in spreadsheet format.

E. Record point-to-point connection diagrams showing schedule of control wiring raceways, wire numbers, conduit tags, and wire identification.

F. Review shop drawings of equipment furnished under other related sections and prepare coordinated control wiring interconnection diagrams.

PART 2 -- PRODUCTS

NOT USED

PART 3 -- EXECUTION

3.01 SITE VERIFICATION

A. Prior to start of work, Contractor shall review existing as-builts and shall perform site walk to have a general understanding of the existing conditions and systems.

B. Obtain the existing equipment shop drawings from the ENGINEER OF RECORD before attempting to make any modifications to the existing equipment wiring. Verify all existing wiring and connections for correctness. If record drawings are not available, trace all

circuits in the field and develop the wiring diagrams necessary for completion of the work.

3.02 DEMOLITION AND MODIFICATION WORK

A. Identify and mark equipment, wiring devices, and raceways to be demolished. Identify source power, control, and monitoring connection. Isolate circuits prior to demolition.

B. Provide alternate sources or means to power, control, and monitor systems impacted by demolition or modification work.

C. Coordinate and schedule the sequence of demolition with the sequence of construction to maintain plant operations. Remove and demolish equipment and materials in such a sequence that the existing and proposed plant will function properly with no disruption of operations.

D. Demolish all power supply, control, and communication wires back to their sources or upstream protective device.

E. Remove abandoned conduits, boxes, and unused equipment.

F. Paint and refinish surfaces and footprints left as part of demolition work. Match adjacent finished.

3.03 SITE ELECTRICAL WORK

A. Perform underground survey prior to any excavation work.

B. Call “811” to perform underground survey. Contractor shall hire underground surveying and locator service prior to excavation work inside the treatment and pumping plants.

3.04 ELECTRICAL ROUGH-IN AND EQUIPMENT LAYOUT

A. Electrical drawings show the general locations of equipment, devices, and raceways. They are not exact. Prior to installation of conduits, raceways, and equipment, contractor shall mark and rough-in location of the electrical system. Contractor shall coordinate location with other trades. Contractor shall walk the site with the inspector and CONSTRUCTION MANAGER to review rough-in and layouts. Required working clearance shall be also marked during this walk-through. Contractor shall obtain approval prior to installation of equipment from CONSTRUCTION MANAGER.

B. Unless otherwise approved by the ENGINEER OF RECORD, conduit shown on the Drawings shall be concealed. Raceways installed exposed shall be pre-approved during rough-in. Route exposed conduits near the ceiling or along walls of the areas through which they pass and shall be routed to avoid conflicts with HVAC ducts, cranes hoists, monorails, equipment hatches, doors, windows, etc.

C. Approved concealed raceways locations include concrete floor slabs, walls or ceilings and above suspended ceilings, or in partitions as required.

D. Where circuits are shown as “home runs”, all necessary fittings and boxes shall be provided for a complete raceway installation. Where home-runs indicate conduit is to be

installed concealed or exposed, the entire branch circuit shall be installed in the same manner.

3.05 SLEEVES AND FORMS FOR OPENINGS

A. Provide and place all sleeves for conduits penetrating floors, walls, partitions, etc. Locate all necessary slots for electrical work and form before concrete is poured.

B. Exact locations are required for stubbing up and terminating concealed conduit. Obtain shop drawings and templates from equipment vendors or other subcontractors and locate the concealed conduit before the floor slab is poured.

C. Where setting drawings are not available in time to avoid delay in scheduled floor slab pours, the ENGINEER OF RECORD may allow the installations of such conduit to be exposed. Requests for this deviation must be submitted in writing. No additional compensation for such change will be allowed.

D. Seal all openings, sleeves, penetration and slots as specified in Division 03. Seal openings and penetration through fire rated construction to maintain or exceed fire and thermal ratings of the structure.

3.06 CUTTING AND PATCHING

A. Cutting and patching shall be done in compliance with modifications and repair to concrete as specified in Section 29.

B. Prior to core drill, x-ray concrete walls and floors. Core drill holes in concrete floors and walls as approved.

C. Install work at such time as to minimize the amount of cutting and patching.

D. Do not cut joists, beams, girders, columns or any other structural members.

E. Cut opening only large enough to allow installation of the conduit.

F. Patching to be of the same kind and quality of material as was removed.

G. The completed patching work shall restore the surface to its original appearance or better.

H. Patching of waterproofed surfaces shall render the area of the patching completely waterproof.

I. Remove rubble and excess patching materials from the premises.

J. When existing conduits are cut at the floor line of wall line, they shall be filled with grout or patching material approved by the ENGINEER OF RECORD.

3.07 INSTALLATION

A. Install according to manufacturer’s installation instructions.

B. Work not installed according to the Drawings and Specifications shall be subject to change as directed by the CONSTRUCTION MANAGER at no additional cost to the District.

C. Electrical equipment shall be protected against mechanical and water damage. Store electrical equipment in dry permanent shelters. Do not install electrical equipment in place until structures are weather-tight.

D. Provide temporary power connection to equipment space heaters as required by the equipment manufacturer's storage instructions.

E. Damaged equipment shall be replaced or repaired by the equipment manufacturer, at the CONSTRUCTION MANAGER's discretion and at no additional cost to the District.

F. Repaint any damage to factory-applied paint finish using touch up paint furnished by the equipment manufacturer. The entire damaged panel or section shall be repainted in accordance with the field painting requirements specified in Section 29 at no additional cost to the District.

3.08 MANUFACTURERS SERVICE

A. Provide manufacturer's services for testing and startup of the equipment in accordance with the requirements of each individual specification section.

B. Testing and startup shall not be combined with training. Testing and start up time shall not be used for manufacturer's warranty repairs.

3.09 TRAINING

A. Provide manufacturer's services for training of plant personnel in operation and maintenance of the equipment furnished under Division 36 in conformance with the requirements of the Special Provisions. The training and instruction shall be directly related to the system being supplied.

B. The training program shall represent a comprehensive program covering all aspects of the operation and maintenance of each system. Provide detailed O&M manuals to supplement the training courses. The manuals shall include specific details of equipment supplied and operations specific to the project.

C. All training schedules shall be coordinated with, and at the convenience of, the District. Shift training may be required to correspond to the District's working schedule.

D. All dimensions shall be field verified at the job site and coordinated with the work of all other trades.

E. Document all changes made to the wiring diagrams and return a marked-up set of Record Drawings to the District after the work is complete.

END OF SECTION

SECTION 26 01 26

ELECTRICAL TESTS

PART 1 -- GENERAL

1.01 THE SUMMARY

A. Article Includes:

1. Perform field tests.

2. Provide all material, equipment, labor, and technical supervision to perform tests.

3. Adjust all protective devices to the settings recommended in the system study.

B. Related Section:

1. Section 26 00 00, Electrical Work, General.

1.02 REFERENCES

A. Testing and calculations required under this Article shall be per the guidelines specified in the ANSI/NETA publication “Standard for Acceptance Testing Specification for Electric Power Equipment and Systems.” Testing requirements in this Article are specifically referenced to the ANSI/NETA ATS-2017 edition of this publication.

B. The Acceptance Testing Specifications are copyrighted by the InterNational Electrical Testing Association, 3050 Old Centre Avenue, Suite 102, Portage, MI 49024. Certain portions of that publication are included in these Specifications as allowed per the conditions of the copyright.

1.03 SUBMITTALS

A. All submittals shall be in accordance with Standard Provisions Section 7 and Section 26 00 00.

B. Submittals shall include:

1. Testing firm qualifications, employee resumes, and proof of NETA membership.

C. Submit complete system test procedures for review. Test procedures shall include but not be limited to:

1. Detailed procedures in sufficient detail to verify conformance with these Specifications.

2. Detailed comprehensive testing schedule including:

a. Each major piece of electrical distribution equipment.

b. Each major electrical subsystem.

c. Duration of each test.

d. Milestone test completion date.

e. Ambient Conditions at time of test

f. Date of test results submittals following completion of the tests.

g. Names and qualifications of the individual(s) responsible for performing the testing.

D. Following completion of the test submit the completed test results to the ENGINEER OF RECORD for review. The results shall include a dedicated section with the “as-left” settings of all devices, relays, circuit breakers, etc.

E. Test results shall be submitted and as one submittal package.

F. Test reports shall be based on NETA’s latest Acceptance Testing Specifications having a sign-off, pass/fail data filed for each line item covered by NETA’s Acceptance Testing Specifications latest edition.

1.04 OPERATION AND MAINTENANCE MANUALS

A. Manuals shall be in accordance with Section 26 00 00.

1.05 SYSTEM DESCRIPTION

A. The following equipment shall be tested and adjusted per the requirements of this Article:

1. All new and existing equipment from, and including, the service entrance switchgear through, and including, all 480-Volt switchgear, panelboards, and motor control centers and to the main secondary breaker for 480-208Y/120 volt, 480-120/208 volt, and 480-120/240 volt transformers.

B. It is the intent of these tests to assure that all electrical equipment is operational and within industry and manufacturer’s tolerances and is installed in accordance with design specifications.

C. The tests shall help determine suitability for energization.

1.06 QUALIFICATIONS

A. The testing firm shall be a corporately independent testing organization which can function as an unbiased testing authority, professionally independent of the manufacturers, suppliers, and installers of equipment or systems evaluated by the testing firm.

B. The testing firm shall be regularly engaged in the testing of electrical equipment devices, installations, and systems.

C. The testing firm shall have been engaged in such practices for a minimum of five years.

D. The testing firm shall meet federal OSHA criteria for accreditation of testing laboratories, Title 29, Parts 1907, 1910, and 1936. Full membership in the International Electrical Testing Association constitutes proof of such criteria.

E. The testing firm's on-site lead technical person shall be currently certified by the International Electrical Testing Association (NETA) in Electrical Power Distribution System Testing. Testing company shall have on staff a NETA **ETT Senior Certified Level IV. This on-site lead shall** supervise electrical system and medium voltage acceptance testing and commissioning.

F. The testing firm shall utilize only full-time technicians who are regularly employed by the firm to provide testing services. Electrically unskilled employees shall not perform testing or assistance of any kind. Electricians and/or linemen may assist but may not perform testing and/or inspection services.

G. The testing firm shall be an independent organization as defined by OSHA Title 29, Part 1936, and the International Electrical Testing Association.

H. All instruments used by the testing firm to evaluate electrical performance shall meet NETA's Specifications for Test Instruments.

I. The testing firm shall be Apparatus Testing and Engineering, Power Systems Testing Company, or equal.

1.07 DIVISION OF RESPONSIBILITY AND COORDINATION OF WORK

A. The contractor shall perform general equipment inspection and checking procedures recommended by the manufacturer and as specified in other sections of these specifications prior to and in addition to tests performed by the testing firm specified in these Specifications.

B. The contractor shall supply a suitable and stable source of electrical power to each test site. The testing firm shall specify the specific power requirements.

C. The contractor shall notify the testing firm when equipment becomes available for acceptance tests. Work shall be coordinated to expedite project scheduling.

D. The testing firm shall notify the CONSTRUCTION MANAGER prior to commencement of any testing.

E. Any system, material, or workmanship which is found defective on the basis of acceptance tests shall be reported.

F. The testing firm shall maintain a written record of all tests and, upon completion of the project, assemble and certify a final test report.

PART 2 -- PRODUCTS

NOT USED

PART 3 -- EXECUTION

3.01 GENERAL TESTING PROCEDURES

A. The NETA Acceptance Testing Specifications shall be referenced specifically in this specification Article by paragraph numbers. These references will appear as “NETA (paragraph no.)”. The testing agency shall reference these specific paragraphs to determine the specific test requirements for each equipment item tested.

B. The testing agency instruments shall be maintained in calibration per the requirements of ANSI/NETA 5.3.

C. The test reports shall be in accordance with ANSI/NETA 5.4 except that reports shall be completed no later than 30 days after completion of testing on equipment.

D. Safety procedures per ANSI/NETA 5.1 shall be adhered to.

3.02 TESTING APPROACH AND DOCUMENTATION

A. General Requirements

1. Testing and commissioning shall be performed in accordance with the latest revision of ANSI/NETA Standard ATS “Acceptance Testing Specifications for Electrical Power Equipment and Systems.”

2. Testing shall be performed in four separate and totally independent steps.

3. A typed report shall be submitted after each testing step is completed. The report shall be submitted to the CONSTRUCTION MANAGER for review, comment and record purposes. The report shall include a data sheet for each component (cable, circuit breaker, transformer, relay, or etc.) tested.

4. Each data sheet shall include:

   a. weather conditions (temperature, humidity, sunny, rain, or etc.) during testing

   b. the time interval when testing was performed

   c. the tester’s observations and findings

   d. any discrepancies

   e. any remedial work performed, or actions taken to resolve problems

   f. technical parameter values obtained during testing

   g. as-left settings of all devices

   h. a statement indicating that the equipment is, or is not, ready to be energized

B. The report shall contain a statement indicating the equipment was tested in accordance with the procedures outlined in the latest edition of The International Testing Association Acceptance Testing Specifications.

1. The following describes the four testing steps to be performed:

a. Step No. 1:

1) Before the electrical equipment is energized the contractor shall test the equipment in accordance with Paragraph b below and set all protective relays, timers, etc., in accordance with the approved system study.

b. Step No. 2:

1) After the Contractor has performed the electrical testing and has set all of the protective devices, but before the equipment is energized, the manufacture of the electrical distribution and motor control equipment (low- and medium-voltage) shall verify all protective device settings and perform testing as specified in Paragraph c below.

c. Step No. 3:

1) After the equipment manufacturer has performed their testing, and the electrical distribution equipment has been energized, the contractor shall perform testing in accordance with Paragraph d below.

d. Step No. 4:

1) When the Project is substantially complete, but before final acceptance by the District, the electrical distribution and control system shall be tested by an independent electrical power systems testing company as specified in Paragraph E below.

C. Step No. 1:

1. Required testing to be performed by the contractor before the equipment is energized:

a. Inspect and mechanically operate all air interrupter switches, circuit breakers, power disconnect switches, transfer switches (automatic and manual), switches supplied on transformers, and circuit breakers/disconnect switches installed within equipment furnished under other sections of these Specifications.

b. Set, calibrate, and test all protective devices including, but not limited to, circuit breakers, protective relays, timing-devices, motor overloads, and electrical protective devices located within equipment furnished under other Articles of these Specifications.

c. Verify that protective relays, current transformers, ground sensing devices, transformer grounding resistors, fuses, interrupter switches, transfer switches, transformers, and motor starters furnished are in accordance with the approved shop drawings and the System Study.

d. Check and test the switchgear DC tripping controls and hardware.

e. Cables:

f. Perform over-potential, high-potential, insulation resistance and shield continuity testing for all medium-voltage cables.

g. Using a “megger”, test all low-voltage power system cables.

h. Transformers:

i. Test transformer insulating oil, check connections and proper torque and tightness of cables and bushings and perform high-potential testing.

j. Set motor circuit protectors. Adjust the settings to lowest setting that will allow the motor to be started when under load conditions. In no case shall the setting exceed that allowed by the NEC.

k. Verify that all power and control power fuses installed are in accordance with the manufacturer’s approved shop drawings, the Protective Device Selective Coordination Study and the NEC. Replace fuses found to be of the incorrect rating.

l. Verify control circuits and functionality of the controls for all motors, automatic transfer systems, remote protective devices (including differential protection relays, alarms systems, safety interlocks, emergency stop controls, and motor, transformer and generator protective devices, etc.). The functionality shall be in accordance with the approved control schematics, wiring diagrams or functional descriptions.

m. Check motor nameplates for correct phase and voltage. Verify motor bearings for proper lubrication.

n. Inspect each piece of electrical equipment in areas designated as HAZARDOUS and/or WET to ensure that equipment of proper rating is installed.

o. Verify that all lightning and surge arrestors, service entrance equipment, power distribution equipment, motors, control centers, utilization equipment, etc., are properly grounded.

p. Verify that the resistance to ground of all power distribution equipment is five ohms or less.

q. Verify that all terminations at the transformers, service entrance and distribution switchgear/switchboards, motor control centers, panelboards, motors, and VFDs, are correctly made and properly torqued.

r. Refer to the individual equipment and material specification sections for additional testing requirements.

s. Verify that all circuit breaker ratings and settings are as required by the Contract Documents, or as amended during shop drawing review. Advise the ENGINEER OF RECORD of discrepancies and make changes as directed by the ENGINEER OF RECORD.

t. Verify proper operation of automatic transfer switches, accessories, devices and motor interlocks.

u. Assist in the testing of the emergency and standby engine-generators.

v. Verify grounding of instrumentation equipment and line surge protection equipment.

w. Provide a test report.

D. Step No. 2:

1. Employ the services of the equipment manufacturer to perform the testing and furnish a test report.

a. Inspect and operate all air interrupter switches, circuit breakers, power disconnect switches, motor starters, and control circuits.

b. Verify settings and test all protective devices including but not limited to, circuit breakers, all ANSI listed protective relays, timing devices, etc. Settings shall be in accordance with the approved system study.

c. Test the DC circuit breaker tripping system and hardware.

d. Using a “megger”, test all switchgear, transformers and motor control center busses. Disconnect all devices that are susceptible to damage from megger testing before testing the busses.

e. Verify settings of all motor circuit protectors. If settings made by the contractor do not comply with the NEC, advise the Contractor to make appropriate adjustments and correct the motor data records provided by the contractor.

f. Verify that all power and control power fuses installed are in accordance with the manufacturer’s approved shop drawings, the Protective Device Selected Coordination Study and the NEC. Replace fuses found to be of the incorrect rating.

g. Verify control circuits and functionality of the controls for all motors, automatic transfer systems, remote protective device (including differential protection relays, alarm systems, safety interlocks, emergency stop controls, etc.). The functionality shall be in accordance with the approved control schematics, wiring diagrams or functional descriptions.

h. Verify contractor's recorded data for each motor. The records shall include motor name and number, the MCC and MCC bucket to which the motor is connected, the overload rating, and the motor circuit protector rating and setting for each motor furnished on the project. The rating and setting of the overload device and the motor circuit protector shall be compared to the ratings allowed by the NEC.

i. Verify that all lightning and surge arrestors, service entrance equipment, power distribution equipment, motors, control centers utilization equipment, etc., are properly grounded.

j. Verify that the resistance to ground of all power distribution equipment is less than or equal to 5 ohms.

k. Verify that all terminations at the transformers, service entrance and distribution switchgear, motor control centers, and panelboards are correctly installed and torqued.

l. Refer to the individual equipment and material specification sections for additional testing requirements.

E. Step No. 3:

1. After the electrical distribution equipment has been energized, the contractor shall perform the following tests:

2. Verify phase rotation at the service entrance and distribution switchgear, motor control centers and panelboards. The phase rotation shall be A, B, C from front-to-back, top-to-bottom and from left-to-right.

3. Adjust the taps on the transformers to produce a nominal voltage at the terminals of the transformers.

4. Use a motor rotation tester to verify correct motor rotation and disconnect the motor/driven equipment if damage could occur due to incorrect rotation. If the rotation is found to be incorrect, adjust the wiring terminations at the motor terminal box.

5. Check all instrument wiring and verify grounding is in accordance with the manufacturer's recommendations.

6. Measure the full load current of each motor. Where power factor correction capacitors are provided, the capacitor shall be in the circuit at the time of the measurement. Compare the measured current value to the rating of the thermal overload devices furnished and verify compliance with the NEC.

F. Submit a typed list record for each motor. The list shall include the motor name and number, the MCC and MCC bucket to which the motor is connected, the overload rating, and the motor circuit protector rating and setting. The rating and setting of the overload device and the motor circuit protector shall be compared to the ratings allowed by the NEC.

G. Step No. 4:

1. Employ the services of the independent recognized electrical power systems testing company, which shall be other than any of the manufacturers of the electrical equipment furnished under Division 26, to perform a final acceptance test of the completed electrical systems.

   a. The following work shall be provided:

      1) Retest all of the components, controls, systems and hardware previously tested under Paragraphs B, C and D above.

      2) The Testing Firm shall obtain the reports previously submitted along with the approved/corrected Protective Device Selective Coordination Study before starting the testing and shall become familiar with the reports and the Selective Coordination Study. All discrepancies shall be addressed before the testing begins.

      3) Testing shall be supervised by a Registered Professional Engineer licensed in California. The Professional Engineer shall be a full-time employee of the Testing Firm.

      4) Testing shall be in accordance with ANSI/NETA requirements as defined in these Specifications.

H. Submit a typed final report. The report shall be stamped and signed by the Registered Professional Engineer.

3.03 NETA TESTING REQUIREMENTS

A. Visual and Mechanical Inspections

1. The ANSI/NETA requirements for visual and mechanical inspections of equipment are considered the contractor's responsibility under this Work. At the contractor's discretion, however, the work may be included under this Article.

B. THERMOGRAPHIC SURVEY

1. Visual and Mechanical Inspection

   a. Remove all necessary covers prior to thermographic inspection. Utilize appropriate caution, safety devices, and personal protective equipment.

2. Equipment to be inspected shall include all 120 volt and higher current-carrying devices including all switchgear, switchboards, distribution panels, cable and bus connections, motor control centers and starters, disconnect switches, and other critical equipment. Testing of lighting luminaires, field instrumentation, SCADA & PLC's are not required.

3. Provide report including the following:

   a. Description of equipment to be tested.

b. Discrepancies.

c. Temperature difference between the area of concern and the reference area.

d. Probable cause of temperature difference.

e. Areas inspected. Identify inaccessible and/or unobservable areas and/or equipment.

f. Identify load conditions at time of inspection.

g. Provide photographs and/or thermograms of the deficient area.

h. Recommended action.

4. Test Parameters

a. Inspect distribution systems with imaging equipment capable of detecting a minimum temperature difference of 1°C at 30°C.

b. Equipment shall detect emitted radiation and convert detected radiation to visual signal.

c. Thermographic surveys should be performed during periods of maximum possible loading but not less than 40 percent of rated load of the electrical equipment being inspected. Refer to ANSI/NFPA 70B-2010, Section 11-17 (Infrared Inspection).

5. Test Values

a. Suggested actions based on temperature rise can be found in Table 100.18.

6. Re-Inspection

a. All items that are reported deficient in the thermography reports section of the inspection report shall be re-inspected after repairs have been made.

b. Original specification will apply to re-inspections.

c. Submit re-inspection reports and indicate that repairs have fixed the anomaly or indicate any remaining anomalies.

d. Perform a follow-up thermographic survey within 12 months of final acceptance by the owner.

C. Grounding Systems

1. The following grounding systems shall be tested:

a. All new grounding system from, and including, all 480 volt switchgear, panelboards, motor control centers, and the following step-down transformers:

1) 480-208Y/120 volts

2) 480-120/208 volts

3) 480-120/240 volts

2. The grounding system test shall be performed in accordance with the requirements of ANSI/NETA 7.13.2

3. The resistance to ground shall not exceed one ohm. If readings in excess of one ohm are found, the Testing Firm shall prepare a list of recommended means of improving the grounding system and submit with the test results.

D. Switchgear and Switchboard

1. Switchgear and switchboards shall be tested per the requirements of this Article.

2. Electrical testing shall be performed in accordance with NETA 7.1.2 and 7.1.3 with the following exceptions:

a. ANSI/NETA 7.1.2.4: Insulation testing of control wiring is not required.

b. ANSI/NETA 7.1.2.8.1: Control power transformers testing is not required.

E. Liquid-Filled Transformers

1. Liquid-filled transformers shall be tested per the requirements of this Article.

2. Electrical testing shall be performed in accordance with NETA 7.2.2 with the following exceptions:

a. ANSI/NETA 7.2.2.2.10: Insulating liquid testing is not required.

b. ANSI/NETA 7.2.2.2.6: Excitation current testing is not required.

c. ANSI/NETA 7.2.2.2.7: Winding resistance testing is not required.

d. ANSI/NETA 7.2.2.2.11: Dissolved gas analysis is not required.

e. ANSI/NETA 7.2.2.2.9: Oxygen test of nitrogen blanket is not required.

F. Low-Voltage Cables, 600 V Maximum

1. All low-voltage cables shall be tested per the requirements of this Section.

2. Electrical testing shall be in accordance with ANSI/NETA 7.3.2.2 and 7.3.2.3.

G. Circuit Breakers, Low-Voltage Insulated Case

1. 480 V circuit breakers in switchboards shall be tested per the requirements of this Section.

2. Electrical testing shall be performed in accordance with ANSI/NETA 7.6.1.1.2 and 7.6.1.1.3.

H. Protective Relays

1. Protective relays in switchgear and motor starters shall be tested per the requirements of this Section.

2. Electrical testing shall be in accordance with ANSI/NETA 7.9.1.2 and 7.9.1.3 for electromechanical and solid-state protective relays, and ANSI/NETA 7.9.2.2 and 7.9.2.3 for microprocessor-based protective relays.

I. Ground Fault Systems

1. Ground fault protection systems and equipment shall be tested per the requirements of this Article.

2. Electrical testing shall be performed in accordance with ANSI/NETA 7.14.2 and 7.14.3.

J. Rotating Machinery

1. All motors 50 HP and larger shall be tested per the requirements of this Article as noted.

2. Electrical testing shall be performed in accordance with ANSI/NETA 7.15.1.2 and 7.15.1.3 with the following exceptions:

a. Testing indicated as optional.

3. A test report/data sheet shall be prepared for each new motor 1/2 HP and larger. A separate test report/data sheet shall be prepared for each motor and shall include the following information:

a. Equipment name and number.

b. Motor manufacturer.

c. Motor enclosure type.

d. Motor nameplate data: hp, rpm, FLA, volts, S.F., NEMA Design, Code Letter

e. Running FLA (measured).

f. Running volts (measured).

g. Motor overload heater installed: Model #/amps.

h. Motor insulation test (measured): phase-to-ground.

i. Temperature of motor during test (deg. F).

j. Branch circuit insulation test (measured for motors of 50 HP and larger): phase-to-ground.

k. Dielectric absorption ratio test (measured for motors of 50 HP and larger).

l. Date of test.

m. Tested by.

K. Low-Voltage Motor Control Centers

1. Motor control centers shall be tested per the requirements of this Article as follows:

a. All new equipment.

2. Testing shall be performed in accordance with ANSI/NETA 7.16.2.1 with the following exceptions.

a. ANSI/NETA 7.16.1.1.2.3: Insulation resistance of control circuits need not be tested.

b. ANSI/NETA 7.16.1.1.2.6: Operational tests are the contractor's responsibility and may be performed under this Article at the contractor's option.

L. Variable Frequency Drives

1. Adjustable speed drives shall be tested per the requirements of this Article.

2. Electrical testing shall be performed in accordance with ANSI/NETA 7.17.2 and 7.17.3.

M. Harmonic Filters Field Acceptance Test

1. A field harmonics analysis shall be conducted on the following new drives to verify compliance with the harmonic performance requirements specified in Section 26 29 23. Harmonics testing shall be conducted regardless of whether or not filters are included.

a. Variable frequency drives: All drives 50 HP and larger installed under Section 26 29 23.

2. The testing agency shall provide all materials, equipment, labor, and technical supervision to perform such tests and inspections. It is the intent of these tests to ensure that the combined drives, transformers, and filters meet the specified criteria for overall distortion. The test and inspections shall determine the suitability for energization.

3. The tests shall be performed as necessary to verify compliance with all performance requirements specified. The test durations under each condition of operation specified shall be a minimum of four hours or as recommended by the testing agency to prove specification conformance.

4. If the drives do not meet the specified performance levels, the equipment suppliers shall reconfigure the filters or add additional filter devices as required. The tests shall then be run again until the specified performance is obtained.

TABLE 100.18

THERMOGRAPHIC SURVEY
SUGGESTED ACTIONS BASED ON TEMPERATURE RISE

Temperature difference (ΔT) based on comparisons between similar components under similar loading.	Temperature difference (ΔT) based upon comparisons between component and ambient air temperatures.	Recommended Action
1ºC - 3ºC	1ºC - 10ºC	Possible deficiency; warrants investigation
4ºC - 15ºC	11ºC - 20ºC	Indicates probable deficiency; repair as time permits
- - - - - -	21ºC - 40ºC	Monitor until corrective measures can be accomplished
>15ºC	>40ºC	Major discrepancy; repair immediately

Temperature specifications vary depending on the exact type of equipment. Even in the same class of equipment (i.e., cables) there are various temperature ratings. Heating is generally related to the square of the current; therefore, the load current will have a major impact on ΔT. In the absence of consensus standards for ΔT, the values in this table will provide reasonable guidelines.

An alternative method of evaluation is the standards-based temperature rating system as discussed in Chapter 8.9.2, Conducting an IR Thermographic Inspection, *Electrical Power Systems Maintenance and Testing*, by Paul Gill, PE, 1998.

It is a necessary and valid requirement that the person performing the electrical inspection be thoroughly trained and experienced concerning the apparatus and systems being evaluated as well as knowledgeable of thermographic methodology

END OF SECTION

SECTION 26 05 05

DEMOLITION FOR ELECTRICAL

PART 1 -- GENERAL

1.01 THE SUMMARY

A. Article includes all labor, materials, and incidentals required to demolish, modify and/or remove the electrical and instrumentation systems and equipment as shown on the Drawings and/or specified in these Specifications. Unless specifically noted as being reused, all conduit, wire, boxes, etc. detailed on the Drawings shall be new equipment installed under this Work.

B. The electrical modifications and removals work shall consist of, but not necessarily be limited to, removal or modifications of existing equipment in the following generalized categories:

1. Modification of motor control centers, motor starters, panels, and other devices as indicated on the Drawings.

2. Any electrically powered or controlled equipment indicated as being removed in this Contract and associated electrical appurtenances.

3. Existing electrical equipment or electrical equipment associated with mechanical or process equipment which must be removed or relocated due to conflicts with new construction.

4. Electrical control devices, starters, wiring, and other miscellaneous devices associated with equipment that will be modified or reused under this Contract.

5. Instrumentation and control equipment and related conduit and wire associated with equipment being removed under this Contract.

C. Related Sections:

1. Section 02 41 19, Selective Demolition.

2. Special Provisions Article 14.08, Salvaged Material and Equipment

3. Special Provisions Section 16, Work Constraints and Site Restrictions

1.02 SUBMITTALS

A. All submittals shall be in accordance with Standard Provisions Section 7 and Section 26 00 00.

B. Submit detailed time schedule for equipment which will be either modified or removed under this Work. Include details of work to be done, anticipated duration of the work, impact of the work on plant operations, coordination with other trades, etc.

C. Submit shop drawings for all modified motor control centers (MCC), switchboards, and other panels.

PART 2 -- PRODUCTS

NOT USED

PART 3 -- EXECUTION

3.01 MODIFICATIONS

A. All MCCs, switchboards, and other panels requiring modification under this Work shall comply with the following general requirements:

1. Equipment removed from service shall have suitable covers placed over any unused exterior panel holes. Covers shall be painted to match the existing panel and shall be securely retained on the panel with machine screws and nuts.

2. Newly installed equipment shall be mounted, connected, and identified consistent with the other equipment in or on the panel.

3. Devices installed in compartmentalized panels shall be provided with new doors and interior mounting pans as required to match the existing panel construction style.

4. Mounting holes required for new equipment shall be neatly cut and de-burred.

5. Nameplates shall be provided for all new equipment mounted on the exterior of existing panels. Nameplates shall match the existing panel nameplates.

6. Interior panel wiring for newly added devices shall match the existing panel wiring and mounting.

7. All modifications made to 480 volts power system panels shall be retrofit with components furnished by the original panel manufacturer to maintain all original UL and NEMA labeling and certifications.

B. All modifications made to existing MCCs, switchboards, and other panels shall be fully described in shop drawing submittals. The submittals shall include the following as a minimum:

1. Panel elevation drawings specifically identifying the exact equipment that will be removed.

2. Revised panel wiring diagrams specifically indicating the revised connections of the new devices.

3. Technical details on the new equipment that will be added including electrical characteristics, physical sizing, and installation requirements.

4. Enclosure or housing modifications required to accept the new equipment including nameplates and enclosure alterations.

5. Engraving schedule details for all new nameplates.

3.02 EQUIPMENT TO BE REMOVED

A. Only the major electrical and instrumentation equipment to be removed is shown or noted on the Drawings and failure to detail all equipment exactly shall not relieve the contractor from the responsibility for its removal as directed by the CONSTRUCTION MANAGER. Removal items such as wire, conduit, junction boxes, etc. are in general not detailed on the Drawings.

B. Where removal of electrical, instrumentation, or any other equipment with wired connections is called for in this Work, the work shall include the removal of the associated electrical hardware as specified in these Specifications unless noted otherwise.

C. In general, all wiring shall be removed from the conduits. Boxes and fittings and all exposed conduit shall be removed. Concealed conduits shall be cut flush with the floor, wall, or ceiling and plugged with grout or other permanent material.

D. Electrical power, control, or instrumentation equipment, exposed conduit, wiring, etc. rendered inoperative by modifications to existing equipment under these articles or other sections of this contract shall be removed unless specifically noted that it is to be abandoned in place.

E. Not all existing conduits are shown on the Drawings. In general, existing conduits are shown only where they may be reused, or where they potentially affect or may be affected by new work under this Contract, or for providing useful background information to the contractor regarding the existing electrical installation.

F. Where existing conduit or wire associated with removed equipment is to be reused, it will be specifically noted on the Drawings. Where existing conduit is clearly required to be removed or relocated including the buried or embedded portion due to new construction, it will be noted as such on the Drawings. In instances where existing electrical underground or concealed work is close to, but not clearly in the way of, new construction, it shall be the contractor's responsibility to include that portion of work in the Contract scope if required.

G. No existing conduits, wiring, or electrical appurtenances shall be removed, or in any way damaged, unless allowed by the provisions of this Article. Any existing conduits or wiring or other electrical appurtenances that are encountered as an obstruction to new construction which are not covered by the provisions of this Specification shall be brought to the attention of the District.

H. Where functions of existing cables and/or conduits are replaced by new cable and/or conduits because of additions of new panels, instruments, revision to control strategy, etc., the existing cables and exposed conduits shall be removed unless noted otherwise. Concealed conduits shall be retained and marked as spares unless noted otherwise.

I. Equipment removed shall not be reused under this contract unless specifically noted on the Drawings or Specifications.

J. To minimize disruptions to the existing plant operations, the schedule for modifications and removal of existing equipment shall be coordinated with, and approved by, the CONSTRUCTION MANAGER and District.

K. Where any existing circuits are disconnected due to abandonment or removal of existing equipment, the remaining motor starters or circuit breakers for these circuits shall be retagged as spares. At motor control centers, the tags shall be laminated nameplates matching the existing ones. In circuit breaker panels, the circuit card or listing shall be changed.

3.03 DEMOLITION

A. The contractor shall survey the existing electrical systems and equipment identified for removal with representatives from the other trades and the CONSTRUCTION MANAGER prior to performing any demolition work. Prior to removal, identify all conduit and equipment to be removed with tags or paint.

B. Where a piece of equipment is to be removed, all associated ancillary components (e.g. solenoid valves, pressure switches, etc.) and associated wiring and conduit shall also be removed.

C. Building or structures scheduled for complete demolition shall be made safe from electrical shock hazard prior to demolition. Disconnect all electrical power, communications, alarms, and signal systems.

D. Remove electrical work associated with equipment scheduled for demolition except those portions indicated to remain or be reused.

E. Remove unused exposed conduit and wiring back to point-of-concealment, including abandoned conduit above accessible ceiling finishes. Remove unused wiring in concealed conduits back to source (or nearest point of usage).

F. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank covers for abandoned outlets which are not removed.

G. Disconnect and remove abandoned panelboards, disconnect switches, control stations, distribution equipment, etc.

H. Disconnect and remove abandoned lighting fixtures. Remove brackets, stems, hangers and other accessories.

I. Repair adjacent construction and finishes damaged during demolition and extension work.

J. Where electrical systems pass through the demolition areas to serve other portions of the premises, they shall remain or be suitably relocated, and the system restored to normal operation.

K. Coordinate outages in electrical systems with the CONSTRUCTION MANAGER. Where duration of proposed outage cannot be allowed by the District, provide temporary connections as required to maintain service.

L. Trace out existing wiring that is to be relocated or removed and perform the relocation or removal work as required for a complete operating and safe system.

M. Continuous service is required on all circuits and outlets affected by these changes, except where the District will permit an outage for a specific time. Obtain CONSTRUCTION MANAGER's consent before removing any circuit from continuous service.

N. Remove exposed conduits, wireways, outlet boxes, pull boxes and hangers made obsolete by the alterations, unless specifically designated to remain. Patch surfaces and provide blank covers for abandoned outlets which are removed.

O. All equipment, materials, controls, motor starters, branch and feeder breakers, panelboards, transformers, wiring, raceways, etc., furnished and installed to temporarily keep circuits energized shall be removed when the permanent installation is fully operational.

3.04 DISPOSITION OF REMOVED MATERIALS AND EQUIPMENT

A. In general, it is intended that material and equipment indicated to be removed and disposed of by the contractor shall, upon removal, become the contractor's property and shall be disposed of off the site by the contractor, unless otherwise directed by the District. A receipt showing acceptable disposal of any legally regulated materials or equipment shall be given to the Owner.

B. Ballasts in each existing lighting fixture shall be assumed to contain PCB's unless specifically marked with a label indicating "No PCBs." Remove ballasts from each lighting fixture and pack them in accordance with EPA PCB regulations. Ship ballasts in approved containers to an EPA-approved recycling facility and pay all shipping, packaging and recycle costs.

C. PCBs and PCB contaminated equipment shall be removed, packaged, shipped and disposed of in accordance with all State and Federal regulations. Obtain the services of a firm licensed and regularly engaged in the removal of PCBs and PCB-contaminated equipment. The firm shall be licensed in the State or States in which the contaminated material is handled, shipped and disposed. Pay all fees associated with the removal of the contaminated material and equipment and provide documentation showing acceptable disposal.

D. Should the contractor discover PCB-contaminated equipment that was not identified, they shall cease work on or about the equipment and notify the CONSTRUCTION MANAGER immediately. The contractor shall then proceed with the work as directed by the CONSTRUCTION MANAGER.

END OF SECTION

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SECTION 26 05 06

SPECIFIC ELECTRICAL DESIGN & INSTALLATION REQUIREMENTS

PART 1 -- GENERAL

1.01 THE SUMMARY

A. Section Includes:

1. Specific methods and requirements pertinent to the installation of the electrical and instrumentation work under this Contract.

2. The requirements of this section shall be in addition to those specifically detailed in other Sections of these Specifications and shown on the Drawings.

3. The requirements of this section shall be complied with where the project Drawings and Specifications do not contain specific design or installation details. In general, all requirements of the National Electric Code (NEC) shall be followed except as enhanced or modified by the requirements of this Section.

B. Related Sections:

1. Section 26 00 00, Electrical Work, General

PART 2 -- PRODUCTS

NOT USED

PART 3 -- EXECUTION

3.01 RACEWAYS INSTALLATION

A. No conduit smaller than 3/4" shall be used.

B. No underground conduit smaller than 1" shall be used.

C. Use PVC wrapped rigid conduit in chemical feed rooms and transition from underground to above ground.

D. Use of EMT shall be pre-approved and shall be limited.

E. If not noted in the drawings, enclosures shall be NEMA 4X.

F. Underground pullboxes shall be no smaller than 17” x 30” x 24” (Deep).

3.02 CONDUCTOR INSTALLATION

A. Number 12 AWG shall be the minimum size for power wires.

B. All electrical wire and cables shall be installed in conduits.

C. No more than one (1) 480 VAC circuit shall be installed in any one conduit.

D. No more than three (3) 120 VAC branch circuits shall be run in any one conduit.

E. Number 14 AWG shall be the minimum control wire size except that connections to I/O boards inside a PLC shall be made using No. 18 AWG TFN.

F. Signal conductors carrying analog instrumentation signals (4-20 mA dc or 1-5 V dc) shall not be run in the same conduit or pull boxes with ac power conductors.

G. Fire alarm cabling shall be in conduit.

H. Control conductors may be run in the same conduit as 480 Vac power conductors only if the power conductors are No. 6 AWG or smaller and if they are functionally associated with the power conductors.

3.03 CONTROL AND PROTECTIVE DEVICES

A. Manual motor starters with overload elements shall be provided for all fractional horsepower 120 Vac motors.

B. No motor starter smaller than a NEMA Size 1 unit shall be allowed for 208 volts or 480 volts three-phase motors.

3.04 GROUNDING

Provide grounding bus bar tied back to the main service entrance ground or the last grounding point of an alternately derived system at the following location:

1. Main Point of Entrance for Communications (telephone, internet, microwave, etc)
2. At each RTU, I/O, and PLC Cabinet
3. At each main distribution frame or intermediate distribution frame room
4. At each SCADA Room
5. At each Server Room
6. At each Communication Room

END OF SECTION

SECTION 26 05 10

ELECTRIC MOTORS

PART 1 -- GENERAL

1.01 THE SUMMARY

A. Section Includes:

1. Motors 200 hp and less.

2. Motors furnished under other sections, in conformance with the requirements listed in this section, unless otherwise noted.

B. Related Sections:

1. Section 26 00 00, Electrical Work, General

2. Section 26 01 26, Electrical Tests

3. Section 26 29 23, Variable Frequency Drive.

1.02 REFERENCES

A. Institute of Electrical and Electronics Engineers (IEEE)

1. IEEE 112, “Standard Test Procedures for Polyphase Induction Motors and Generators.”

2. IEEE 114, “Standard Test Procedures for Single-Phase Induction Motors.”

3. IEEE 841™-2009, Petroleum and Chemical Industry—Premium-Efficiency, Severe-Duty, Totally Enclosed Fan-Cooled (TEFC) Squirrel Cage Induction Motors—Up to and Including 370 kW (500 Hp)

B. National Electrical Manufacturers Association (NEMA)

1. NEMA MG1, “Motors and Generators”

C. Anti-Friction Bearing Manufacturers’ Association (AFBMA).

1.03 SUBMITTALS

A. Submittals shall be in accordance with Standard Provisions Section 7, Section 26 00 00 and Section 26 01 26.

B. All submittals shall be in accordance with Article 9.02. Submittal of motor data for acceptance shall include complete nameplate data and test characteristics in accordance with NEMA Standard MG1 Part 12 and, in addition, the following for motors typical of the units furnished:

1. Efficiency at 1/2, 3/4 and full load

2. Power factor at 1/2, 3/4 and full load

3. Motor outline, dimensions, and weight

4. Descriptive bulletins, including full description of insulation system

5. Bearing design data

6. Special features (i.e., space heaters, temperature detectors, etc.)

7. Power factor correction capacitor rating and type.

1.04 QUALITY ASSURANCE

A. Routine tests shall be performed on representative motors and shall include the information described on NEMA MG1 Part 12. Efficiency shall be determined in accordance with IEEE Publication No. 112, Method B. Power factor shall be measured on representative motors.

1.05 SYSTEM DESCRIPTION

A. Motors specified in these Specifications are three-phase, squirrel-cage induction type for 1/2 hp and above; single phase for less than 1/2 hp; or DC motors.

PART 2 -- PRODUCTS

2.01 MOTORS CONFORMING TO IEEE 841

A. The following motors shall conform to IEEE Standard 841™-2009.

1. Motors for pumps used for pumping water, indoors and outdoors, except sump pumps.

2. Motors for pumps used for pumping chemicals, indoors and outdoors, except sump pumps.

B. For motors required to conform to IEEE 841, the requirements of IEEE Standard 841™-2009 shall take precedence over other requirements of these Specifications.

2.02 RATINGS

A. Each motor shall develop ample torque for its required service throughout its acceleration range at a voltage ten percent below nameplate rating. Where shown on the Drawings to be operated on a reduced voltage starter, the motor shall develop ample torque under the conditions imposed by the reduced voltage starting method.

B. The motor shall not be required to deliver more than its rated nameplate horsepower, at unity (1.0) service factor, under any condition of mechanical or hydraulic loading.

C. All motors shall be continuous time rated suitable for operation in a 40 degrees C ambient unless noted otherwise.

D. Specific motor data such as hp, rpm, enclosure type, etc, is specified under the detailed specification for the equipment with which the motor is supplied.

2.03 ENCLOSURE TYPES

A. Motors shall conform to one or more of the following standard enclosure designs as specified in these Specifications:

1. Open Drip-Proof
2. Totally Enclosed Fan-Cooled
3. Totally Enclosed Non-Ventilated
4. Explosion-Proof
5. Severe-Duty
6. Inverter-Duty
7. Submersible

2.04 NAMEPLATES

A. The motor manufacturer's nameplates shall be engraved or embossed on stainless steel and fastened to the motor frame with stainless steel screws or drive pins. Nameplates shall indicate clearly all of the items of information enumerated in NEMA Standard MG1-10.38 or MG1-20.60, as applicable. At a minimum the nameplates shall include the following:

1. Rated Horsepower
2. Full Load Speed at Rated Voltage
3. Frequency
4. NEMA Code Letter
5. Design Letter
6. Rated Voltage
7. Manufacturer’s Serial Number
8. Service Factor
9. Insulation Class
10. Maximum Ambient Temperature
11. Full-Load Current at Rated Voltage
12. NEMA Frame Type

13. Enclosure Type
14. NEMA Nominal Efficiency
15. Bearing numbers for all bearings
16. Power Factor at full load
17. Maximum recommended power factor correction capacitors kVAR to produce a 90% power factor
18. Phase
19. Locked Rotor KVA
20. Motor Model Number
21. Heater Model number
22. Heater Wattage
23. Heater Voltage
24. Lubrication and assembly instructions

2.05 BALANCE AND VIBRATION

A. Motors shall be balanced in accordance with NEMA MG 1 (2006), 7.8.1 through 7.9.3. Bearing housing vibration shall not exceed a maximum amplitude displacement of 0.15 in/sec.

2.06 NOISE LEVELS

A. Motors shall have no-load sound power levels not to exceed the values specified in NEMA MG 1-2006, 9.6.1 through 9.7.

2.07 MOTOR FEATURES

A. Condensation heaters, where specified under the detailed mechanical specifications shall be of the cartridge or flexible wrap around type installed within the motor enclosure adjacent to the core iron. Heaters shall be rated for 120 volts, single-phase, with wattage as required. The heater wattage and voltage shall be embossed on the motor nameplate. Power leads for heaters shall be brought out at the motor lead junction box.

B. Winding temperature detectors, where specified under the detailed mechanical specifications for individual equipment, shall be a factory installed, embedded, bi-metallic switch type with leads terminating in the main conduit box. This device shall protect the motor against damage from overheating caused by single phasing, overload, high ambient temperature, abnormal voltage, locked rotor, frequent starts or ventilation failure. The switch shall have normally closed contacts. Not less than three detectors shall be furnished with each motor. All motors 40 hp and larger that are connected to variable frequency drives shall be equipped with winding temperature detectors.

C. Motors shall be equipped with removable lifting lugs.

2.08 SINGLE-PHASE MOTORS

A. Unless otherwise specified, motors smaller than 1/2 hp shall be single-phase, capacitor start. Small fan motors may be split-phase or shaded pole type if such are standard for the equipment. Wound rotor or commutator type single-phase motors are not acceptable unless their specific characteristics are necessary for the application.

B. Single-phase motors shall be rated for operation at 115 volts, 200 volts, or 230 volts, single-phase, 60 Hz, as shown on the Drawings.

C. Locked rotor current shall not be greater than specified in NEMA Standard MG1, Part 12, Design “N.”

D. Motors shall be totally-enclosed in conformance with NEMA Standard MG1, Part 1. Small fan motors may be open type if suitably protected from moisture, dripping water and lint accumulation.

E. Motors shall be provided with sealed ball bearings lubricated for ten (10) years of normal use.

2.09 THREE-PHASE MOTORS

A. General

1. Unless otherwise specified, motors 1/2 hp and larger shall be 3-phase, squirrel-cage induction type.

2. All motors 3/4 hp and larger shall be a NEMA frame 143T or larger. One-half (1/2) hp motors and 3/4 hp motors rated 1800 rpm and 3600 rpm, shall have a 56 frame. Motors shall be designed and connected for operation on 480 volts, three-phase, 60 Hz alternating current system.

3. Unless otherwise required by the load, all motors shall be NEMA Design B, normal starting torque. Locked rotor kVA/hp shall not exceed Code Letter G as described in NEMA Standard MG1-10.37 for motors 20 hp and larger.

4. Motors connected to variable frequency drives shall be inverter-duty rated.

5. Motors shall be U.S. Electrical Motors, Baldor, or equal.

B. Bearings

1. Bearings shall be either greaseable or oil lubricated.

2. Oil-lubricated bearings shall be contained in an oil reservoir with oil sight level gauge and oil-fill and drain openings with plugs.

3. All grease-lubricated bearings, except those specified to be factory sealed and lubricated, shall be fitted with grease supply, flush, drain and relief fittings which are easily accessible without removal of any covers or guards. Extension tubes shall be used when necessary.

4. Grease supply fittings shall be standard hydraulic type by the Alemite Division of the Stewart-Warner Corporation, or equal.

5. Bearings shall be rated for an in-service ABMA L-10 life of 60,000 hours or more.

C. Insulation

1. For 480 volts motors, insulation systems shall be Class F, operated at Class B temperature rise and shall be manufacturer's premium-grade, resistant to attack by moisture, acids, alkalis and mechanical or thermal shock.

   a. For medium-voltage motors, provide 80 degree C, Class B rise, or better, by resistance at 100 percent load and provide a Class F insulation system, suitable for an ambient temperature motor operation of 0 to 40 degree C at no more than 3,300 feet above sea level.

   b. These temperature rises shall apply when motors are connected across-the-line, or when operated and controlled from VFD(s). The motor insulation system shall have full capability to handle the common-mode voltage conditions imposed by an VFD.

2. Motors for outdoor service shall have vacuum/pressure impregnated epoxy insulation for moisture resistance.

3. Insulation for inverter-duty motor windings shall meet or exceed the Pulse Endurance Index for magnetic wire and shall not be injured when exposed to repeated pulse type waveforms, repetitive high-voltage transients, switching frequency and rate of rise of the pulse. Class H varnish shall be used.

D. Enclosures

1. Motors shall have a steel or cast-iron frame and a cast iron or stamped steel conduit box, as specified below. Conduit box shall be split from top to bottom and shall be capable of being rotated to four positions. Synthetic rubber-like gaskets shall be provided between the frame and the conduit box and between the conduit box and its cover. Motor leads shall be sealed with a non-wicking, non-hygroscopic insulating material. A frame mounted pad with drilled and tapped hole, not less than 1/4-in diameter, shall be provided inside the conduit box for motor frame grounding.

   a. Totally-Enclosed Fan-Cooled (TEFC) motors shall have a steel or cast iron frame, cast iron end brackets, cast iron conduit box, 1.15 service factor at 40 degrees C, tapped drain holes (corrosion resistant plugs for frames 286T and smaller and automatic breather/drain devices for frames 324T and larger) and upgraded insulation by additional dips and bakes to increase moisture resistance.

   b. Totally Enclosed Non-Ventilated (TENV) motors shall include the same rating and accessories as specified for TEFC motors.

   c. Explosion Proof motors shall have a cast iron frame, cast iron end brackets, cast iron conduit box, 1.15 service factor at 40 degrees C, tapped drain holes (corrosion resistant plugs for frames 286T and smaller and automatic

breather/drain devices for frames 324T and larger) and be UL listed for Class 1, Div. 1, Group D hazardous areas.

d. Severe Duty Motors shall be of the corrosion resistant type conforming to motors designated by the manufacturer as “Corro-Duty,” “Mill and Chemical,” “Custom Severe Duty,” or similar quality designation. Severe duty motors shall have a cast iron frame, cast iron end brackets, cast iron conduit box and 1.15 service factor at 40 degrees C and tapped drain holes (corrosion resistant plug for frames 286T and smaller and automatic breather/drain devices for frames 324T and larger).

E. Inverter Duty Rated Motors

1. Motors for operation on variable frequency drives shall meet current power quality levels published in NEMA MG1, Part 31 (2018).

2. Motor shaft and bearings shall be insulated. Internal service factor shall be 1.0 times the nameplate service factor.

3. Unless otherwise noted, provide enclosures suitable for “severe duty.”

4. Motors 40 hp and larger shall be furnished with an internal thermal switch. Ventilation system shall be designed for maximum heat transfer.

5. Stator laminations shall be stagger-stacked and stamped from high grade electrical steel to minimize eddy-current losses and heat build-up caused by inverter induced harmonics.

6. Rotors shall be configured to minimize skin-effect heating.

7. Inverter duty motors shall be provided with shaft grounding rings. Rings shall be factory installed, and shall be manufactured by **Aegis**, or equal. The motor warranty shall include coverage against VFD-induced bearing damage or failure.

F. Motor Efficiencies

1. Three-phase motors rated 1 hp and larger shall be of the premium efficiency type. Efficiency values shall be based on tests performed in accordance with IEEE Publication No. 112, Method B. Motors with horsepower or rpms not listed shall conform to comparable standards of construction and materials as those for listed motors.

2. Where California laws dictate higher efficiencies than those listed, the higher efficiency motors shall be furnished.

Table 12-11
NEMA Full-Load Efficiencies of Energy Efficient Motors*
ENCLOSED MOTORS

Hp	2 POLE		4 POLE		6 POLE		8 POLE	
	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency
1.0	75.5	72.0	82.5	80.0	80.0	77.0	74.0	70.0
1.5	82.5	80.0	84.0	81.5	85.5	82.5	77.0	74.0
2.0	84.0	81.5	84.0	81.5	86.5	84.0	82.5	80.0
3.0	85.5	82.5	87.5	85.5	87.5	85.5	84.0	81.5
5.0	87.5	85.5	87.5	85.5	87.5	85.5	85.5	82.5
7.5	88.5	86.5	89.5	87.5	89.5	87.5	85.5	82.5
10	89.5	87.5	89.5	87.5	89.5	87.5	88.5	86.5
15	90.2	88.5	91.0	89.5	90.2	88.5	88.5	86.5
20	90.2	88.5	91.0	89.5	90.2	88.5	89.5	87.5
25	91.0	89.5	92.4	91.0	91.7	90.2	89.5	87.5
30	91.0	89.5	92.4	91.0	91.7	90.2	91.0	89.5
40	91.7	90.2	93.0	91.7	93.0	91.7	91.0	89.5
50	92.4	91.0	93.0	91.7	93.0	91.7	91.7	90.2
60	93.0	91.7	93.6	92.4	93.6	92.4	91.7	90.2
75	93.0	91.7	94.1	93.0	93.6	92.4	93.0	91.7
100	93.6	92.4	94.5	93.6	94.1	93.0	93.0	91.7
125	94.5	93.6	94.5	93.6	94.1	93.0	93.6	92.4
150	94.5	93.6	95.0	94.1	95.0	94.1	93.6	92.4
200	95.0	94.1	95.0	94.1	95.0	94.1	94.1	93.0
250	95.4	94.5	95.0	94.1	95.0	94.1	94.5	93.6
300	95.4	94.5	94.5	94.5	95.0	94.1	--	--
350	95.4	94.5	95.4	94.5	95.0	94.1	--	--
400	95.4	94.5	95.4	94.5	--	--	--	--
450	95.4	94.5	95.4	94.5	--	--	--	--
500	95.4	94.5	95.8	95.0	--	--	--	--

Notes:
* Values included in the table above were taken from the NEMA Standards MG 1-2006

Table 12-11
NEMA Full-Load Efficiencies of Energy Efficient Motors*
OPEN MOTORS

	2 POLE		4 POLE		6 POLE		8 POLE	
Hp	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency
1.0	--	--	82.5	80.0	80.0	77.0	74.0	70.0
1.5	82.5	80.0	84.0	81.5	84.0	81.5	75.5	72.0
2.0	84.0	81.5	84.0	81.5	85.5	82.5	85.5	82.5
3.0	84.0	81.5	86.5	84.0	86.5	84.0	86.5	84.0
5.0	85.5	82.5	87.5	85.5	87.5	85.5	87.5	85.5
7.5	87.5	85.5	88.5	86.5	88.5	86.5	88.5	86.5
10	88.5	86.5	89.5	87.5	90.2	88.5	89.5	87.5
15	89.5	87.5	91.0	89.5	90.2	88.5	89.5	87.5
20	90.2	88.5	91.0	89.5	91.0	89.5	90.2	88.5
25	91.0	89.5	91.7	90.2	91.7	90.2	90.2	88.5
30	91.0	89.5	92.4	91.0	92.4	91.0	91.0	89.5
40	91.7	90.2	93.0	91.7	93.0	91.7	91.0	89.5
50	92.4	91.0	93.0	91.7	93.0	91.7	91.7	90.2
60	93.0	91.7	93.6	92.4	93.6	92.4	92.4	91.0
75	93.0	91.7	94.1	93.0	93.6	92.4	93.6	92.4
100	93.0	91.7	94.1	93.0	94.1	93.0	93.6	92.4
125	93.6	92.4	94.5	93.6	94.1	93.0	93.6	92.4
150	93.6	92.4	95.0	94.1	94.5	93.6	93.6	92.4
200	94.5	93.6	95.0	94.1	94.5	93.6	93.6	92.4
250	94.5	93.6	95.4	94.5	95.4	94.5	94.5	93.6
300	95.0	94.1	95.4	94.5	95.4	94.5	--	--
350	95.0	94.1	95.4	94.5	95.4	94.5	--	--
400	95.4	94.5	95.4	94.5	--	--	--	--
450	95.8	95.0	95.8	95.0	--	--	--	--
500	95.8	95.0	95.8	95.0	--	--	--	--

Notes:
* Values included in the table above were taken from the NEMA Standards MG 1-2006

Table 12-12
NEMA Premium Full Load Efficiencies*
ENCLOSED MOTORS

Hp	3600 RPM		1800 RPM		1200 RPM	
	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency
1.0	77.0	74.0	85.5	82.5	82.5	80.0
1.5	84.0	81.5	86.5	84.0	87.5	85.5
2.0	85.5	82.5	86.5	84.0	88.5	86.5
3.0	86.5	84.0	89.5	87.5	89.5	87.5
5.0	88.5	86.5	89.5	87.5	89.5	87.5
7.5	89.5	87.5	91.7	90.2	91.0	89.5
10	90.2	88.5	91.7	90.2	91.0	89.5
15	91.0	89.5	92.4	91.0	91.7	90.2
20	91.0	89.5	93.0	91.7	91.7	90.2
25	91.7	90.2	93.6	92.4	93.0	91.7
30	91.7	90.2	93.6	92.4	93.0	91.7
40	92.4	91.0	94.1	93.0	94.1	93.0
50	93.0	91.7	94.5	93.6	94.1	93.0
60	93.6	92.4	95.0	94.1	94.5	93.6
75	93.6	92.4	95.4	94.5	94.5	93.6
100	94.1	93.0	95.4	94.5	95.0	94.1
125	95.0	94.1	95.4	94.5	95.0	94.1
150	95.0	94.1	95.8	95.0	95.8	95.0
200	95.4	94.5	96.2	95.4	95.8	95.0
250	95.8	95.0	96.2	95.4	95.8	95.0
300	95.8	95.0	96.2	95.4	95.8	95.0
350	95.8	95.0	96.2	95.4	95.8	95.0
400	95.8	95.0	96.2	95.4	95.8	95.0
450	95.8	95.0	96.2	95.4	95.8	95.0
500	95.8	95.0	96.2	95.4	95.8	95.0

Notes

* Values included in the table above were taken from the NEMA Standards MG 1-2006.

Table 12-12
NEMA Premium Full Load Efficiencies*
OPEN MOTORS

Hp	3600 RPM		1800 RPM		1200 RPM	
	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency
1.0	77.0	74.0	85.5	82.5	82.5	80.0
1.5	84.0	81.5	86.5	84.0	86.5	84.0
2.0	85.5	82.5	86.5	84.0	87.5	85.5
3.0	85.5	82.5	89.5	87.5	88.5	86.5
5.0	86.5	84.0	89.5	87.5	89.5	85.7
7.5	88.5	86.5	91.0	89.5	90.2	88.5
10	89.5	87.5	91.7	90.2	91.7	90.2
15	90.2	88.5	93.0	91.7	91.7	90.2
20	91.0	89.5	93.0	91.7	92.4	91.0
25	91.7	90.2	93.6	92.4	93.0	91.7
30	91.7	90.2	94.1	93.0	93.6	92.4
40	92.4	91.0	94.1	93.0	94.1	93.0
50	93.0	91.7	94.5	93.6	94.1	93.0
60	93.6	92.4	95.0	94.1	94.5	93.6
75	93.6	92.4	95.0	94.1	94.5	93.6
100	93.6	92.4	95.4	94.5	95.0	94.1
125	94.1	93.0	95.4	94.5	95.0	94.1
150	94.1	93.0	95.8	95.0	95.4	94.5
200	95.0	94.1	95.8	95.0	95.4	94.5
250	95.0	94.1	95.8	95.0	95.4	94.5
300	95.4	94.5	95.8	95.0	95.4	94.5
350	95.4	94.5	95.8	95.0	95.4	94.5
400	95.8	95.0	96.2	95.4	96.2	95.4
450	95.8	95.0	96.2	95.4	96.2	95.4
500	95.8	95.0	96.2	95.4	96.2	95.4

Notes
* Values included in the table above were taken from the NEMA Standards MG 1-2006.

G. Power Factor Correction Capacitors

1. All single-speed motors over five horsepower, except motors powered from variable frequency drives, shall be provided with a heavy-duty industrial type power factor correction capacitor selected, recommended and furnished by the motor manufacturer to raise the motor power factor to approximately 95 percent. For non-explosion-proof motors, the capacitor shall be mounted on the equipment base plate adjacent to the motor and shall be connected to the motor junction box with liquid tight flexible conduit. For explosion-proof motors, the capacitors shall be wall-mounted in a non-hazardous area.

2. Capacitors shall be dry film or liquid insulated and shall be hermetically sealed in steel enclosures.

3. Each capacitor unit shall be furnished with three high-interrupting capacity current-limiting fuses. Fuses shall be equipped with “blown-fuse” indicators.

4. Capacitor enclosures shall be suitable for conduit connection. Covers shall be gasketed, bolt-on type.

5. Capacitors shall be UL listed.

6. Capacitors shall be by General Electric Co., Square D Co., or equal.

PART 3 -- EXECUTION

3.01 FIELD OPERATING TESTS

A. Compare equipment nameplate and data with drawings and specifications.

B. Inspect physical and mechanical condition.

C. Inspect for correct anchorage, mounting, grounding, connection, and lubrication.

D. When applicable, perform special tests such as air gap spacing and pedestal alignment.

E. Verify the absence of unusual mechanical or electrical noise or signs of overheating during initial test run.

F. Perform insulation resistance tests in accordance with ANSI/IEEE 43. Test duration shall be one minute. Calculate the dielectric absorption ratio. See Test Record Below.

G. Perform Polarization Index Test in accordance with ANSI/IEEE 43. Test duration shall be 10 minutes. See Test Record Below.

H. Verify that motor space heaters, where provided, are functional.

I. Run each motor under normal operating conditions to demonstrate correct rotation direction, alignment, wiring size, proper overload relay sizing, speed, and satisfactory operation. Test interlocks and control features to verify correct wiring and operation.

J. Measure and record motor current in each phase and include in the O&M manual. Repair or replace motor or driven equipment if current exceeds motor nameplate value.

EQUIPMENT ABSORPTION RATIO AND POLARIZATION INDEX TEST RECORD

TEST EQUIPMENT: _____ TEST VOLTAGE: _____

AMBIENT TEMPERATURE: ___ ºC ___ ºF DATE: _____

EQUIP. TEMP., IF KNOWN: ___ ºC ___ ºF REL. HUMIDITY: _____

NOTES: 1. Perform test as indicated

2. Absorption Ratio = $\frac{\text{1-Minute Resistance Value}}{\text{30-Second Resistance Value}}$

3. Polarization Index = $\frac{\text{10-Minute Resistance Value}}{\text{1-Minute Resistance Value}}$

OHMS TO GROUND 30-SECOND READING ∅A TO GROUND	OHMS TO GROUND 1-MINUTE READING ∅A TO GROUND	OHMS TO GROUND 10-MINUTE READING ∅A TO GROUND	DIELECTRIC ABSORPTION RATIO	POLARIZATION INDEX
OHMS TO GROUND 30-SECOND READING ∅B TO GROUND	OHMS TO GROUND 1-MINUTE READING ∅B TO GROUND	OHMS TO GROUND 10-MINUTE READING ∅B TO GROUND	DIELECTRIC ABSORPTION RATIO	POLARIZATION INDEX
OHMS TO GROUND 30-SECOND READING ∅C TO GROUND	OHMS TO GROUND 1-MINUTE READING ∅C TO GROUND	OHMS TO GROUND 10-MINUTE READING ∅C TO GROUND	DIELECTRIC ABSORPTION RATIO	POLARIZATION INDEX

TESTER'S INITIALS/DATE _____

DISTRIBUTION:

END OF SECTION

SECTION 26 05 15

INDUSTRIAL CONTROL PANELS

PART 1 -- GENERAL

1.01 THE SUMMARY

A. The CONTRACTOR shall provide complete industrial control panels and/or local control stations as indicated herein or in other Sections of the Specifications. The stations shall be designed to provide the sequence of operation in Section 40 91 00 – Process Control and Instrumentation Systems and the P&ID Drawings.

B. This section also specifies miscellaneous electrical devices used throughout this project. These devices are not limited to use within industrial control panels or local control stations.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Industrial control panels and/or local control stations shall comply with the requirements of NEC (including Article 409), NEMA, and UL.

1.03 CONTRACTOR SUBMITTALS

A. Furnish Shop Drawings in accordance with the Article 19.02 and Section 26 00 00 – Electrical Work, General.

1. Ladder diagrams and written descriptions explaining ladder diagram operation and system operation.

2. Include catalog cuts of control equipment including enclosures, overcurrent devices, relays, pilot devices, terminations, and wire troughs.

PART 2 -- PRODUCTS

2.01 GENERAL

A. The CONTRACTOR shall provide the equipment, panels and stations to satisfy the functional requirements in the relevant mechanical equipment and Instrumentation and Control specifications and the Electrical Elementary Schematics. Each panel and station shall be fabricated with UL labeled components. Equipment not specifically indicated as being WORK of other Sections shall be provided under this Section. All equipment, panels and stations shall be wired under this Section.

B. The controls shall be 120 V maximum. Where the electrical power supply is 240 V, single phase or 480 V, 3 phase, the station shall be provided with a fused control power transformer. Control conductors shall be provided in accordance with Section 26 05 19 – Wire and Cabling.

C. Each panel and/or station shall be provided with identified terminal strips for the connection of external conductors. The CONTRACTOR shall provide sufficient terminal blocks to connect 25 percent additional conductors for future use. Termination points shall be identified in accordance with Shop Drawings. The panels and/or stations shall be the source of power for all 120 VAC solenoid valves interconnected with the panels and/or stations. Equipment associated with the panels and/or stations shall be ready for service after connection of conductors to equipment, controls, panels and/or stations.

D. Wiring to door-mounted devices shall be extra flexible and anchored to doors using wire anchors cemented in place. Exposed terminals of door-mounted devices shall be guarded to prevent accidental personnel contact with energized terminals.

E. Enclosures

1. In finished rooms, enclosures shall be NEMA 1 steel enclosures painted with ANSI 61 exterior and white interior.

2. In all other non-hazardous areas, enclosures shall be NEMA 4X stainless steel with brushed finish. Where possible, penetrations shall be made in such a manner to maintain the NEMA 4X rating. If this is not possible, the penetrations shall be made in such a manner to minimize entry of foreign materials into the enclosure, subject to approval by the ENGINEER OF RECORD.

3. In hazardous areas, enclosures shall be cast aluminum NEMA 7 and shall be UL listed for use in hazardous or classified locations.

4. Enclosures shall be freestanding, pedestal-mounted, or equipment skid-mounted, as indicated. Internal control components shall be mounted on a removable mounting pan. Mounting pan shall be finished white.

5. Outdoor mounted enclosures shall be provided with thermostatically-controlled heaters. Heaters shall be operated at ½ rated voltage (240 volt heaters shall be sized and operated at 120 volts).

6. Provide screened weep holes for draining condensation.

F. Disconnect Switches

1. Heavy duty, fusible, single throw switches shall be rated not less than 65 KA at 480 VAC.

2. Horsepower rated

3. UL listed

4. Padlockable in "Off" position and door interlock

5. Enclosure per area classification in Section 26 00 00 – Electrical Work, General.

6. 480 V, 3-phase, 3-pole (6-pole when used with 2-speed motor).

7. Auxiliary control contact as applicable and where indicated.

8. As manufactured by **G.E., Eaton Electrical, Square D,** or equal.

G. Identification of panel-mounted devices, conductors, and electrical components shall be in accordance with Section 26 00 00 – Electrical Work, General.

H. Panel-mounted devices shall be mounted a minimum of 3-feet above finished floor elevation, but not higher than 6'-6" above finished floor, unless noted otherwise.

I. Provide UL Label for all Panels and Enclosures: UL 508A label stating "Listed Enclosed Industrial Control Panel." All control panel components shall be UL listed. Where unique products have to be used inside a panel enclosure due to lack of comparable UL listed products, the Contractor shall have such products approved for safety and compliance to NEC by an independent testing laboratory approved by the Authority Having Jurisdiction, per National Electrical Code 90.7 and 110.3. Unique products are products for which there is no listing available from UL or an approved testing laboratory and for which there are no nationally recognized standards of safety. Whether the components inside an enclosure are UL listed, UL recognized, unique products, or combination of some or all of the above, the entire enclosure assembly comprising of all the components shall be UL listed. All existing control panel modifications shall meet UL 508A standards and the CONTRACTOR shall provide UL label for the modified control panel. The final installation and assembly shall have a minimum SCCR of 65 kA symmetrical fault current where 480V power is applied, and a minimum SCCR of 10 kA symmetrical fault current where 120V power is applied.

2.02 PANEL/STATION COMPONENTS

A. Pushbuttons, selector switches, and pilot lights shall be the heavy-duty, oil-tight type, sized to 30-mm. Miniature style devices are not acceptable. Devices shall be as manufactured by **General Electric, Eaton Electrical, Square D,** or equal.

1. Lens colors shall be red for "run," "open," or "on"; green for "stopped," "closed," or "off"; and amber for alarm.

2. Pilot lights shall be full voltage, push-to-test, LED cluster type.

3. Provide hazardous location type pilot devices in classified locations.

B. Relays shall be 3 PDT with 10 amp contacts, plug-in type with indicating light, rectangular blades and provided with sockets for screw-type termination and hold-down clips. Relays shall be as manufactured by **Square D, Potter Brumfield,** or equal.

C. Elapsed time meters shall be non-resettable type, read to a maximum of 99999.9 hours and shall be as manufactured by **General Electric, Eaton Electrical,** or equal.

D. Magnetic starters shall be:

1. NEMA rated, Size 1 minimum. IEC or dual NEMA/IEC rated type are not acceptable.

2. FVNR type unless indicated otherwise.

3. Combination starters with magnetic only instantaneous trip circuit breakers such as **Eaton Electrical HMCP, General Electric Mag-Break,** or equal. Breakers shall be rated 65 KA minimum.

4. Control transformers shall be provided with primary and secondary fuses, 120 V maximum control voltage. VA rating of transformer shall be based on devices on the control schematic.

E. Terminal strips shall be provided for every panel and shall be the flanged fork or ring lug type suitable for No. 12 AWG stranded wire minimum. Provide 25 percent spare terminals in each panel.

F. Time delay relays shall be combination on delay and off delay (selectable) with adjustable timing ranges. Provide socket with screw terminal connections and retaining strap. Time delay relays shall be **Square D, ATC, Eaton Electrical,** or equal.

2.03 FACTORY TESTING

A. Each panel/station shall be factory assembled and tested for sequence of operation prior to delivery.

2.04 SPARE PARTS

A. Provide a minimum of 10 percent spare lamps (minimum 2) and one spare lens for each color pilot lamp in each panel.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Panels/stations shall be installed in accordance with in Section 26 00 00 – Electrical Work, General and in accordance with the manufacturer's recommendations.

B. Panels/stations shall be protected at the site from loss, damage, and the effects of weather. Panels/stations shall be stored in an indoor, dry location. Heating shall be provided in areas subject to corrosion and humidity.

C. Panels/station interiors and exteriors shall be cleaned, and coatings shall be touched up to match original finish upon completion of the WORK.

D. Conduit, conductors, and terminations shall be installed in accordance with Section 26 00 00 – Electrical Work, General.

3.02 FIELD TESTING

A. Each panel/station shall be tested again for functional operation in the field after the connection of external conductors and prior to equipment startup.

END OF SECTION

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SECTION 26 05 19

WIRE AND CABLING

PART 1 -- GENERAL

1.01 THE SUMMARY

A. Article Includes:

1. All wire, cable and appurtenances as shown on the Drawings and as specified in these Specifications.

2. Wire and cable identification.

3. Install data highway, fiberoptic, coaxial and I/O cables furnished under Section 26 05 19 .

B. Related Sections:

1. Section 26 00 00, Electrical Work, General.

2. Section 41 90 00, General Instrumentation and Control Systems Requirements.

1.02 SUBMITTALS

A. Submittals shall be in accordance with Standard Provisions Section 7 and Section 26 00 00. Submittals shall include:

1. Samples of each type of proposed wire and manufacturer's product data cut sheets. Each sample shall have the size, type of insulation and voltage stenciled on the jacket. Approved samples will be sent to the project location for comparison by the CONSTRUCTION MANAGER with the wire actually installed.

2. Motor terminations.

3. Splices and terminations for instrumentation conductors.

4. Wire and cable markers.

5. Field test results.

1.03 DELIVERY, STORAGE AND HANDLING

A. Carefully handle all conductors to avoid kinks and damage to insulation. Store in protected areas.

PART 2 -- PRODUCTS

2.01 GENERAL

A. Wires and cables shall be of annealed, 98 percent conductivity, soft drawn copper.

B. All conductors shall be stranded, except that lighting and receptacle wiring shall be solid.

C. Except for control, signal and instrumentation circuits, wire smaller than No. 12 AWG shall not be used.

2.02 POWER CONDUCTORS

A. Wire for lighting, receptacles and other circuits not exceeding 150 Volts to ground shall be NEC type XHHW-2 conforming to UL-44 as manufactured by the Okonite Co.; Carol Cable Co., Inc.; Pirelli Cable Corp.; or equal.

B. Wire for circuits over 150 Volts to ground shall be NEC type XHHW-2 as manufactured by the Okonite Co.; Carol Cable Co. Inc.; Pirelli Cable Corp. or equal.

C. Multi-conductor control and power cables shall have stranded conductors with type XHHW-2 cross-linked polyethylene insulation. Cable shall be TC rated and conform to UL 1277 and IEEE 383 Standards. Cable shall be flame resistant, nonpropagating and suitable for installation in a Class I, Division II hazardous location and for direct burial in earth. Power and control cables shall be furnished with a green ground conductor. Power cables shall be furnished with a white neutral conductor where required to serve phase-to-neutral loads.

Multi-conductor control and power cables shall be as manufactured by the Okonite Co., Southwire Co., General Cable Co., or equal.

D. Provide ¾”C, 3#12 AWG minimum for each circuit.

E. Provide separate grounding wires. Metallic conduits are not acceptable as equipment ground.

2.03 VFD POWER CABLE

A. VFD power cable shall be three (3) conductor, stranded copper, PVC jacketed, shielded type, tray cable (TC) rated 600 volts with three (3) symmetrical ground conductors. The individual conductors shall be UL listed as Type XHHW-2 rated for 90 degrees C at wet and dry locations, with XLPE insulation.

B. VFD Cables shall be as manufactured by Belden, Alpha, General Cable, or equal.

2.04 CONTROL, STATUS AND ALARM WIRE

A. Control, status, and alarm wires installed between field devices and field terminals inside the I/O cabinet shall be No.14 AWG, Type MTW, stranded, as manufactured by the Okonite Co.; Carol Cable Co. Inc.; Pirelli Cable Corp.; or equal.

B. Control, status, and alarm wires installed between field terminals inside the I/O cabinet and I/O cards shall be No.18 AWG, Type MTW, stranded, as manufactured by the Okonite Co.; Carol Cable Co., Inc.; Pirelli Cable Corp.; or equal.

C. Multi-conductor control cable, where shown on the Drawings, shall be stranded, No. 14 AWG, 600 volts, polyvinyl chloride insulated, nylon jacket over insulation, polyvinyl chloride jacket overall, Type TC as manufactured by the Okonite Co., Pirelli Cable Corp., or equal.

2.05 INSTRUMENTATION WIRE

A. Wire for process instrumentation signals (i.e. 1-5 VDC, 4-20 mADC), R.T.D., potentiometer, and similar signals shall be:

1. Single-pair cable:

a. Conductors: Two No. 16 AWG stranded and twisted on two-inch lay

b. Insulation: PVC with 600 volts, 105 degree C rating

c. Shield: 100 percent Mylar tape with drain wire

d. Jacket: PVC with UL Subject 13, UL 1581 and manufacturers identification

e. Maximum overall diameter: 0.262 inches

f. Misc.: UL Subject 13, Type PLTC

g. Manufacturers: Okonite, N type P-0S, Model No. 264-60-4401; or equal.

2. Three-conductor (triad) cable:

a. Conductors: Three No. 16 AWG, stranded, and twisted on two inches lay

b. Insulation: PVC with 600 volts, 105 degree C rating

c. Shield: 100 percent Mylar tape with drain wire

d. Jacket: PVC with UL Subject 13, UL 1581 and manufacturers identification

e. Max overall diameter: 0.276 inches

f. Misc.: UL Subject 13, Type PLTC

g. Manufacturers: Okonite, N Type P-OS, No. 264-65-4401; or equal.

B. Wire for the power monitoring data highway shall be:

1. Two-pair cable:

a. Conductors: Two No. 22 AWG, tinned copper, stranded and twisted.

b. Insulation: PVC with 300 volts, 105 degree C rating.

c. Shielding: Individual shielded pairs.

d. Jacket: PVC, UL1581.

e. Maximum overall diameter: 0.165 inches.

~~f.~~ Manufacturers: Belden 8723; Okonite, N type SP-OS; or equal.

2. Suitable for use on an RS-485, four-wire system.

2.06 RIO NETWORK CABLES

A. RIO network trunk cables shall be RG-11 and drop cables shall be RG-6.

B. RG-6 cables shall be:

1. Attenuation: 0.38 dB/100 ft @ 2 MHz, 0.36 db/100 ft @ 1.544 MHz, RIO Transmit Frequency

2. Impedance and Tolerance: 75 W (+/- 3 W)

3. Velocity of Propagation: 82%

4. Capacitance: 16.2 pF/ft

5. Type of Shield: Bonded Foil Quad-Shield

6. UL/NEC Rating: CMR or CL2R

7. Type of Jacket: PVC

8. Minimum Bend Radius: 3 in.

9. Maximum Pull Strength: 162 lb.

10. Manufacturers: Modicon 97-5750-000 RG-6 Cable (Belden 3092A).

C. RG-11 cables shall be:

1. Attenuation: 0.38 dB/100 ft @ 5 MHz, 0.17 dB/100 ft @ 1.544 MHz, RIO Transmit Frequency

2. Impedance and Tolerance: 75 W +/- 3 W

3. Velocity of Propagation: 82%

4. Capacitance: 16.2 pF/ft

5. Type of Shield: Bonded Foil Quad-Shield

6. Type of Jacket: PVC

7. UL/NEC Rating: CMR and CLR2

8. Minimum Bend Radius: 4.5 in.

9. Maximum Pull Strength: 300 lb.

10. Manufacturers: Modicon 97-5951-000 RG-11 Cable (Belden 3094A).

2.07 SPLICES (POWER CONDUCTORS)

A. Compression type connectors shall be insulated with a heat-shrink boot or outer covering and epoxy filling.

Splice kits shall be as manufactured by Raychem, Ideal Industries, 3M Co., or equal.

B. Solderless pressure connectors shall be self-contained, waterproof and corrosion-proof units incorporating prefilled silicone grease to block out moisture and air. Connectors shall be sized according to manufacturer's recommendations.

The connectors shall be UL listed and CSA approved, as manufactured by King Technology, St Louis, MO; Ideal Industries, Inc., Sycamore, IL; or equal.

2.08 MOTOR CONNECTIONS

A. Motor connections shall be ring-type mechanical compression terminations installed on the branch circuit wires and the motor leads and secured with bolt, nut and springwasher. Connections shall be insulated with a Raychem Type RVC, roll-on stub insulator; or equal.

B. Conduits shall be terminated so as to permit neat connection to motor and other equipment.

2.09 TERMINATION AND SPLICES FOR CONTROL, STATUS, & ALARM CONDUCTORS

A. Terminations shall be of the solderless, nylon insulated, locking fork-end (upturned leg ends) or eyelet type.

B. Splices (connectors) shall be of the solderless, nylon insulated parallel or pigtail type.

C. Terminations and connectors shall be as manufactured by Thomas & Betts, Ideal Industries; 3M Co.; Panduit Corp.; or equal.

D. Solderless pressure connectors utilized below grade shall be self-contained, waterproof and corrosion-proof units incorporating prefilled silicone grease to block out moisture and air. The connectors shall be UL listed and CSA approved, as manufactured by King Technology, St Louis, MO; Ideal Industries, Inc., Sycamore, IL; or equal.

2.10 TERMINATIONS FOR INSTRUMENTATION CABLES

A. Termination connectors shall be of the insulated locking fork-end (upturned leg ends) or eyelet type.

B. Terminations shall utilize nylon insulation.

C. Terminations shall be as manufactured by Thomas & Betts, Ideal Industries; 3M Co.; Panduit Corp.; or equal.

2.11 WIRE AND CABLE MARKERS

A. Wire and cable markers shall be “Omni-Grip” as manufactured by the W.H. Brady Co., Thomas & Betts Co., 3M Co., or equal.

B. Wire and cables with diameters exceeding the capacity of the “Omni-Grip” shall be marked with pre-printed, self-adhesive vinyl tapes as manufactured by the W.H. Brady Co., Panduit Corp., or equal.

C. Printed using Brady marker “XC PLUS,” or equal.

D. Markers used in tunnels or other wet locations shall be on heat-shrinkable marking sleeves.

E. Use self-laminating vinyl on white background for markers within electrical equipment such as panels, termination cabinets, motor control centers.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Uniquely identify all wires, cables and each conductor of multi-conductor cables at each end with wire and cable markers.

B. Use lubrications to facilitate wire pulling. Lubricants shall be UL approved for use with the insulation specified.

3.02 CIRCUIT IDENTIFICATION

A. Color Coding General

1. All wire shall be color-coded or coded using electrical tape in sizes where colored insulation is not available. Where tape is used as the identification system, it shall be applied in all junction boxes, manholes and other accessible intermediate locations as well as at each termination.

B. Color Coding Table

System	Wire	Color
240/120 Volts Single-phase, three-wire	Neutral Line 1 Line 2	White Black Red
208Y/120 Volts Three-phase, four-wire	Neutral Phase A Phase B Phase C	White Black Red Blue
480Y/277 Volts Three-phase, four-wire	Neutral Phase A Phase B Phase C	White Brown Orange Yellow
Equipment Grounding Cables		**Green**
General Purpose AC Control Cables		Red
Discrete AC Cables at I/O Cards		Red
24V General Purpose DC Control Cables		Blue / White w/ Blue Tracer
24V Discrete DC Cables at I/O Cards		Blue / White w/ Blue Tracer
12V General Purpose DC Control Cables		Pink w/ White Tracer / Black w/ White Tracer
12V Discrete DC Cables at I/O Cards		Blue / White w/ Blue Tracer Pink w/ White Tracer / Black w/ White Tracer
Instrumentation Cables including Shielded Pair		Black/White
Externally-Fed Control Cables (Interlocks)		Yellow

1. Use control cable or instrumentation cable for alarm annunciator field wiring as shown on the Drawings and specified. Use color coding and phasing consistent throughout the site. Bus bars at panelboards and motor control centers to be connected Phase A-B-C, top-to-bottom, or left- to-right facing connecting lugs.

2. Conductors No. 2 AWG and smaller shall be factory color-coded with a separate color for each phase and neutral. Larger cables shall be coded by the use of colored tape.

3. In addition to color coding, for all single-phase and three-phase systems, identify each cable (single or multi-conductor) and conductor at each end, in each manhole, pull box, cable tray, or other component of the raceway system. This identification is applicable to all power, control, alarm, signal, and instrumentation cables, and conductors.

4. Identify each cable (single or multi-conductor) and groups or bundles of individual single conductors in each manhole, pull box, or other component of the raceway

system with circuit identification markers. Implement a “from-to” cable/conductor bundle tagging system as part of this identification effort.

5. Identify each individual conductor at each termination. This includes such locations as switchgear, switchboards, motor control centers, variable frequency drives, control panels, junction/terminal boxes, all field devices, and all other locations where conductors are terminated. Identify the termination of these conductors in accordance with the accepted shop drawings. Tag conductors with sleeve-type labels.

6. Where more than one nominal voltage system exists, identify each ungrounded system conductor by phase and system. Permanently attach means of identification at each branch-circuit panelboard, switchboard, switchgear, motor control center, or other type of power distribution equipment.

C. Power Conductors

1. Include the following information for power wire and cable identification:

   a. Circuit Number

   b. Origin

   c. Destination

2. Circuit number shall be as indicated on one-line diagrams for circuits fed from switchgear, switchboards, and motor control centers and as shown on panelboard schedules for circuits fed from lighting or distribution panelboards.

3. Origin is included in the circuit number.

4. Destination shall be the load tag name for an individual item of equipment, panelboard, or control panel as shown on the Drawings.

5. Example identification: ######ROHPCP401/ROHP01

6. where #### is the circuit number shown on the Drawings

D. Instrumentation and Control Conductors

1. Use the following information for instrumentation and control conductor identification:

   a. Process area codes:

      1) CS Caustic Soda

   b. Function designation and loop numbers:

      1) For circuits between field source and control panel, use the equipment tag name.

2) For circuits between control panel and I/O drop, use point number in Appendix I.

3) Example identification: For the Caustic Soda Pump No. 2 RUN status DI circuit, the two wires between ROHPCP and I/O Drop 18 should be labeled:

4) “CS-MN902-1”

5) “CS-MN902-2”

E. Drawings

1. Contractor shall prepare and submit shop drawings for electrical equipment room layouts, drawn at a minimum scale of 3/8 inch = 1 foot. Wiring plans shall be drawn at a minimum scale of ¼ inch = 1 foot.

2. Wiring diagrams shall carry a uniform and coordinated set of wire numbers and terminal block numbers to permit cross-referencing between the contract document drawings, the drawings prepared by the Contractor, and equipment O&M Manual Drawings.

3. Drawing number cross-references and continuation references shall also be provided. Contractor-prepared drawings shall reference applicable Contractor drawings such as P&IDs, control and logic diagrams, interface wiring diagrams, panel drawings, etc. Contractor-prepared drawings shall also reference applicable drawings provided by equipment manufacturers. Continuation and cross references denoted as “By Others” or similar non-specific wording are unacceptable.

4. On any drawing prepared for this project, if a wire, circuit, enclosure, panel, or device is continued on another drawing, the continuation drawing shall be referenced (and vice-versa). Wherever wires are shown connected to terminals, the drawings which show the continuation of the circuits on those terminals must be referenced.

5. Equipment interconnection diagrams shall be produced with the latest version of AutoCAD software, printed on 11 inches by 17inches size paper, and submitted on both electronic CD-ROM media and paper drawings. Submit complete interconnection diagrams no later than 70 days prior to any cable installation into raceways. Contractor shall note that the equipment interconnection diagram submittal will not be partially approved (“Approved as Noted”). Cables shall not be installed into raceways until the wiring interconnection diagrams are reviewed by the ENGINEER OF RECORD and returned marked as “No Exceptions Noted.”

3.03 TERMINATIONS AND SPLICES

A. Power conductors:

1. Terminations shall be die-compression type.

2. Splices (where allowed) shall be die-type compression connector and waterproof with heat-shrink boot or epoxy filling for copper conductors No. 4 AWG and larger.

3. Splices shall be solderless pressure connectors with insulating covers for copper conductors No. 6 AWG and smaller.

B. Control Conductors:

1. Termination on saddle-type terminals shall be wired directly with a maximum of two conductors.

2. Termination on screw type terminals shall be made with a maximum of two locking fork or eyelet connectors.

3. Splices, where allowed, shall be made with insulated compression type connectors.

C. Instrumentation Signal Conductors including for graphic panel, alarm, low- and high-level signals:

1. Terminations same as for control conductors.

2. Splices allowed at instrumentation terminal boxes only.

D. Except where permitted by the ENGINEER OF RECORD no splices will be allowed in manholes, handholes or other below grade located boxes.

E. Splices shall not be made in push-button control stations, control devices (i.e., pressure switches, flow switches, etc.), conduit bodies, panelboards, etc.

3.04 INSTRUMENTATION CABLES

A. Instrumentation cables shall be installed in raceways as specified or as shown on the Drawings. All circuits shall be installed as twisted pairs or triads. In no case shall a circuit be made up using conductors from different pairs or triads. Triads shall be used wherever three wire circuits are required.

B. Terminal blocks shall be provided at all instrument cable junctions, and all circuits shall be identified at such junctions.

C. Shielded instrumentation wire, coaxial, data highway, I/O and fiberoptic cables shall be run without splices between instruments, terminal boxes, or panels.

D. Shields shall be grounded as recommended by the instrument manufacturer and isolated at all other locations. Terminal blocks shall be provided for inter-connecting shield drain wires at all junction boxes. Where individual circuit shielding is required, each shield circuit shall be provided with its own block.

3.05 FIELD TESTING

A. Test all 600-volt power wire insulation with a megohm meter after installation. Make tests at not less than 500 volts DC. Submit a written test report of the results to the CONSTRUCTION MANAGER.

END OF SECTION

SECTION 26 05 26

GROUNDING

PART 1 -- GENERAL

1.01 THE SUMMARY

A. Article Includes:

1. All labor, materials, equipment and incidentals required to install a complete grounding system in strict accordance with Article 250 of the National Electrical Code (NEC), as shown on the Drawings and as specified in these Specifications.

2. All raceways, conduits and ducts shall contain equipment grounding conductors sized in accordance with the NEC. Minimum sizes shall be No. 12 AWG.

B. Related Articles:

1. Section 26 00 00, General Electrical Requirements.

2. Section 26 01 26, Electrical Tests.

1.02 SUBMITTALS

A. Submittals shall be made in accordance with Standard Provisions Section 7 and Sections 26 00 00 and 26 01 26. Submittals shall include testing results. Submittals shall include shop drawings, product data, for the following:

1. Ground rods.

2. Exothermic welding methods and materials.

PART 2 -- PRODUCTS

2.01 MATERIALS

A. Ground wire shall be as specified under Section 26 05 19.

B. Ground rods shall be 3/4-inches by 10-feet copper-clad steel and constructed in accordance with UL 467. The minimum copper thickness shall be 0.25 mm. Ground rods shall be Copperweld, or equal.

C. Grounding conduit hubs shall be malleable iron type, and of the correct size for the conduit, as manufactured by Thomas & Betts Co., Catalog No. 3940 Series; similar by Burndy or O.Z. Gedney Co.; or equal.

D. Waterpipe ground clamps shall be cast-bronze saddle type, and of the correct size for the pipe, as manufactured by Thomas & Betts Co., Cat. No. 2; similar by Burndy, O.Z. Gedney Co.; or equal.

E. Make buried, concrete-encased, or otherwise inaccessible cable-to-cable and cable-to-ground rod connections using exothermic welds by **Cadweld, Thermoweld,** or equal.

F. All connections to structural steel shall be made by the Cadweld process, or equal exothermic welding system.

1. Molds, cartridge materials and accessories shall be as recommended by the manufacturer of the molds for the items to be welded. Molds and powder shall be furnished by the same manufacturer.

2. Molds used for welding shall be new. The number of welds made per mold shall not exceed manufacturer's recommendations.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Run grounding electrode conductors in rigid steel conduits. Bond the protecting conduits to the grounding electrode conductors at both ends. Do not allow water pipe connections to be painted. If the connections are painted, dis-assemble them and re-make them with new fittings.

B. Install equipment grounding conductors with all feeders and branch circuits.

1. The grounded circuit conductor shall not be used for grounding non-current-carrying parts of equipment, raceways, and other enclosures except where specifically listed and permitted by the NEC.

C. Bond steel building columns in new structures together with grounding cable and connect to the distribution equipment ground bus, as shown on the Drawings.

D. Grounding cable connections to structural steel columns shall be made with exothermic welds.

E. Metal conduits stubbed into a motor control center shall be terminated with insulated grounding bushings and connected to the motor control center ground bus. Size the grounding cable in accordance with NEC Table 250-122, except that minimum size shall be No. 12 AWG.

F. Liquid-tight flexible metal conduit in sizes 1-1/2 inches and larger shall have bonding jumpers. Bonding jumpers shall be external, run parallel (not spiraled) and fastened with plastic tie-wraps. Plastic tie-wraps shall be ultraviolet-resistant for outdoor applications.

G. Ground transformer neutrals to the nearest available grounding electrode with a conductor sized in accordance with NEC Article 250-66.

H. Install grounding electrodes at locations as shown on the Drawings.

I. All equipment enclosures, motor and transformer frames, conduit systems, cable armor, exposed structural steel and all other equipment and materials required by the NEC to be grounded, shall be grounded and bonded in accordance with NEC Article 250.

J. Seal exposed connections between different metals with No-Oxide Paint Grade A, or equal.

K. Lay all underground grounding conductors slack, and where exposed to mechanical injury protect with pipes or other substantial guards. If guards are magnetic material, electrically connect conductors to both ends of the guard.

L. Embed a grounding conductor in every duct bank as indicated. The ground conductor shall be terminated at the ground grid at each end of the duct bank. Where no ground grid is installed, terminate at a suitable grounding electrode conductor near the end of the duct bank in accordance with the NEC.

M. Provide a separate grounding conductor in each individual raceway for parallel feeders. Connect the parallel ground conductors together at each end of the parallel run, as required by the NEC.

N. The installation shall ensure good grounding continuity between the conduit system and equipment frames and enclosures. Where necessary, jumper wires shall be installed.

O. All grounding type receptacles shall be grounded to the outlet boxes with a No. 12 THW green conductor connected to the ground terminal of the receptacle and fastened to the outlet box by means of a grounding screw.

3.02 INSPECTION AND TESTING

A. Inspect the grounding and bonding system conductors and connections for tightness and proper installation.

B. Testing shall be performed before energizing the distribution system.

C. A separate test shall be conducted for each building or system.

D. Grounding system testing shall be performed as required under Section 26 01 26.

E. Resistance-to-ground testing shall be performed during dry season.

END OF SECTION

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SECTION 26 05 33

ELECTRICAL RACEWAY SYSTEMS

PART 1 -- GENERAL

1.01 THE SUMMARY

A. Article Includes:

1. Complete raceway systems as shown on the Drawings and as specified in these Specifications.

2. Raceway identification.

B. Related Sections:

1. Section 26 00 00, Electrical Work, General

2. Section 26 05 26, Grounding.

1.02 SYSTEM DESCRIPTION

A. Conduits indicated to be run “exposed” on the schedules shall be run near the ceilings or along the walls of the areas through which they pass and shall be routed to avoid conflicts with HVAC ducts, cranes and hoists, lighting fixtures, doors and hatches, etc.

B. Conduits indicated to be run concealed shall be run in the center of concrete floor slabs, in partitions, or above hung ceilings, as required.

1.03 SUBMITTALS

A. Submittals shall be in accordance with Standard Provisions Section 7 and Section 26 00 00 and shall include:

1. The manufacturers’ names, product designation, catalog numbers, and catalog cut sheets of all materials specified.

2. All conduit racks suspended from ceilings shall be submitted detailing the materials and installation required to comply with seismic requirements of Article 13.05.01.

PART 2 -- PRODUCTS

2.01 MATERIALS

A. Rigid Steel Conduit

1. Rigid steel conduit interior and exterior shall be hot-dipped galvanized and shall be as manufactured by the Allied Tube and Conduit Corp., Wheatland Tube Co., or equal.

B. PVC Coated Rigid Steel Conduit

1. PVC coated rigid steel conduit shall have a minimum 0.040 inches thick, polyvinyl chloride coating permanently bonded to hot-dipped galvanized steel conduit and an internal chemically cured urethane or enamel coating. The ends of all couplings, fittings, etc., shall have a minimum of one pipe diameter in length of PVC overlap. PVC coated rigid steel conduit and fittings shall be manufactured by Occidental Coating Company, “Plasti-Bond Red” as manufactured by Robroy Industries, or equal.

C. Electrical Metallic Tubing or Intermediate conduit

1. Electrical metallic tubing and Intermediate conduit shall not be accepted.

D. Rigid Non-metallic Conduit

1. Non-metallic conduit shall be rigid polyvinyl chloride (PVC) schedule 40 as manufactured by Carlon; Kraloy Products Co., Inc.; Highland Plastics Inc.; or equal.

E. Liquidtight Flexible Metal Conduit, Couplings and Fittings

1. Liquidtight flexible metal conduit shall be Sealtite, Type UA, manufactured by the Anaconda Metal Hose Div.; Anaconda American Brass Co.; American Flexible Conduit Co., Inc.; Universal Metal Hose Co.; or equal.

2. Fittings used with liquidtight flexible metal conduit shall be of the screw-in type as manufactured by the Thomas & Betts Co., Crouse-Hinds Co., or equal.

F. Flexible Metallic Tubing

1. Flexible metallic tubing shall be for use under the provisions of NEC Article 348.

2. Flexible metallic tubing shall be hot-dipped galvanized steel strips shaped into interlocking convolutions firmly joined to one another assuring a complete lock similar to Tristeel as manufactured by Triangle, PWC, Inc., or equal.

3. Flexible metallic tubing shall be used only indoors for connection to lighting fixtures in NEMA 1 administration and office areas.

4. Furnish and install insulated bushings at terminations for conductor protection.

G. Flexible Couplings

1. Flexible couplings shall be type ECGJH as manufactured by the Crouse-Hinds Co., Appleton Electric Co., Killark Electric Manufacturing Co., or equal.

H. Boxes and Fittings

1. Pressed steel switch and outlet boxes shall be hot-dipped galvanized as manufactured by the Raco Manufacturing Co., Adalet Co., O.Z. Manufacturing Co., or equal.

2. NEMA 1 and NEMA 12 area boxes:

    a. Terminal boxes, junction boxes, pull boxes, etc., shall be sheet steel unless otherwise shown on the Drawings.

    b. Boxes shall be galvanized and have continuously welded seams. Welds shall be ground smooth and galvanized.

    c. Box bodies shall be flanged and shall not have holes or knockouts. Box bodies shall not be less than 14-gauge metal and covers shall not be less than 12-gauge metal.

    d. Covers shall be gasketed and fastened with stainless steel screws.

    e. Terminal boxes shall be furnished with hinged doors, terminal mounting straps and brackets. Terminal blocks shall be NEMA type, not less than 20 amps, and 600 volts.

    f. Boxes shall be as manufactured by Hoffman Engineering Co.; Lee Products Co.; Keystone/Rees, Inc.; or equal.

3. NEMA 4 area boxes:

    a. Terminal boxes, junction boxes, pull boxes, etc., shall be sheet stainless steel unless otherwise shown on the Drawings.

    b. Boxes shall have continuously welded seams and mounting feet. Welds shall be ground smooth.

    c. Boxes shall be flanged and shall not have holes or knockouts. Box bodies shall not be less than 14-gauge metal and covers shall not be less than 12-gauge metal.

    d. Covers shall be gasketed and fastened with stainless steel clamps.

    e. Terminal boxes shall be furnished with hinged doors, terminal mounting straps and brackets. Terminal blocks shall be NEMA type, not less than 20 amps, and 600 volts.

    f. Boxes shall be as manufactured by Hoffman Engineering Co.; Lee Products Co.; Keystone/Rees, Inc.; or equal.

4. NEMA 4X area boxes:

    a. Terminal boxes, junction boxes and pull boxes shall be Type 316 stainless steel.

    b. Terminal boxes shall be furnished with hinged doors, terminal mounting straps and brackets. Terminal blocks shall be NEMA type, not less than 20 amps, and 600 volts.

c. Boxes shall be as manufactured by Hoffman Engineering Co.; Lee Products Co.; Keystone / Rees, Inc.; or equal.

5. Explosion-proof boxes shall be designed for Class 1, Group D, Division 1 hazardous locations. They shall be cast iron with cadmium-zinc or hot-dipped galvanized finish, stainless steel or hot-dipped galvanized bolts; Type EJB as manufactured by the Crouse-Hinds Company, Appleton Electric Co., The Pyle-National Co., or equal.

6. All metal boxes and fittings used with PVC coated conduit shall be furnished with a PVC coating bonded to the metal, the same thickness as used on the coated steel conduit. The ends of couplings and fittings shall have a minimum of one pipe diameter PVC overlap to cover threads and provide a seal.

7. Cast or malleable iron device boxes shall be Type FD. All cast or malleable iron boxes and fittings shall have cadmium-zinc finish with cast covers and stainless-steel screws as manufactured by the Crouse-Hinds Co., or equal.

8. Steel elbows and couplings shall be hot-dipped galvanized. Elbows and couplings used with PVC-coated conduit shall be furnished with a PVC coating bonded to the steel, the same thickness as used on the coated steel conduit.

9. Electrical metallic tubing fittings shall be of the raintight, concrete-tight, compression type as manufactured by the Appleton Electric Co., Crouse-Hinds Co., or equal.

10. Conduit hubs shall be as manufactured by Myers Electric Products, Inc., or equal.

11. Conduit wall seals for new concrete walls below grade shall be O.Z./Gedney Co., Type WSK; Spring City Electrical Manufacturing Co., Type WDP; or equal.

12. Conduit wall seals for cored holes shall be Type CSML as manufactured by the O.Z./Gedney Co., or equal.

13. Conduit wall and floor seals for sleeved openings shall be Type CSMI as manufactured by the O.Z./Gedney Co., or equal.

14. Combination expansion-deflection fittings embedded in concrete shall be Type XD as manufactured by the Crouse-Hinds Co.; O.Z./Gedney Co.; Spring City Electrical Mfg. Co.; or equal.

15. Combination expansion-deflection fittings installed exposed shall be Type XJ as manufactured by Crouse-Hinds Co.; O.Z. Gedney Co.; Spring City Electrical Mfg. Co.; or equal.

16. Explosion-proof fittings shall be as manufactured by the Crouse-Hinds Co.; Appleton Electric Co.; O.Z./Gedney Co.; or equal.

17. Conduit sealing bushings shall be O.Z./Gedney, Type CSB; or equal.

I. Conduit Mounting Equipment

1. In dry indoor areas, hangers, rods, backplates, beam clamps, channel, etc., shall be galvanized iron or galvanized steel.

2. PVC-coated steel channel or Fiberglass channel with stainless steel hardware shall be used in areas designated NEMA 4 or 4X on the Drawings or which are wet or corrosive. Fiberglass channel shall be resistant to the chemicals present in the area in which it is used.

3. Conduit mounted on ceilings shall have supports designed in accordance with the requirements of Section 40 05 07, Pipe Supports.

J. Conduit Identification Tags

1. Exposed conduit shall be tagged with numbers, pressure stamped into a non-corrosive, two inches long, one-half inch wide, stainless steel tape; Dymo marking system, or equal.

2. A tag with number shall be fixed with No. 18 AWG or larger Type 304 stainless steel wire to each conduit segment, at the end of each conduit and within three (3) feet of each pull box, panelboard and switchboard.

K. Wall and Floor Slab Opening Seals

1. Wall and floor slab openings shall be sealed with a UL classified, FM approved fire barrier as manufactured by 3M Electrical Products Division; Specified Technologies, Inc.; the Thomas & Betts Corp.; or equal.

L. Cold Galvanizing Compound

1. Cold galvanizing compound shall be as manufactured by ZRC Products Company, a Division of Norfolk Corp.; or equal.

M. Gas Containment Area Sealing

1. To seal conduits from the passage of noxious gases, a synthetic elastomer type caulking material shall be provided at locations as noted on the Drawings and installed in accordance with the manufacturer's instructions. The caulking shall be 3M Series CP25, or equal.

N. Chemical Containment Area Sealing

1. To seal conduits from the passage of liquid chemicals, a polyurethane elastomeric caulking material shall be provided at the locations as noted on the Drawings and installed in accordance with the manufacturer's instructions. The material shall be SikaFlex-2C used with primer No. 449 or No. 260 as appropriate for the conduit.

PART 3 -- EXECUTION

3.01 RACEWAY APPLICATIONS

A. Except where otherwise shown on the Drawings, or specified, all wiring shall be in rigid steel conduit.

B. PVC coated rigid steel conduit shall be used where shown on the Drawings and in areas designated NEMA 4X on the Drawings.

C. PVC conduit shall be used for all conduit embedded in concrete walls, floors, and ceilings.

D. PVC conduit shall be used for concrete encased underground duct banks as specified in Section 26 05 43.

E. Size

1. Provide exposed conduit of 3/4-inch minimum trade size.

2. Provide encased conduit of one-inch minimum trade size.

3.02 BOX APPLICATIONS

A. Unless otherwise specified in these Specifications or shown on the Drawings, all boxes shall be metal.

B. Switch, receptacle and lighting outlet boxes and conduit fittings utilized in NEMA 3R, 4, 4X, and 12 areas shall be cast iron or malleable iron.

C. Switch, receptacle and lighting outlet boxes utilized in NEMA 1 areas and installed concealed shall be pressed steel.

D. Switch, receptacle, and lighting outlet boxes utilized in NEMA 1 areas and installed exposed shall be cast iron or malleable iron.

E. Terminal boxes, junction boxes, and pull boxes shall have NEMA ratings suitable for the location in which they are installed.

3.03 FITTINGS APPLICATIONS

A. Combination expansion-deflection fittings shall be used where conduits cross structure expansion joints. Refer to Drawings for expansion joint locations. Provide bonding jumpers around fittings.

B. Conduit wall seals shall be used where underground conduits penetrate walls or at other locations shown on the Drawings.

C. Conduit sealing bushings shall be used to seal conduit ends exposed to the weather and at other locations shown on the Drawings.

3.04 INSTALLATION

A. Conduit smaller than ¾ inches electrical trade size shall not be used, nor shall there be more than the equivalent of three 90-degree bends in any one run. Pull boxes shall be provided as required or directed.

B. Prior to rough-in, mark-up conduit route and jbox locations for approval.

C. Coordinate conduit routing with other pipes and route similar to existing installation.

D. No wire shall be pulled until the conduit system is complete in all details; in the case of concealed work, until all rough plastering or masonry has been completed; in the case of exposed work, until the conduit system has been completed in every detail.

E. The ends of all conduits shall be tightly plugged to exclude dust and moisture during construction.

F. Conduit supports, other than for underground raceways, shall be spaced at intervals of eight feet or less, as required to obtain rigid construction.

G. Single conduits shall be supported by means of one-hole pipe clamps in combination with one-screw back plates, to raise conduits from the surface. Multiple runs of conduits shall be supported on trapeze type hangers with steel horizontal members and threaded hanger rods. The rods shall be not less than 3/8 inches diameter. Surface mounted panel boxes, junction boxes, conduit, etc., shall be supported by spacers to provide a minimum of one-half inches clearance between wall and equipment.

H. Conduit hangers shall be attached to structural steel by means of beam or channel clamps. Where attached to concrete surfaces, concrete inserts of the spot type shall be provided.

I. All conduits on exposed work, within partitions and above suspended ceilings, shall be run at right angles to and parallel with the surrounding wall and shall conform to the form of the ceiling. No diagonal runs will be allowed. Bends in parallel conduit runs shall be concentric. All conduit shall be run perfectly straight and true.

J. Conduit terminating in pressed steel boxes shall have double-locknuts and insulated bushings.

K. Conduit terminating in NEMA 3R, 4, 4X and 12 enclosures shall be terminated with Myers-type conduit hubs.

L. Conduits containing equipment grounding conductors and terminating in sheet steel boxes shall have insulated throat grounding bushings.

M. Conduits shall be installed using threaded fittings.

N. Liquidtight flexible metal conduit shall be used for all motor terminations, the primary and secondary of transformers, generator terminations and other equipment where vibration is present. The maximum length of liquidtight flexible conduit shall be limited to three (3) feet at each termination.

O. Where conduits pass through openings in fire-rated walls or floor slabs, the openings shall be sealed with sealing systems of equal fire rating to the wall, ceiling, or floor. Refer to Architectural Drawings for fire ratings.

P. PVC conduit to non-metallic box connections shall be made with PVC socket-to-male thread terminal adapters with neoprene O-ring and PVC round edge bushings.

Q. Open-ended conduits containing SO cable, or similar cable that continues outside the conduit to the utilization equipment, shall be sealed with suitably sized conduit sealing bushings.

R. PVC conduit shall be supported with non-metallic clamps or PVC-coated steel or non-metallic racks and stainless-steel hardware.

S. PVC boxes, conduit fittings, etc., with integral hubs shall be solvent welded directly to the PVC conduit system.

T. Non-metallic boxes with field-drilled or punched holes shall be connected to the PVC conduit system with threaded and gasketed PVC Terminal Adapters.

U. Expansion fittings shall be used on exposed runs of PVC conduit where required for thermal expansion. Installation and number of fittings shall be as recommended by the conduit manufacturer.

V. All conduit entering or leaving a motor control center, switchboard or other multiple compartment enclosure shall be stubbed up into the bottom horizontal wireway, or other manufacturer-designated area, directly below the vertical section in which the conductors are to be terminated.

W. Conduit sealing and drain fittings shall be installed in areas designated as NEMA 7.

X. A conduit identification plate shall be installed on all power, instrumentation, alarm and control conduits at each end of the run and at intermediate junction boxes, manholes, etc. Conduit plates shall be installed before conductors are pulled into conduits. Exact identification plate location shall be coordinated with the ENGINEER OF RECORD at the time of installation to provide uniformity of placement and ease of reading. Conduit numbers shall be exactly as shown on the Drawings.

Y. Conduits noted as spare shall be capped or plugged at both ends with easily removable fittings.

Z. Mandrels shall be pulled through all existing conduits which will be reused and through all new conduits which are two (2) inches diameter and larger prior to installing conductors.

AA. 3/16-in polypropylene pull lines shall be installed in all new conduits noted as spares or designated for future equipment.

BB. All conduit which may under any circumstance contain liquids such as water, condensation, liquid chemicals, etc., shall be arranged to drain away from the equipment served. If conduit drainage is not possible, conduit seals shall be used to plug the conduits.

CC. Flexible metallic conduit shall be used for recessed light fixtures in hung ceilings to connect fixtures to the conduit system.

DD. Where no type or size is indicated for junction boxes, pull boxes or terminal cabinets, they shall be sized in accordance with the requirements of NEC Article 314.

EE. Miscellaneous steel for the support of fixtures, boxes, transformers, starters, contactors, panels and conduit shall be furnished and installed.

FF. Steel channels, flat iron and channel iron shall be furnished and installed for the support of all electrical equipment and devices, where required, including all anchors, inserts, bolts, nuts, washers, etc., for a rigid installation.

GG. Conduits shall not cross pipe shafts, access hatches or vent duct openings. They shall be routed to avoid such present or future openings in floor or ceiling construction.

HH. The use of running threads is prohibited and a three-piece union shall be used in lieu of running threads.

II. Conduits passing from heated to unheated spaces, exterior spaces, refrigerated spaces, cold air plenums, etc., shall be sealed with “Duxseal” as manufactured by Manville, or by using a seal fitting, to prevent the accumulation of condensation.

JJ. Conduits shall be located a minimum of three (3) inches from steam or hot water piping. Where crossings are unavoidable, the conduit shall be kept at least one (1) inch from the covering of the pipe crossed.

KK. Conduits terminating at a cable tray or busduct shall be supported independently from the busduct or cable tray. Provide a conduit support within one (1) foot of the cable tray or busduct. The weight of the conduit shall not bear on the cable tray or busduct.

LL. Provide sway braces for cable trays and bus ducts. Sway braces shall be U-channel supports installed at a 45-degree angle from the tray or busduct and anchored to the concrete ceiling structure or structural support system. Braces shall be provided on twenty-feet spacing centers. Alternate the direction of the bracing supports.

MM. Rigid galvanized steel conduits buried in earth shall not be utilized.

NN. Rigid galvanized steel conduits which have been field-cut and threaded shall be painted with cold galvanizing compounds.

OO. PVC-coated galvanized rigid steel conduit shall be used for elbows and risers at the utility pole for electrical and telephone service conduits.

PP. PVC-coated galvanized rigid steel elbows shall be used for pad-mounted transformer stub-ups.

3.05 RACEWAY IDENTIFICATION

A. Individual raceways shall be identified by the designation “X-ORIG/DEST” as follows:

For grounding	X = G
For power	X = P
For control (DO), status (DI), and alarm (DI)	X = C
For combined power and control	X = P/C
For signal (AI/AO)	X = S
For network data cables	X = N
For voice cables	X = V

ORIG = the enclosure at the raceway system origination.
DEST = the raceway destination item of equipment, control panel, etc.

Example raceway identification: P-MCC-5/ROHPCP

END OF SECTION

SECTION 26 05 36

WIRING DEVICES

PART 1 -- GENERAL

1.01 THE SUMMARY

A. Article Includes:

1. All labor, materials, and equipment to install wiring devices as shown on the Drawings and as specified in these Specifications.

2. Provide all interconnecting conduit and branch circuit wiring for receptacle circuits in accordance with the NEC.

B. Related Sections:

1. Section 26 00 00, Electrical Work, General

1.02 REFERENCES

A. Wiring devices shall comply with the requirements of the National Electric Code (NEC) and shall be Underwriters Laboratories (UL) labeled.

1.03 SUBMITTALS

A. Submittals shall be in accordance with Standard Provisions Section 7 and Section 26 00 00 and shall include the manufacturers' names, product designation, catalog numbers, and catalog cutsheets for a material specified.

PART 2 -- PRODUCTS

2.01 MATERIALS

A. Wall switches shall be heavy-duty, specification-grade, toggle-action, flush- mounting quiet type, and brown in color in process areas. Color shall be as approved by the architect in architecturally finished areas. All switches shall conform to the latest revision of Federal Specification WS-896.

1. Wall switches shall be as follows:

2. Single-pole, 20 amps, 120/277 volts. Arrow-Hart, Catalog No. 1991; similar by Harvey Hubbell, Inc.; Pass & Seymour, Inc.; or equal.

3. Double-pole, 20 amps, 120/277 volts. Arrow-Hart, Catalog No. 1992; similar by Harvey Hubbell, Inc.; Pass & Seymour, Inc.; or equal.

4. Three-way, 20 amps, 120/277 volts. Arrow-Hart, Catalog No. 1993; similar by Harvey Hubbell, Inc.; Pass & Seymour, Inc.; or equal.

5. Four-way, 20 amps, 120/277 volts. Arrow-Hart, Catalog No. 1994; similar by Harvey Hubbell, Inc.; Pass & Seymour, Inc.; or equal.

6. Single-pole, 20 amps, 120/277 volts, key-operated. Arrow-Hart, Catalog No. 1991-L; similar by Harvey Hubbell, Inc.; Pass & Seymour, Inc.; or equal.

7. Single-pole, 20 amps, 120 volts, red pilot-lighted handle. Arrow-Hart, Catalog No. 1991PL; similar by Harvey Hubbell, Inc.; Pass & Seymour, Inc.; or equal.

8. Single-pole, 20 amps, 120 volts, clear-lighted handle. Arrow-Hart, Catalog No. 1991ILC; similar by Harvey Hubbell, Inc.; or equal.

9. Momentary-contact, three-position, two-circuit, center-off. Arrow-Hart, Catalog No. 1895; similar by Harvey Hubbell Inc.; Pass & Seymour, Inc.; or equal.

B. Receptacles shall be heavy-duty, specification-grade, brown color in process areas. Color shall be as approved by the architect in architecturally finished areas.

Receptacles shall conform to Fed Spec WC596-F and shall be as follows:

1. Duplex, 20 amps, 125 volts, 2-pole, 3-wire. Arrow-Hart, Catalog No. 5362; similar by Harvey Hubbell, Inc.; Pass & Seymour, Inc.; or equal.

2. Weatherproof/corrosion-resistant single type, 20 amps, 125 volts, 2-pole, 3-wire, with cover. Crouse-Hinds Co., Catalog No. WLRS-5-20; similar by Appleton Electric; or equal.

3. Weatherproof/corrosion resistant duplex, 20 amps, 125 volts, 2-pole, 3-wire, with cover; Crouse-Hinds Co., Catalog No. WLRD-5-20; similar by Appleton Electric; or equal.

4. Ground-fault interrupter, duplex, 20 amps, 125 volts, 2-pole, 3-wire, GFCI feed-thru type with “test” and “reset” buttons. Arrow-Hart, Catalog No. GF5342; similar by Harvey Hubbell, Inc.; Pass & Seymour, Inc.; or equal.

5. Duplex, 20 amps, 125 volts, 2-pole, 3-wire, transient voltage surge suppressor and audio alarm or indicating light to indicate bad ground or failed MOV. Arrow-Hart, Catalog No. 5362S; similar by Harvey Hubbell, Inc.; Pass & Seymour, Inc.; or equal.

C. Device Plates

1. Plates for indoor flush mounted devices shall be of the required number of gangs for the application involved and shall be as follows:

a. In administration-type buildings:

1) Smooth, high impact nylon of the same manufacturer and color as the device. Final color to be as selected by the Architect.

b. Where permitted in other areas of the plant:

1) Flush-mounted devices in cement block construction shall be Type 302 high nickel (18-8) stainless steel of the same manufacturer as the devices.

2. Plates for indoor surface-mounted device boxes shall be cast metal of the same material as the box; Crouse-Hinds No. DS23G and DS32G, or equal.

3. Oversized plates shall be installed where standard plates do not fully cover the wall opening.

4. Device plates for switches mounted outdoors or indicated as weatherproof shall be gasketed, cast aluminum with provisions for padlocking switches “ON” and “OFF”; Crouse-Hinds No. DS185, or equal.

5. Multiple surface-mounted devices shall be ganged in a single, common box and provided with an adapter, if necessary, to allow mounting of single-gang device plates on multi-gang cast boxes.

6. Engraved device plates shall be provided where required.

7. Weatherproof, gasketed cover for GFI receptacle mounted in a FS/FD box shall be: Arrow-Hart, Catalog No. 4501-FS; similar by Harvey Hubbell, Inc.; Pass & Seymour, Inc.; or equal.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Switch and receptacle outlets shall be installed flush with the finished wall surfaces in areas with stud frame and gypsum board construction, in dry areas with cement block construction or when raceways are shown as concealed on the Drawings.

B. Do not install flush-mounted devices in areas designated NEMA 3R, 4, or 4X on the Drawings. Provide surface mounted devices in these areas.

C. Provide weatherproof device covers in areas designated NEMA 3R, 4, or 4X on the Drawings.

D. Convenience outlets shall be installed 18 inches above the floor unless otherwise required.

E. Convenience outlets installed outdoors and in rooms where equipment may be hosed down shall be 48 inches above floor or grade (unless otherwise shown or noted on the Drawings).

F. Switches shall be installed 48 inches above the finished floor unless otherwise shown or noted on the Drawings.

G. The location of all devices is shown, in general, on the Drawings, and may be varied within reasonable limits so as to avoid any piping or other obstruction without extra cost, subject to the approval of the ENGINEER OF RECORD. Coordinate the installation of the devices for piping and equipment clearance.

END OF SECTION

SECTION 26 05 43

UNDERGROUND ELECTRICAL RACEWAY SYSTEMS

PART 1 -- GENERAL

1.01 THE SUMMARY

A. Section includes a complete underground raceway system manhole, pullboxes, handholes, conduits, and accessories as shown on the drawings and as specified in these Specifications.

B. Related Section:

1. Section 26 00 00, Electrical Work, General.

2. Section 26 05 33, Electrical Raceway Systems.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the Special Provisions and Section 26 00 00.

B. Submittals shall contain shop drawings and product data for the following:

1. Manholes, pullboxes, and handholes

2. Frames and covers

3. Underground accessories

PART 2 -- PRODUCTS

2.01 CONDUITS

A. General type of underground raceways shall be Schedule 40 Polyvinyl Chloride (PVC) conduit.

B. At transition from below ground to above ground, raceways shall be PVC wrapped Rigid Steel Conduit.

C. Conduit splices and fittings shall be the materials as the conduits and approved by the manufacturer for the specific use.

D. At terminations, provide conduits with integral bell ends and bushings. Provide conduit plugs.

E. Provide bell ends, conduit spacers, spacers with bases, and reducers. Manufactured by Carlon, Underground Devices, TVC Inc., or equal.

2.02 MANHOLES

A. Manholes size shall be 72’ (L) x 96’ (W) x 72’ (H) minimum, nominal interior dimensions.

B. Manholes shall be engineered. Manholes shall be traffic loading made up of 4500 psi reinforced, designed for traffic loading.

C. Conduits shall enter and exit the manholes in a straight-line method. The remaining parallel walls are to remain free of conduit entrances. These walls are to remain free to allow cable support and splicing operations.

D. Pulling irons shall to be provided on opposite side of the ducts, rated at 10,000 pounds pulling tensions.

E. Bonding jumpers shall be provided between each section and attached to reinforcing steel of the manhole.

F. Cover

1. Provide heavy-duty, cast-iron, frame with nominal 36 inches opening equal to NEENAH #R-1640-D with drop handles and security bolting or approved equal.

2. Manhole frames and covers shall be cast-iron, heavy-duty type for Class H-20-wheel loading.

3. Lid to be lettered "SCVWD", “ELECTRIC”, “HIGH VOLTAGE”, and numbered as shown in the drawings.

4. Provide collar in 1” increment as needed to install cover flush with grade.

G. Provide a 14-inch sump with gravel and grate cover.

H. Provide space for ground rod at each opposite end. Provide a grounding connection to concrete reinforcement for grounding.

2.03 PULLBOXES AND HANDHOLES

A. Sizes

1. Pullboxes size shall be 36” (L) x 60 (W) x 36 (D), minimum. Bottom shall be solid concrete construction.

2. Handhole

a. 17” (L) x 30” (W) x 24” (D), unless otherwise noted in the drawings. Bottom shall be open construction.

b. 17” (L) x 10” (W) x 12” (D), Bottom shall be open construction

3. Handhole extensions shall be in 12” increments.

B. Construction

1. Pullboxes and handholes shall be precast concrete, heavy-duty type. Precast units shall be as manufactured by Old Castle Precast, Jensen Precast, Christy, or equal.

2. At handholes, conduits shall enter and exit in a straight-line method. The remaining parallel walls are to remain free of conduit entrances. These walls are to remain free to allow cable support and splicing operations.

3. At pullboxes, conduits shall enter and exit at the bottom.

C. Covers

1. Handholes

a. Landscaped Areas

1) 10” X17” Handhole covers shall be concrete steel reinforced lid. Jensen Precast, HN1017-L02, or equal.

2) 17” X 30” Handhole covers shall be concrete steel reinforced lid. Jensen Precast, CYN36-FL36D, or equal.

b. Incidental Traffic Areas

1) 10” X17” Handhole covers shall be steel diamond plate bolt down lid. Jensen Precast, HN1017-C01, or equal.

2) 17” X 30” Handhole covers shall be concrete steel reinforced lid. Jensen Precast, CYN36-61J, or equal.

c. Traffic Areas

1) 17” X 30” Handhole covers shall be cast in frame steel lid. Oldcastle Precast, 01-7962, or equal.

2. Pullboxes (36” x 60” x 36”, minimum)

a. Pullbox covers shall be H-20 traffic rated, slip resistant, with security bolts and hinged at non-traffic locations.

b. Pullbox covers shall be H-20 traffic rated, slip resistant, and bolt down full coverage at traffic locations.

c. Pullbox covers shall be equipped with height adjustments.

2.04 ACCESSORIES

A. Cable racks, supports, pulling irons, ladders, and hardwares shall be galvanized steel.

B. Cable racks, supports, ladders, and hardwares shall be fiberglass in manholes and pullboxes containing medium voltage cables.

C. Detectable Warning Tape

1. Warning tapes used to mark wires with voltage above 120VAC shall be Red with label “Caution Buried Electric Line Below”.

2. Warning tapes used to mark communication wires shall be orange with label “Caution Buried Communication Line Below”.

3. Tape shall be 2” wide, 5-mil with aluminum backing to make it detectable underground using a non-ferrous locator

4. Underground warning tapes shall be by Seton or approved equal.

D. Pullropes shall be polypropylene rope, rot/mildew resistance, and unaffected by chemicals or water exposure. Diameter shall be ¼”, and 1000 lbs. tensile strength minimum. Mule tape not acceptable.

E. Lubricant shall be environmentally safe and harmless to human, clean, slow-drying, water-based, high-performance gel. Lubricant shall provide maximum tension reduction in all types of cable pulling. Lubricant shall be specification-grade lubricant that does not promote flame propagation when used with fire-retardant cables and systems. It shall be compatible with all common cable jacket materials. Lubricant shall be Polywater Lubricant J or equal.

F. Duct Seal shall be semi-permanent and can be removed. Foam type that expands and cures quickly and evenly. Duct seal shall seal ducts neatly. Seal shall tolerate cable movement, but shall provide seal for water, rodents, and other contaminants in the conduit. Duct seal shall be Polywater, FST-250, or equal.

G. Cable Ties shall be made up of durable nylon, heavy duty, Thomas Betts Ty-Rap, or equal.

PART 3 -- EXECUTION

3.01 UNDERGROUND SURVEY PRIOR TO EXCAVATION

A. Prior to any excavation work, call “811” and/or hire an underground utility locator to identify existing buried utilities. Submit findings to ENGINEER OF RECORD, prior to excavation work.

B. If contractor fails to perform underground survey, costs and loss of revenue associated with downtime of impacted system shall be the contractor’s responsibility.

3.02 INSTALLATION

A. General Installation

1. Install underground conduits in trenches. Trench excavation width over 48 inches shall be provided with shoring protection and plans are subject to structural engineer's review.

2. Dry and wet utilities shall not occupy the same trench. Provide at least five (5) feet separation between dry and wet utility trenches.

3. In general, dry utilities shall be routed above wet utilities.

4. Underground clearances shall be 36 inches below grade for power conduits and 30 inches below grade for signal/communication conduits.

5. Provide at least 1 inch spacing between conduits control, telemetry, and signal of 120V or less. Provide at least 2 inches spacing between low voltage (control, telemetry, and signal) conduits and power conduits below 600 Volts.

6. Maintain a minimum distance of 12 inches between conduits with conductors below 600Volts and conduits with conductors for medium voltage conductors

7. Maintain at least 1 inch spacing between conduits with similar low voltage conductors.

8. Maintain at least 2 inches spacing between medium voltage conduits.

9. Conduit for service entrance (Power and Communication) installation shall comply with utility requirements.

B. Installation in Trenches

1. Concrete encased ductbank at the following locations

   a. As shown in the drawings, or

   b. Concrete encasement of ductbank is required if underground minimum clearances are not met, or

   c. When crossing wet utilities, where the conduits are route below the wet utilities or,

   d. When routed parallel to wet utilities, where trench distance to pipe is less than five feet.

2. Install raceways to slope away from buildings. Raceways between manholes, pullboxes or handholes shall drain toward the largest manholes, pullboxes, or handholes. Raceway slopes shall not be less than ¼ inch per foot.

3. Raceways shall be lay in sand bedding material with 3-inch cover all around. Compaction shall be every 10 -12 inches with backfill material, as shown in the drawings.

4. Lay underground raceways trenches parallel and perpendicular to roads, structures, and path of travel or as shown on the Drawings.

5. Use plastic spacers to hold raceways in place. Space at least every four feet with conduit base spacers every ten feet, or as suggested by the manufacturer.

6. Raceway entrances to buildings, structures, and equipment shall be PVC-coated rigid steel conduit not less than three feet long.

C. Underground Conduit Terminations and Entries

1. Raceway terminations at manholes shall be end bells for PVC conduit and insulated throat grounding bushings for steel conduit.

2. Conduit entries at manholes and pullboxes shall be at the side with minimum clearance of 6 inches above bottom of manhole and pullboxes.

3. Conduit in entries at handholes shall be at the bottom and shall use long radius elbows, sweeps and offsets. Communication conduit sweeps shall be at least 12 times the diameter of the communication wire it contains.

D. Clean and mandrel raceways before installing cable. Use cable lubricant in pull wires.

E. Train cables in manholes and pullboxes and support and restrain them on racks and hooks. Furnish inserts on all manhole and handhole walls for mounting future racks, as well as racks required for present installation.

F. Plug spare raceways and seal them watertight at all manholes, buildings and structures. Use conduit plugs.

G. Seal the ends of raceways and make watertight at all manholes, buildings and structures. Use duct seat.

H. Drainage

1. Handholes shall be set above 12 inches of drain rock.

2. At pullboxes and manholes, provide pipe at the bottom for drainage to nearest storm drain or French drain.

I. Label

1. Provide permanent etching of “SCVWD” at manhole, pullbox, and handhole covers.

2. Label manholes, pullboxes, and handhole covers with their identification as called out in the drawings. Typical label:

a. “EMH-X” or “SMH-X” = Electrical Manhole “X” or Signal Manhole “X”

b. ““EPB-X” or “SPB-X” = Electrical Pullbox “X” or Signal Pullbox “X”

c. ““EHH-X” or “SHH-X” = Electrical Handhole “X” or Signal Handhole “X”

J. Grounding

1. Install at least two ground rods at each manhole and pullbox. Install one ground rod at each handhole. Tie ground rod to grounding pigtail provided at each manhole and pullbox that is connected to the reinforcement.

2. Ground all non-current carrying metal and shielding to the ground rod. Connect all cable rack supports, manhole steps and manhole hardware to a grounding rod.

3.03 DOCUMENTATION

A. Provide an as built of underground conduit system. Include the following:

1. General Route

2. Typical Depth

3. General conduit orientation

END OF SECTION

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SECTION 26 05 50

ELECTRIC HEAT TRACING

PART 1 -- GENERAL

1.01 THE SUMMARY

A. The CONTRACTOR shall provide electric heat tracing systems, complete and operable, in accordance with the Contract Documents.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

ISA-S 5.1 Instrumentation Symbols and Identification.

1.03 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 - Contractor Submittals.

B. Shop Drawings

1. Show the location of thermostats and interphasing with electric power supply.

2. Manufacturer's Data: Complete manufacturer's data of the electric heating cables and the thermostats.

PART 2 -- PRODUCTS

2.01 GENERAL

A. Heat tracing shall consist of spiral wrapping with electrical heating cables as recommended by manufacturer under insulation with fiber glass sections, sealed and weatherproofed per Section 23 07 00 - Pipe and Equipment Insulation. The heating cables shall be controlled from thermostats installed in representative locations and accessible for adjustment. The heat tracing systems shall be installed complete, including heating elements, power connections, end seals, and controlling thermostats in accordance with the manufacturer's printed installation instructions.

2.02 BASIC MATERIALS

A. Heating Cable: The electrical heat tracing system shall consist of a flat, flexible, low heat density, electrical heating strip of parallel construction, consisting of a continuous inner core of conductive material between 2 parallel copper bus strips. The electrical insulation of the heater strip shall be polyester rated for 140 degrees F temperature, and its width shall be a minimum of 1/2-inch. It shall be suitable for operation on 120 volts.

B. Thermostats: A thermostat with a range of 40 degrees to 120 degrees F shall be provided for each heated pipe. It shall be double-pole, single-throw, and be mounted in a weatherproof NEMA Type 4 enclosure. The capillary bulb shall be mounted on the pipe under the insulation. Heating strips for pipes over 2-inches in size shall be rated at 8 watts per foot; for pipes 2-inches and smaller they shall be rated at 4 watts per foot.

C. Manufacturers, or equal

1. **Briscoe Manufacturing Co.**

2. **Chromalox (Emerson Electric Co.)**

3. **Nelson Electric (A Unit of General Signal)**

4. **Raychem Corporation**

5. **Thermon Manufacturing Company**

6. For thermostats: **Honeywell, Chromalox**

PART 3 -- EXECUTION

3.01 INSTALLATION

A. General

1. Pipes, valves, equipment and appurtenances shall be provided with heat tracing where indicated. Where not indicated, heat tracing shall be provided in all cases where items could be endangered by freezing.

2. The CONTRACTOR shall assemble and install equipment in strict accordance with the manufacturer's published instructions under the supervision of the manufacturer's representative. Installation shall be accomplished by competent craftsmen in a workmanlike manner. Heating strips shall be cut in the field and wrapped on the pipelines as required.

B. Contractor Coordination: The CONTRACTOR shall coordinate installation with the electrical WORK, to ascertain the correct location of electrical outlets.

C. Electrical Circuit: The CONTRACTOR shall provide heat tracing electric circuits in accordance with the National Electrical Code, NFPA 70, Article 427. Ground fault protection shall be provided for the heat tracing by a Class B GFCI circuit breaker with 30 mA trip. The GFCI circuit breaker may be installed in the panelboard feeding the circuit or in an enclosure by the heat traced equipment.

3.02 TESTING

A. The CONTRACTOR shall prepare the equipment for operational use in accordance with the manufacturer's printed instructions. Each system shall be tested for proper operation and the thermostats shall be set.

3.03 ACCEPTANCE

A. Final acceptance of the equipment is contingent on satisfactory appearance and operation.

END OF SECTION

SECTION 26 05 73

PROTECTIVE DEVICE STUDIES

PART 1 -- GENERAL

1.01 THE SUMMARY

A. Article includes:

1. Perform electrical system studies including arc flash hazard evaluation, short circuit and coordination studies, and load flow analysis.

2. Furnish and install arc flash hazard warning labels.

B. Related Sections:

1. Section 26 00 00, Electrical Work, General

2. Section 26 01 26, Electrical Tests

1.02 REFERENCES

A. IEEE Standard 1584

B. NFPA 70E

1.03 SUBMITTALS

A. All submittals shall be in accordance with Standard Provisions Section 7 and Section 26 00 00.

B. Initial arc flash assessment including shock hazard analysis

C. Submittals shall include:

1. System study firm qualifications.

2. System study.

3. Sample arc flash hazard warning label.

1.04 SYSTEM DESCRIPTION

A. The following equipment shall be included in the systems study as per the requirements of this article.

1. All new and existing equipment from, and including, the service entrance switchgear through, and including, all 480 volts switchgear, panelboards, and motor control centers, and 208 volts and 240 volts panelboards.

B. The studies shall help determine suitability for energization.

1.05 QUALIFICATIONS

A. The systems studies shall be performed by a Professional Electrical Engineer, registered in the state of California, with a minimum of five (5) years' experience in the performance of such studies.

PART 2 -- PRODUCTS

NOT USED

PART 3 -- EXECUTION

3.01 SYSTEM STUDIES

A. Consultant shall perform initial arc flash evaluation and shock hazard analysis to determine equipment that require more comprehensive arc flash study.

B. Provide a complete arc flash analysis, short circuit study, protective device coordination study, and load flow analysis for both the utility power distribution system and the emergency/standby power distribution systems.

1. The study shall include the following major and minor components:

a. Utility protective devices

b. Service entrance and distribution switchgear.

c. Medium- and low-voltage power system transformers.

d. Medium-voltage motor control centers.

e. Low-voltage switchgear, switchboards, power distribution panels, and motor control centers.

f. Three-phase panelboards, 208 volts and 240 volts.

g. Single-phase panelboards, 208 volts and 240 volts.

h. Variable frequency drives and harmonic mitigating equipment for motors 50 horsepower and greater.

i. Emergency and standby generators and associated paralleling and distribution equipment.

j. Power factor correction equipment.

k. The largest low-voltage motor on each bus shall be used to verify coordination.

l. Each medium-voltage motor.

m. The short circuit study may lump all low-voltage motors connected to a single bus.

C. The study shall be performed on SKM Power Tools software.

D. The study shall be in full compliance with applicable ANSI and IEEE Standards including IEEE 1584.

E. The testing firm performing the study shall be responsible for obtaining all data required to complete the study and recommended settings.

F. The study shall include but shall not be limited to:

1. Overall electrical distribution single line diagram. The diagram shall identify each bus, transformer, reactor, etc., by name and corresponding node number. The available fault currents, for each node, shall be indicated on the diagram.

2. Available three-phase and ground fault asymmetrical and symmetrical fault currents at each piece of electrical equipment, bus, transformer, etc.

3. Overall system impedance diagram. The diagram shall include the power companies' impedance and X/R ratio, circuit element impedances (e.g. transformers, generators, motors, VFDs, feeders, distribution buses, etc.).

4. The available fault current at each bus within the limits of the study shall be identified and listed.

5. The momentary and interrupting rating of all elements of the distribution system shall be listed. The maximum available fault current available at each element shall be calculated.

6. Determine the adequacy of the electrical protective devices to withstand the maximum available fault at the terminals of the equipment. Provide an equipment list, the equipment rating (both momentary and withstand), the maximum available fault rating and the adequacy of the equipment to withstand the fault. Equipment that does not have adequate ratings shall be identified immediately and brought to the attention of the CONSTRUCTION MANAGER.

7. Provide a complete set of time-current coordination curves on log paper. Limit the number of protective devices shown on any drawing to a maximum of four. A one-line diagram depicting the portion of the distribution system under study shall appear with the curve. The minimum size log paper to be submitted shall be 11.5 inches by 18 inches.

8. The time-current curves shall include transformer ANSI damage and inrush curves, cable damage curves, circuit breaker and fuse ratings and settings, protective relay settings and any other information required by ANSI and good design practices. As a minimum provide curves for:

a. Each medium-voltage and low-voltage feeder down to 480-volt motor control centers, distribution panelboards and adjustable speed drives.

b. Each main, tie and feeder circuit breaker located in the medium voltage and 480 volts distribution switchgear, motor control centers and distribution switchgear. Include the largest feeder circuit breaker in each motor control center and distribution panelboard.

c. Each ground fault protective device provided for the medium- voltage and 480 volts distribution systems.

d. Motor starting profile for the largest motor connected to each motor control center and switchgear.

e. A tabulation of all the settings for every over current protective device, timer, power system relays (e.g. ANSI 25, 27, 32, etc.), circuit breaker, recommended fuse and current transformer ratings, etc.

f. Transformer damage curves in accordance with ANSI C57.109.

g. Transformer excitation current.

h. Motor, generator and cable damage curves in accordance with the manufacturer's recommendations.

i. Select relay types (i.e. inverse, very inverse, or extremely inverse overcurrent, with or without voltage restraint, timers, etc.), current transformer ratings and types, fuse, residual or zero-sequence connected ground fault protection, etc., that will allow the system to be protected within the equipment fault ratings and provide the maximum possible coordination between the protective devices.

j. A complete set of coordination curves for every protective relay, circuit breaker, fuse, timer, etc., serving or located in the electrical equipment furnished for the project including the utility protective devices.

9. Provide recommended settings for all protective devices furnished or installed under Division 26.

10. Executive summary describing the distribution system, the procedures used to develop the study, utility related information furnished by the utility company including the name and telephone number of the individual supplying the information. Identify all assumptions made in the preparation of the study and identify any problem areas and provide a definitive statement concerning the adequacy of the distribution system to interrupt and withstand the maximum possible fault current.

11. Computer printout of the input data.

12. Computer printouts for the three-phase, single-phase and ground fault studies. Printouts shall indicate the fault current available at each major equipment, distribution bus within the medium- and low-voltage distribution systems.

13. Table listing all the electrical distribution and utilization equipment, including adjustable speed drives, the equipment interrupting and withstand ratings, the available fault current at the terminals of the equipment, and the ability of the equipment to interrupt and/or withstand the fault.

G. Provide a preliminary short-circuit and system coordination report, and load flow analysis report, with the switchgear shop drawing submittal. The preliminary report shall verify that equipment is being applied within design ratings and that electrical protective devices will coordinate.

H. The coordination study shall be bound in a standard 8-1/2 inches by 11 inches size report. The selection of all protective relays types, current transformers, fuse types, and ratings shall be the responsibility of the manufacturer and shall be based on the coordination study preliminary draft, which shall be submitted with the equipment shop drawings.

I. The coordination study shall be stamped and signed by a Professional Electrical Engineer, registered in the state of California.

J. The complete study shall be approved by the ENGINEER OF RECORD before any equipment is shipped.

K. Furnish and install shock hazard labels and arc flash warning labels on equipment. Labels shall include data calculated in the arc flash analysis.

L. Load flow analysis tables and diagrams.

M. Complete Final SKM Project Files (electronic) including all Project Libraries for future use by the District.

END OF SECTION

SECTION 26 09 13

ELECTRICAL POWER MONITORING

PART 1 -- GENERAL

1.01 THE SUMMARY

A. Article includes:

1. Furnish, install, and configure the electronic circuit monitor (ECM) system as shown on the Drawings and as specified in these Specifications.

2. The ECMs shall be factory-mounted in the equipment as shown on the Drawings.

3. ECMs shall be either Type 1, Type 2. Or Type 3 devices as detailed in this Section.

4. Since this Section includes products that are listed as “no equal,” the supplier/agent shall submit copies of three or more separate legitimate purchase orders (invoices) on supplier/agent letterhead within the 12 months prior to the bid date listing the purchase cost for comparable products and services. The Contractor shall submit the cost quoted for these products and services under this Work to the ENGINEER OF RECORD for comparison. The District reserves the right to institute a contract change of products and services without compensation to the product supplier/agent if the cost quoted is greater than the median cost listed in the submitted purchase orders (invoices). The supplier/agent shall not compel bidders (or Contractor) to purchase other products or services in conjunction with products listed as “no equal.”

B. Related Sections:

1. Section 26 00 00, General Electrical Requirements.

2. Section 26 05 19, Wire and Cabling.

3. Section 26 29 00, Low Voltage Motor Control Centers.

1.02 SUBMITTALS

A. Submittals shall be in accordance with Standard Provisions Section 7 and Section 26 00 00. Submittals shall include Shop Drawings and Product Data for the following:

1. ECM outline and dimensional drawings showing device layout, interconnection points and mounting requirements.

2. Submit wiring, interconnection, and mounting diagrams for the ECM for each switchgear, switchboard, panel, or MCC where the ECM is to be installed. Submit detailed drawings including wire numbers and terminals for each installation. Standard or generic diagrams will not be acceptable.

3. Submit ECM catalog data indicating all options, special features, ratings, and physical details.

1.03 SYSTEM DESCRIPTION

A. The District has a Square D PowerLogic power monitoring system. The system presently has several components installed as indicated on the Drawings and this system will be augmented by this project.

B. Styles of ECM devices shall be installed under this project.

1. Type 1 ECMs shall be connected to the power monitoring data highway and shall be used for local and remote monitoring of critical feeders, excluding the incoming utility main.

2. Type 2 ECMs shall be connected to the power monitoring data highway and shall be used for local and remote monitoring of specific branch and feeder circuits.

3. Type 3 ECMs shall be connected to the power monitoring data highway and shall be used for monitoring of the incoming utility main services to facilities. Type 3 ECM can also be used for Type 1 applications.

1.04 QUALITY ASSURANCE

A. Coordinate with the suppliers of the electrical distribution equipment to ensure that sufficient space is available for mounting CTs, PTs, and ECM modules, and that all environmental requirements for the ECM modules are met when mounted within the equipment enclosures.

1.05 OPERATIONS AND MAINTENANCE MANUALS

A. Furnish in accordance with Standard Provisions Article 14.01 and Section 26 00 00. Provide new manuals for each component provided.

B. Include an index of each ECM provided including location and equipment number per District standards, as shown on the Drawings.

C. Include all set-up and program calibration details with the “as-left” conditions.

1.06 ECM MANUFACTURER’S FIELD SERVICE ENGINEER

A. The ECM manufacturer’s Field Service Engineer shall be present at the site to perform the services described and for the minimum time listed. Travel time is not included.

Time (hours)	Service
8	Installation assistance and certification
8	Field-testing and startup (see Section 01 75 06 for additional requirements)

B. Submit an ECM manufacturer's certificate of proper installation upon successful completion of the field testing and startup effort.

C. Field Service Engineer shall be certified Schneider and Power Logic Field Service Engineers. Certified field service engineer includes Scheinder Electric, Applied Power Technologies, Alameda Electric, or equal.

PART 2 -- PRODUCTS

2.01 TYPE 1 ECM

A. Type 1 ECMs shall be furnished with all options required for connection to the proprietary Square D power monitoring network as shown on the Drawings.

B. Type 1 ECMs shall be Square D CM4000 Series. No others are acceptable.

C. All Type 1 ECMs shall be provided with a memory size of 10 MB.

D. Type 1 ECMs shall be provided with a local display.

E. Provide standard RS-485, RS-232, and optical ports for local communication link in a daisy chain network topology. Configure the RS-485 ports for Modbus protocol communications.

F. Provide optional Ethernet RJ45 port for networking and remote monitoring.

G. Type 1 ECM shall also be provided with license to be programmed into the SPM Power Logic.

2.02 TYPE 2 ECM

A. Type 2 ECMs shall be furnished with all options required for connection to the proprietary Square D power monitoring network as shown on the Drawings.

B. Type 2 ECMs shall be Square D PM-850. Power Meter with peak demand functions. No others are acceptable.

C. All Type 2 ECMs shall be provided with a memory size of 5 MB.

D. Type 2 ECMs shall be provided with a local display.

E. Provide standard RS-485, RS-232, and optical ports for local communication link in a daisy chain network topology. Configure the RS-485 ports for Modbus protocol communications.

F. Provide optional Ethernet RJ45 port for networking and remote monitoring.

G. Type 2 ECM shall also be provided with license to be programmed into the SPM Power Logic.

2.03 TYPE 3 ECM

A. Type 3 ECMs shall be furnished with all options required for connection to the proprietary Square D power monitoring Ethernet data highway as shown on the Drawings.

B. Type 3 ECMs shall be Square D PowerLogic Ion7650. No others are acceptable.

C. All Type 3 ECMs shall be provided with a memory size of 10 MB.

D. Provide status input for a 4-20 ma pulse signal from the utility meter where shown on the Drawings.

E. Type 3 ECMs shall be provided with a local display.

F. Provide optional Ethernet RJ45 port for networking and remote monitoring.

G. Type 3 ECM shall also be provided with license to be programmed into the SPM Power Logic.

2.04 PT, CT & CPT REQUIREMENTS

A. Coordinate auxiliary potential transformer (PT) requirements with MCC or switchgear manufacturer. PT shall be 0.3% accuracy class.

B. Provide three isolated phase current transformer (CT) and one isolated neutral CT inputs with 5 amps secondary. CT shall be 0.3% accuracy class.

C. Provide control power transformer (CPT) with 120 V secondary.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. ECM modules shall be factory installed into the switchgear, switchboards, MCCs, or panels as shown on the Drawings, and as specified in these Specifications. Provide all mounting hardware, CTs, PTs, CPTs, and installation details including grounding requirements to ensure that the ECM modules are installed in conformance with the ECM manufacturer and the supplier of the switchgear, switchboards, MCCs, and panelboards.

B. ECM installation within the switchgear, switchboard, or panelboard shall not violate the manufacturer’s warranty for the ECM or the respective switchgear, switchboards, MCCs, or panels.

C. Extend conduit and Ethernet wires to the ECM from the nearest District Network Switch. Connect ECM to the nearest District Network Switch.

D. ECM shall be programmed with IP address and give a unique device address.

E. ECM shall be locally programmed and ready to be network to the remote monitoring system.

3.02 STARTUP, CONFIGURATION, AND TESTING

A. The ECM field service engineer shall provide all startup, configuration, and field testing of the installed ECM system. As a minimum, this service shall include the following:

1. Configure new and existing ECM devices as required to communicate with the District's PowerLogic application SPM software (existing on District-owned PC). Set parameters for ECM devices via LAN and PC using the existing PowerLogic software.

2. Connect the new and existing ECMs to the existing PowerLogic Data Highway and Ethernet communications module as directed by the District.

3. Develop user diagrams for elevations, one lines, and system network diagram. The development and programming of at least 12 user diagrams in the SPM Vista module shall be included.

END OF SECTION

SECTION 26 09 23

LIGHTING CONTROL DEVICES

PART 1 -- GENERAL

1.01 THE SUMMARY

A. Section includes:

1. The contractor shall furnish all labor, materials, equipment, and incidentals required, and shall install complete, ready for operation, the Lighting Energy Management System in these Specifications, hereafter called “the system”, as shown on the Drawings and as specified in these Specifications.

2. Lighting systems as shown on the Drawings shall comply with this Specification Article. The following buildings and/or structures shall include lighting energy management systems:

   a. Centrifuge Building B.

3. The Lighting Energy Management System shall be supplied by a single Lighting Energy Management System Supplier (LEMSS). The LEMSS shall perform all work necessary to design, select, furnish, install, supervise installation, test, and document the system which shall be in complete compliance with the system specified in these Specifications.

4. The LEMSS shall complete the conceptual design as detailed on the Drawings in full compliance with applicable sections of the California Energy Efficiency Standards for Non-Residential Buildings (Title 24) and any local code requirements. The Drawings and Specifications are not intended to be a complete listing of all components required for the system. All auxiliary and accessory equipment necessary for system performance in compliance with the applicable codes shall be provided even if not specifically detailed on the Drawings or in these Specifications. Preparation and submittal of detailed, project specific installation drawings (including but not necessarily limited to mounting, interconnection, wiring type details, supportive calculations, etc.) shall be included as a part of this work.

5. The LEMSS shall coordinate the system with other related equipment and materials furnished by other suppliers under other Sections of these Specifications.

6. The LEMSS shall ensure that all equipment of the system is furnished, installed and connected in accordance with the manufacturer’s instructions.

B. Related Sections

1. Standard line voltage lighting control switches are included in Section 26 05 36.

2. Lighting fixtures and accessories are included in Section 26 50 00.

3. Typical lighting control diagrams, lighting fixture schedules and lighting plans are included in the Drawings.

1.02 QUALIFICATIONS

A. The LEMSS shall be a “Specialty Contractor,” supplier, or manufacturer regularly engaged in the design and specification of lighting energy management systems and their associated subsystems. The supplier shall comply with the following criteria:

1. Employs a professional Electrical Engineer, registered in the state of California, to supervise or perform the work required by this Specification article.

2. Employs personnel on this project who have successfully completed training courses on California Title 24 Energy Standards.

3. Has performed work of similar or greater complexity on at least five previous projects.

4. Has been actively engaged in the type of work specified in this Specification article for a minimum of five years.

B. The LEMSS shall maintain a permanent, fully staffed and equipped service facility within 100 miles of the project site with adequate personnel and equipment to maintain and repair the system.

C. Actual installation of the system need not be performed by the LEMSS’s employees; however, the LEMSS, as a minimum, shall be responsible for the technical supervision of the installation.

D. The LEMSS shall furnish equipment which is the product of one manufacturer to the maximum practical extent. Where this is not practical, all equipment of a given type shall be the product of one manufacturer.

E. The LEMSS shall be one of the following, or equal, as approved by the ENGINEER OF RECORD.

1. Lighting Systems; Pleasanton and Berkeley, CA.

2. Honeywell.

3. The Watt Stopper; Livermore, CA (formerly Thomas Controls, Brentwood, CA).

F. F. Listing in this specification article does not relieve any potential LEMSS of the requirements of these specifications.

G. Manufacturer’s model numbers are included to provide an indication of the basic system component and features; however, the equipment furnished shall be inclusive of all requirements of the written text to the extent that the text specifies optional or additional features not included with the basic model number.

H. The system shown on the plan drawings is based on a design from the first named supplier (Lighting Systems), using the products of the first named manufacturers (Novitas and PLC Multipoint). Designs using alternative products may require different components, additional sensors, different sensor locations, etc. The supplier shall design and provide a system that provides the desired control functions with a guaranteed 100% coverage from the occupancy sensors used.

1.03 SUBMITTALS

A. Submittals shall include those set forth in Standard Provisions Section 7 and Section 26 00 00.

B. In addition, the submittals shall contain the following as a minimum:

1. Elementary or control schematics for each control scheme employed in the facility. Schematics shall be project specific and clearly marked to identify which room or area they are applicable to.

2. Conduit and wiring riser diagram with all components identified. Wiring size and quantity shall be identified.

3. Complete bill of materials detailing quantity, description and manufacturers model number of all components furnished.

4. Manufacturer's catalog data sheets for all components furnished.

5. Operational details of all equipment.

6. Panel interior and exterior elevation drawings showing relative location of all components.

1.04 FIELD ACCEPTANCE TEST BINDER

A. A system field acceptance test binder shall be prepared and furnished by the LEMSS. The purpose of this binder is to consolidate and organize the testing requirements and results for all components in the system.

B. A test summary tabulation shall be provided for each switch or control function in the project organized by room/area number. The tabulation shall include the following as a minimum:

1. Room/area number with a separate line for each switch or control function.

2. Physical installation check-off box for each switch and function.

3. Functional check-off box for each switch and function.

4. Full acceptance check-off box for each switch and function.

5. Comments box for each switch and function.

1.05 REFERENCE STANDARDS

A. The equipment furnished shall comply in full of the most current edition of the following standards:

1. UL 916, Standards for Energy Management Equipment.

2. FCC Emission Standard specified in Part 15, Sub-paragraph J for Class "A."

3. California Title 24 Energy Efficiency Standards for Nonresidential Buildings.

4. All panels shall utilize UL listed components and shall be manufactured and assembled in accordance with UL Standard 508.

5. Lighting control devices shall be certified by the California Energy Commission and listed in the “Directory of Automatic Lighting Control Devices.”

1.06 FINAL DOCUMENTATION

A. The LEMSS shall submit the following final documentation prior to final acceptance of the system:

1. As-built documentation of the system.

2. Hardware maintenance documentation.

B. The LEMSS’s final documentation shall be new documentation written specifically for this Contract but may include standard and modified standard documentation. All standard documentation furnished shall have all portions that apply clearly indicated. All portions that do not apply shall be lined out.

C. The documentation shall contain all illustrations, detailed drawings, wiring diagrams, and instructions necessary for installing, operating, and maintaining the equipment. The illustrated parts shall be numbered for identification. All information contained shall apply specifically to the equipment furnished and shall only include instructions that are applicable. All such illustrations shall be incorporated within the printing of the page to form a durable and permanent reference document.

D. The requirements for the LEMSS’s final documentation are as follows:

1. As-built documentation shall include all previous submittals, as described in this Specification, updated to reflect the as-built system. Any errors in or modifications to the system resulting from the Field Acceptance Tests shall be incorporated in this documentation. As-built Drawing documentation shall include, as a minimum, the following information:

a. Field wiring color code and identification tag.

b. Field wiring termination points.

c. Spare wire and control points.

2. The Hardware Maintenance Documentation shall describe the detailed preventive and corrective procedures required to keep the system in good operating condition. A maintenance manual shall be furnished for all delivered hardware. The Hardware Maintenance Documentation shall include, as a minimum, the following information:

a. Operation Information:

b. This information shall include a detailed description of how the equipment operates and a block diagram illustrating each major assembly in the system.

c. Preventive-maintenance Instructions:

d. These instructions shall include all applicable visual examinations, hardware testing and diagnostic routines, and the adjustments necessary for periodic preventive maintenance of the system.

e. Corrective-maintenance Instruction:

f. These instructions shall include guides for locating malfunctions. These guides shall include adequate details for quickly and efficiently locating the cause of an equipment malfunction and shall state the probable source(s) of trouble, the symptoms, probable cause, and instructions for remedying the malfunction.

g. Parts Information:

h. This information shall include the identification of each replaceable or field-repairable module. All parts shall be identified on a list in a drawing; the identification shall be of a level of detail sufficient for procuring any repairable or replaceable part. Cross-references between the LEMSS's part number and manufacturer's part numbers shall be provided.

PART 2 -- PRODUCTS

2.01 SYSTEM DESCRIPTION

A. The system shall implement the following mandatory controls as required by California Title 24 Energy Efficiency Standards and as shown on the Drawings.

1. Occupancy sensor control.

2. Dual level manual lighting control.

3. Manual dual level daylight control.

4. Exterior light photocell control with timer and manual override.

B. The system shall include multiple Lighting Control Panels (LCP) for exterior lighting where shown on the Drawings. The LCPs shall be fully factory assembled and tested.

C. The system shall be designed such that a failure of any one specific component will not prevent lighting from being established (via manual override if necessary) in all controlled areas.

2.02 OCCUPANCY SENSOR

A. Sensors shall be designed specifically for energy conservation of lighting. Sensors shall activate the electrical load upon entry into the controlled area and deactivate it after the area is vacated. Sensors shall be able to detect the minor types of motion (i.e., picking up a telephone, turning a page in a book) of people seated anywhere in offices, classrooms, and conference rooms. Sensors shall be designed specifically for the size and use of the area in which they will be used.

B. Sensors shall contain timing circuitry to provide adjustable “time to lights off” delay of 15 seconds to 30 minutes. Sensors shall contain “sensitivity” controls to adapt to room size and eliminate false triggering by HVAC. Adjustable “sensitivity” and “time delay” controls shall be provided for sensors. Coverage shall remain constant in occupied rooms after sensitivity control has been set. No automatic or inadvertent reduction in coverage shall occur when air-conditioning is in operation. A manual override switch in the Sensor shall allow the load to be turned on without tools in the event of Sensor malfunction. All controls shall be easily accessed, without removal of the sensor. Sensors shall include more than one frequency to enable individual control of adjacent spaces without gaps in coverage. Sensors shall be adjusted as needed to avoid false “on” and “off” signals.

C. Sensors shall be ceiling-mounted type, of an aesthetically pleasing, low profile design. Sensors shall be surface mounted on hung ceilings, pendant or fixture mounted in areas with open ceilings. Sensor housing shall be equipped with a protective grill to shield detectors from damage. Sensor electronics shall be replaceable, in the event of failure, without disturbing hard-wiring or sensor mounting. An easily visible indicator light shall verify that motion is being detected. Except when actually switching the load, system operation shall be silent.

D. Ultrasonic sensors shall not respond to audible sound. Infrared sensors shall incorporate a daylight filter to filter out short wavelength infrared waves such as sunshine. Dual technology sensors shall include separate time delay adjustments for ultrasonic and infrared technologies. Sensors shall be Novitas Designer Series or approved equal.

2.03 TRANSFORMER RELAYS

A. The transformer relay shall be a combined Class 2 transformer and magnetic latching relay. Relay systems requiring an external control transformer are not acceptable. Load contacts shall be rated 20 amps for ballast, tungsten and general use at 120 or 277 Vac and 1 horsepower at 120 Vac. Where required, isolated low voltage auxiliary contacts shall be rated 30 V ac/dc, 1 amp. Auxiliary contacts shall close concurrently with the line voltage contacts and serve to signal relay status through pilot devices or other monitors of load status. Relays with closing coils or solenoids are not acceptable. Transformer relay control circuits shall be 24 Vac maximum. Transformer relay shall be UL Listed Class 2, plenum-rated, with teflon control leads and shall be compatible with occupancy sensors provided. Transformer relays shall be capable of operating multiple sensors and of being connected to additional transformer relays as required by the system design.

B. Transformer relays are not shown on Plan Drawings. Location shall be determined by the LEMSS. Provide an enclosure for each device. Locate in an accessible location, typically near the lighting control switch.

C. Transformer relays shall be Novitas or approved equal.

2.04 INPUT DEVICES

A. Line voltage switches shall be Specification Grade type as specified in Section 26 05 36.

B. Outdoor Photocells:

Exterior mounted photocell shall be a low-voltage sensor designed to interface directly with the timer/controller at the LCP. Sensor shall be NEMA 3R weather-

resistant construction with an adjustable swivel-mount. Adjustable high and low light level settings shall be provided to allow for tuning the on/off deadband.

2.05 LIGHTING CONTROL PANELS (LCP)

A. The panels shall be flush, semi-flush, or surface mounted as indicated on the Drawings. The number of relays or contactors in the panels shall be as required to control the power to each load as indicated on the Drawings and Lighting Panel Schedules. Enclosures shall be suitable for the area in which they are installed. Reference Electrical Drawings for NEMA area classification. Enclosures for NEMA 1 areas shall be 14 gauge cold-rolled steel with baked enamel finish, with a front hinged door with semi-flush lock (all panels to be keyed alike). Panels located in areas noted as non-NEMA 1 shall comply with the more stringent area classification. Panel identification nameplates and control device nameplates shall be mounted to the front of each panel.

B. All power and control wiring will be identified with a unique identification number. Panels shall be provided with terminal strips for connection of all external wiring. Terminal points shall be uniquely identified and consistent with the LEMSS shop drawings.

C. Panels shall contain all necessary hardware to control and/or connect to the lighting loads and sensors specified. The Drawings and specifications are not intended to be a complete listing of all components required for a functional system. All auxiliary and accessory equipment (including but not limited to power supplies, transformers, relays, etc.) necessary for system performance shall be provided by the LEMSS even if not specifically detailed on the Drawings or in these Specifications. 120-volt input power shall be provided for the LCP. The exact number of controlled points shall be determined by the LEMSS from the Drawings; however, a minimum of two spare points in each LCP shall be provided for future use.

D. Timer/Controller

1. The timer controller shall be a microprocessor-based controller that shall accept input from the externally mounted photocell and include an adjustable timer feature. It shall operate to turn the exterior lights on and off in response to the signal from the photocell. Photocell operation shall be overridden by the timer control, for example, to keep the lights off from 2 a.m. to 6 a.m., or to turn lights on at 8 p.m., regardless of the photocell operation. Alternatively, the timer control can be set to “zero” for photocell control only. ON-OFF switches mounted on the face of the LCP shall provide manual-override control for each lighting circuit. “OFF” shall turn lights off until manually reset to resume automatic operation. “ON” shall turn lights on, regardless of photocell or timer input. However, the timer shall operate to automatically return the lights to an “OFF” position every two hours during the timed-off period.

2. The timer controller shall be easily programmed for alternate time periods including holiday schedules and weekday/weekend schedules. Battery backup,100-hour minimum, or EPROM memory shall be provided for time clock and programmed parameters. The controller shall be sized as required for the number of controlled zones shown on the Drawings.

3. Adjustable time delay shall be included on the photo cell control to minimize false switching.

4. Timer controller shall be PLC Multipoint “Nightsweeper” accessories and operations required for the desired control or approved equal.

E. Relay

1. Relays for controlling each zone of exterior lights shall be rated 20 amps at 120 volts.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Conduit and wire requirements are not shown on the Plan Drawings. The system shall be wired in conduit throughout in accordance with the LEMSS’s diagrams and requirements, the system diagrams shown on the Drawings, the remainder of Division 16 specifications, and submittal data. All system wiring shall be installed in conduit (including low voltage Class 2 signaling circuits). Wiring for low-voltage (24 VAC or less) shall be color-coded, stranded Number 20 AWG, or larger, Class 2 wire.

B. All external wiring entering the LCPs shall be provided with an identification tag indicating its termination point in the panel. Tagging shall be permanent, non-smearing, slip-on, heat-shrink tube-type with actual identification marking that is consistent with the LEMSS drawings.

C. Photocells shall generally be mounted facing north and in a location that is unaffected by light fixture sources.

D. All devices and equipment shall be located and mounted as directed by the LEMSS, as shown on the Drawings, and to provide the control system described in these Specifications. Equipment locations shall be coordinated with installed location of HVAC ducting, walls and partitions, room configuration, etc., to provide 100% coverage and eliminate false “ON” and “OFF” switching.

3.02 MANUFACTURER’S SERVICES

A. Supervision: Check-out and certify the installation of all components before power is applied.

B. Check Out: Placing the equipment into operation and making necessary adjustments.

C. Instruction:

1. Instruction of the Owner’s personnel in the use, operation and maintenance of all equipment of the system.

3.03 CORRECTION OF DEFICIENCIES

A. All deficiencies in work and/or items not meeting specified testing requirements shall be corrected in order to meet specification requirements at no additional cost.

B. Corrections shall include adjustments of sensitivity, time delay, aiming, false “on” or “off” signals, relocation or installation of additional sensors if needed to correct problems which

become apparent when the new systems are put into service under actual working conditions.

3.04 TESTS

A. The approved Field Acceptance Test Binder shall form the basis of the documentation of the system acceptance tests. All acceptance tests shall be witnessed by and signed off by the ENGINEER OF RECORD, the LEMSS field engineer, and the installation contractor.

B. The LEMSS shall furnish the services of a field service engineer, and any special tools, equipment and labor to perform the tests.

C. The ENGINEER OF RECORD shall be notified in writing a minimum of two weeks prior to the scheduled day for the field acceptance tests.

D. Each switch and control function connected to the lighting energy management system shall be individually witness tested and recorded in the Field Acceptance Test Binder. Two certified copies of the tests shall be furnished.

END OF SECTION

SECTION 26 12 16

PANELBOARDS AND DRY TYPE TRANFORMERS

PART 1 -- GENERAL

1.01 THE SUMMARY

A. Article includes:

1. All labor, materials, equipment and incidentals required and install all panelboards as shown on the Drawings and as specified in these Specifications.

2. All equipment identified on the Drawings as Lighting Panelboards or Distribution Panelboards shall conform to this specification unless noted otherwise on the Drawings.

B. Related Articles:

1. Section 26 00 00, General Electrical Requirements.

2. Section 26 09 13, Electrical Power Monitoring.

1.02 REFERENCES

A. Panelboards shall be in accordance with the Underwriter Laboratories (UL) “Standard for Panelboards” and “Standard for Cabinets and Boxes” and shall be so labeled where procedures exist. Panelboards shall also comply with NEMA Standard for Panelboards and the National Electrical Code (NEC).

B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.03 SUBMITTALS

A. All submittals shall be in accordance with Standard Provisions Section 7 and Section 26 00 00. The submittals shall include the following:

1. Submit catalog cuts and descriptive literature for each type of panelboard and breaker provided.

2. Submit individual panelboard schedule for each panelboard provided under this Work.

3. Engineering calculations shall be furnished in accordance with Article 13.05.01, Seismic Design Criteria. As a minimum, these shall demonstrate that each of the panelboards will adequately transfer the design seismic forces to the anchor bolts and foundation.

B. Shop Drawings

1. Transformers

a. Dimension drawings

b. Technical certification sheets

c. Drawing of conduit entry/exit locations

d. Transformer ratings, including:

1) Voltage

2) Continuous current

3) Basic impulse level for equipment over 600 volts

4) KVA

e. Descriptive bulletins

f. Product sheets

2. Panelboards

a. Breaker layout drawings with dimensions and nameplate designations

b. Component list

c. Drawings of conduit entry/exit locations

d. Assembly ratings including:

1) Short circuit rating

2) Voltage

3) Continuous current

e. Cable terminal sizes

f. Descriptive bulletins

g. Product sheets

h. Installation information

i. Seismic certification and equipment anchorage details

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

A. 120/240 volts, single-phase, 3-wire and 208/120 volts, 3-phase, 4-wire panelboards: Pow-R-Line 1a by Eaton, equal product by General Electric or Square D, or equal.

B. 480 volts, 3-phase, 3-wire and 480Y/277 volts, 3-phase, 4-wire panelboards: Pow-R-Line 3a or 4b by Eaton, equal product by General Electric or Square D, or equal.

2.02 GENERAL

A. Transformers

1. The transformers shall be dry-type, designed, manufactured, and tested in accordance with the latest applicable standards of ANSI and NEMA.

2. Transformers shall be UL-listed and bear the UL label.

B. Rating

1. Panelboard ratings shall be as shown on the Drawings.

2. Circuit breaker panelboards shall be fully-rated for the specified circuit breaker fault current interrupting capacity. Series connected short circuit ratings will not be acceptable.

3. Where required by the Drawings, panelboards shall be UL labeled as “suitable for use as service entry equipment”.

2.03 TRANSFORMERS

A. Energy Efficiency: Standard dry-type transformers shall meet the energy efficiency requirements of the Department of Energy Code of Federal Regulations (10 CFR PART 431), DOE 2016 Efficiency Levels. The product requirements are in the appliance regulations, Title 20, and the usage requirements are in Title 24.

B. Ratings

1. KVA and voltage ratings shall be as indicated.

2. Transformers shall be designed for continuous operation at rated kVA, for 24 hours a day, 365 days a year operation, with normal life expectancy as defined in ANSI C57.96 - Guide for Loading Dry Type Distribution and Power Transformers

3. Transformer sound levels shall not exceed the following ANSI and NEMA levels for self-cooled ratings:

Up to 9 kVA	40 dB
10 to 50 kVA	45 dB
51 to 150 kVA	50 dB

C. Construction

1. Insulation Systems

a. Transformers shall be insulated as follows:

1) 2 kVA and smaller: 150 deg C insulation system based upon 80 deg C rise.

2) 3 to 15 kVA: 185 deg C insulation system based upon 115 deg C rise.

3) 15 kVA and larger: 220 deg C insulation system based upon 150 deg C rise.

b. Required performance shall be obtained without exceeding the above indicated temperature rise in a 40 deg C maximum ambient.

c. Insulation materials shall be flame-retardant and shall not support combustion as defined in ASTM D 635 - Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position.

2. Transformer windings shall be copper.

3. Transformers shall have four 2-1/2 percent taps, 2 above and 2 below 480 volts.

4. Transformer shall include vibration dampeners between the core and the enclosure to minimize and isolate sound transmission.

D. Manufacturers: **General Electric, Eaton, Schneider Electric/Square D Company, or equal**.

2.04 PANEL BOARDS - MATERIALS, NEMA 1

A. Interiors

1. All interiors shall be completely factory assembled with circuit breakers, wire connectors, etc. All wire connectors, except screw terminals, shall be of the anti-turn solderless type and all shall be suitable for copper or aluminum wire of the sizes indicated.

2. Interiors shall be so designed that circuit breakers can be replaced without disturbing adjacent units and without removing the main bus connectors and shall be so designed that circuits may be changed without machining, drilling or tapping.

3. Branch circuits shall be arranged using double-row construction except when narrow column panels are indicated. Branch circuits shall be numbered by the manufacturer.

4. A nameplate shall be provided listing manufacturer's name, panel type and rating.

B. Buses

1. Bus bars for the mains shall be of copper. Full-size neutral bars shall be included. Phase bussing shall be full height without reduction. Cross connectors shall be copper.

2. Neutral bussing shall have a suitable lug for each outgoing feeder requiring a neutral connection.

3. Spaces for future circuit breakers shall be bussed for the maximum device that can be fitted into them.

4. Equipment ground bars shall be furnished.

C. Boxes

1. Recessed or flush-mounted boxes shall be made from galvanized code gauge steel having multiple knockouts, unless otherwise noted. Boxes shall be of sufficient size to provide a minimum gutter space of four inches on all sides.

2. Surface-mounted boxes and trims shall have an internal and external finish as specified in Paragraph 2.04, D4 below. Surface-mounted boxes shall be field punched for conduit entrances.

3. At least four studs shall be furnished for mounting the panelboard interior.

D. Trim

1. Hinged doors covering all circuit breaker handles shall be included in all panel trims.

2. Doors shall have semi-flush type cylinder lock and catch, except that doors over 48 inches in height shall have a vault handle and three-point catch, complete with lock, arranged to fasten door at top, bottom and center. Door hinges shall be concealed. Furnish two keys for each lock. All locks shall be keyed alike. Directory frame and card having a transparent cover shall be furnished on each door.

3. The trims shall be fabricated from code gauge sheet steel.

4. All exterior and interior steel surfaces of the panelboard shall be properly cleaned and finished with ANSI Z55.1, No. 61 light gray paint over a rust-inhibiting phosphatized coating. The finish paint shall be of a type to which field applied paint will adhere.

5. Trims for flush panels shall overlap the box by at least ¾ inches all around. Surface trims shall have the same width and height as the box. Trims shall be fastened with quarter-turn clamps.

2.05 PANEL BOARDS - MATERIALS, NEMA 3, 4, 4X & 12

A. Interiors and Buses

1. Interiors and buses shall be as specified for NEMA 1 construction.

B. Boxes and Covers

1. Boxes and covers shall be made from stainless steel with natural finish.

2. Boxes and covers shall be bolted together and gasketed.

3. Exterior doors shall be provided with three-point latches and handle with padlocking provisions.

C. Freestanding Panelboards

1. Where indicated on the Drawings as being freestanding, panelboards shall be provided in a 90 inches high by 24 inches deep (minimum) by 24 inches wide (minimum) weatherproof exterior enclosure suitable for floor mounting.

2.06 CIRCUIT BREAKERS

A. Panelboards shall be equipped with circuit breakers with frame size and trip settings as shown on the Drawings.

B. Circuit breakers shall be molded-case, bolt-on type.

C. Each circuit breaker used in 120/240 volts and 208Y/120 volts panelboards shall have an interrupting capacity of not less than 10,000 amps, RMS symmetrical.

D. Each circuit breaker used in 480Y/277 volts and 480 volts panelboards shall have an interrupting capacity of not less than 65,000 amps, RMS symmetrical.

E. GFCI (ground fault circuit interrupter) shall be provided for circuits where shown on the Drawings. GFCI units shall be 1 Pole, 120 volts, molded-case, bolt-on breakers, incorporating a solid-state ground fault interrupter circuit insulated and isolated from the breaker mechanism. The unit shall be UL listed Class A Group I device (5 milliamp sensitivity, 25 millisecond trip time) and an interrupting capacity of 10,000 amps, RMS.

F. Circuit breakers shall be as manufactured by the panelboard manufacturer.

G. Two- and three-pole circuit breakers shall be constructed as a single-unit and shall not require handle-ties.

2.07 ELECTRIC POWER OR CIRCUIT MONITORS (ECM)

A. ECMs shall be factory installed in panelboards as indicated on the Drawings.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Mount boxes for surface-mounted panelboards to allow at least ½ inches air space between the box and the wall.

B. Connect panelboard branch circuit loads so that the load is distributed as equally as possible between the phase busses.

C. Type circuit directories giving location and nature of load served. Install circuit directories in each panelboard.

D. Install markers on the front cover of all panelboards which identify the voltage rating. Markers shall be made of self-sticking B-500 vinyl cloth printed with black characters on an Alert Orange background, 2-1/4 inches high by 9 inches wide, Style A as manufactured by W.H. Brady Co. or equal.

E. Install a one-inches by three-inches laminated plastic nameplate with ¼ inches white letters on a black background on each panelboard. Nameplate lettering shall be as shown on the Drawings. Nameplates shall be epoxy adhesive and stainless- steel-screw mounted.

END OF SECTION

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SECTION 26 29 00

LOW VOLTAGE MOTOR CONTROL CENTERS

PART 1 -- GENERAL

1.01 THE SUMMARY

A. Article Includes:

1. Motor control centers as shown on the Drawings and as specified in these Specifications.

2. Electronic circuit monitors (ECM), Surge Protective Device (SPD), and variable frequency drives (VFD) shall be factory installed by the motor control center manufacturer as shown on the Drawings.

3. Motor control centers shall be sized to include all equipment, including the spares and spaces shown on the Drawings.

B. Related Sections:

1. Section 26 00 00, Electrical Work, General.

2. Section 26 09 13, Electrical Power Monitoring.

3. Section 26 29 23, Variable Frequency Drives (VFD).

4. Section 26 12 16, Panelboards and Dry Type Transformers.

5. Section 26 43 00, Surge Protective Devices.

1.02 REFERENCES

A. Motor control centers shall be designed, built and tested in accordance with NEMA Standard ICS-2 and Underwriters Laboratories (UL) Standard No. UL-845. Equipment shall conform to ANSI C19.3 test standards and the requirements of the National Electric Code (NEC).

1.03 SUBMITTALS

A. Submittals shall be in accordance with Standard Provisions Section 7 and Section 26 00 00. Submittals shall include shop drawings and product data, for the following:

1. Equipment outline drawings showing elevation and plan views, dimensions, weight, shipping splits and metering layouts. Indicate all options, special features, ratings and deviations from this Section.

2. Conduit entrance drawings.

3. Bus arrangement drawings.

4. Unit summary tables showing detailed equipment description and nameplate data for each compartment.

5. Product data sheets and catalog numbers for all components installed in the MCC including, but not limited to overcurrent protective devices, motor starters, control relays, control stations, meters, pilot lights, etc.

    a. List all options, trip adjustments and accessories furnished specifically for this project.

6. Manufacturer's standard unit elementary and compartment wiring diagrams for metering, relay, power and control circuits in accordance with the NEMA wiring class specified.

    a. Show wire and terminal numbers.

7. Instruction and renewal parts books.

8. Itemized list of spare parts tailored specifically for this project, including quantities, description, and part numbers.

9. Test and inspection reports.

10. Complete bill of materials list.

11. The equipment drawings, summary tables, elementary drawings/diagrams, spare parts list and bill of materials list shall be computer generated (i.e. no hand drawings, sketches, or lists will be acceptable).

12. Engineering calculations shall be furnished in accordance with Article 13.05.01, Seismic Design Criteria. As a minimum, these shall demonstrate that each of the MCCs will adequately transfer the design seismic forces to the anchor bolts and foundation.

1.04 QUALITY ASSURANCE

A. The motor control center shall be the product of a manufacturer who shall also be the manufacturer of all of the circuit breakers and motor starters included in the motor control center and who has produced the same type of equipment for a period of at least 15 consecutive years.

B. Motor control centers shall be designed, assembled and tested by the manufacturer of the motor control equipment included in the control center assembly.

C. All units and sections shall be UL labeled. Motor control centers containing service entrance equipment shall be UL labeled "Suitable For Use As Service Equipment."

1.05 OPERATING AND MAINTENANCE MANUALS

A. Operating and maintenance manuals shall be furnished in accordance with the Article 9.02.

B. The manuals shall be bound and shall also include:

1. A list of “as left” settings for all motor circuit protectors and circuit breakers.

2. A table listing cubicle number, load description, installed overload heater size and motor horsepower, amps, service factor, and motor code letter.

1.06 MANUFACTURERS

A. The general arrangement of each motor control center is shown on the Drawings. Motor control centers shall be one of the following products, or equal:

1. Cutler-Hammer Freedom 2100 Series.

2. General Electric 8000-Line.

3. Square D Model 6.

4. Allen-Bradley Centerline Series.

PART 2 -- PRODUCTS

2.01 RATING

A. Service voltage and short circuit withstand, and interrupt rating of the equipment and devices shall be as shown on the Drawings. Main and feeder circuit protective devices shall be fully rated for the indicated short circuit current. Systems employing series connected ratings for main and feeder devices shall not be used. Motor starter units shall be tested, and UL labeled for the indicated short-circuit current in combination with the motor branch circuit protective device.

B. The continuous current rating of the main horizontal bus shall be as shown on the Drawings. Vertical busses shall be sized for the structure load and shall have a minimum rating of 300 amps. Bus bracing shall equal or exceed the specified equipment short circuit rating.

C. Motor control centers, including devices, shall be designed for continuous operation at rated current in a 40 degrees C ambient temperature.

2.02 CONSTRUCTION

A. Enclosure

1. Enclosure type shall be NEMA Type 1A unless otherwise noted on the Drawings.

B. Structure

1. Motor control centers shall consist of a series of metal enclosed, free-standing, dead-front vertical sections bolted together to form double wall construction between sections. Individual vertical sections shall be nominally 90 inches high, 20 inches wide and 20 inches deep unless otherwise shown on the Drawings. Bottom channel sills shall be mounted front and rear of the vertical sections extending the full width of each shipping split. Top of each section shall have removable plates with lifting angle. Make provisions for field installation of additional sections to each end and provide full depth cover plates (rodent barriers) at each end of the motor control center channel sills.

2. Provide continuous top and bottom horizontal wireways extending the full width of the line-up, isolated from the horizontal bus. Provide a four-inch wide, full height, vertical wireway in each section, equipped with a hinged door and cable supports. Vertical wireway shall be isolated from the bus and device compartments. Wireway openings shall have rolled edges or protective grommets.

3. Provide individual, flange-formed, pan type door with concealed hinges and quarter-turn latches for each device compartment and future space. Doors shall be removable, but door removal shall not be required to withdraw starter units or feeder tap devices.

4. Motor control centers shall be designed for against-the-wall mounting. All wiring, bus joints and other mechanical parts requiring tightening or other maintenance shall be accessible from the front.

C. Unit Compartments

1. Provide individual compartments for each removable combination starter and feeder tap device unit. Each vertical section shall accommodate a maximum of six compartments. Steel barriers shall isolate the top, bottom and sides of each compartment from adjacent units and wireways. Removable units shall connect to the vertical bus in each section with tin plated, self-aligning, pressure type copper plug connectors. Size 5 and larger starter units may be wired directly to the bus. Removable units shall be aligned in the structure on guide rails or shelves and secured with a cam latch mechanism or racking screw.

2. Provide individual, isolated compartments for fixed mounted devices such as circuit breakers, cable lugs, metering, relaying and control devices. Main and bus tie circuit breakers shall be wired directly to the main horizontal bus. All bus connections shall be fully rated.

3. Provide the following features:

   a. Provision to padlock removable units in a partially withdrawn TEST position, with the bus stabs disengaged.

   b. Provision to padlock unit disconnect handles in the OFF position with up to three padlocks.

c. Mechanical interlock with bypass to prevent opening unit door with disconnect in the ON position, or moving disconnect to the ON position while the unit door is open.

d. Mechanical split-type terminal blocks for disconnecting external control wiring.

e. Auxiliary contact on unit disconnect to isolate control power when fed from an external source.

f. Disconnect operating handles and control devices mounted on the removable units.

g. Compartments containing motor starters shall have wiring diagrams and heater tables fastened to the compartment door. Compartments containing panelboards shall have circuit directories fastened to the compartment door. Diagrams, tables and directories shall consist of two-ply laminated plastic, with black face and white core.

h. No operator devices shall be located more than six-feet-six-inches above the finished floor. Circuit breaker operation handles more than 78 inches above the finished floor shall have operating arm extensions.

D. Bus Systems

1. Main horizontal bus: Silver-plated copper, bolted joints, accessible from the front of the structure, fully rated throughout the lineup.

2. Vertical section bus: Silver-plated copper, full-height, totally insulated and isolated by glass polyester barriers with shutters to cover stab openings when units are withdrawn.

a. Provide fish-tape barriers to isolate bottom wireways from lower ends of vertical bus.

3. Vertical buses used for a tie circuit breaker or tie feeder lugs shall be rated for a continuous capacity equivalent to the main horizontal bus rating.

4. Horizontal ground bus:

a. Provide a tin-plated copper ground bus in each section equipped with lugs for termination of feeder and branch circuit ground conductors.

b. Connect to ground bus in adjacent sections with splice plates.

5. Buses shall be sized for a maximum current density of 1200 amps per square inch.

E. Wiring

1. Wiring shall be stranded copper, minimum size No. 14 AWG, with 600 volts, 90 degree C, flame retardant, Type MTW thermoplastic insulation, NEMA Class II, Type B.

a. Line-side power wiring shall be sized for the full rating or frame size of the connected device.

2. All wires shall be numbered with type written heat shrinkable wire markers at each termination point, color coding per NEMA standards and the NEC.

a. Foreign voltage control wiring shall have yellow colored insulation.

F. Signage

1. Each motor control center shall be furnished with a sign marked “DANGER! 480 VOLTS. KEEP OUT” Letters shall not be less than one-inches high, 1/4-inches stroke. Signs shall be laminated plastic, engraved white letters with a red background.

2. Compartments with voltages from sources outside of the compartment shall have a sign mounted inside the compartment door marked “CAUTION! THIS UNIT CONTAINS A VOLTAGE FROM AN EXTERNAL SOURCE.” Letters shall be black on a high-visibility yellow background.

3. Provide a two-inches by six-inches nominal engraved master nameplate, of two-ply laminated plastic, black face, ½-inches high by 1/8-inches stroke white letters, screw-fastened to the top wireway of each lineup with epoxy adhesive and stainless-steel screws. Include MCC designation and service ratings.

4. Provide one-inches by three-inches nominal engraved unit nameplates of two-ply laminated plastic, black face, white core, 3/8-inches high by 1/16-inches stroke white letters, epoxy adhesive and screw fastened to each door with stainless steel screws. Equipment names shall be as shown on the one-line diagrams.

2.03 COMPONENTS

A. General

1. The Drawings indicate the approximate horsepower and intended control scheme of the motor driven equipment. Provide the NEMA size starter, circuit breaker trip ratings, control power transformers and thermal overload heater element ratings matched to the motors and control equipment actually supplied, in compliance with the NEC and the manufacturer’s heater selection tables. All variations necessary to accommodate the motors and controls as actually furnished shall be made without extra cost to the District.

B. Circuit Breakers

1. 250 amps trip and higher circuit breakers:

a. One-hundred percent equipment rated, 600 volts, molded-case circuit breakers with integral fully adjustable solid-state trip device.

b. Trip device shall be temperature insensitive and have the following characteristics and functions:

c. Independently adjustable long-time pick-up and delay.

d. Independently adjustable short-time pick-up and delay with I^2t in and out switch.

e. Adjustable instantaneous.

f. Independently adjustable ground fault pick-up and delay.

g. Trip mode targets for overload, short circuit and ground fault.

h. Long-time pick-up light.

2. 225 amps trip and lower circuit breakers:

a. Thermal-magnetic trip type, 600 volts, two- or three-poles as required, labeled in accordance with UL 489.

b. Provide integral current-limiting fuses as required to meet the specified equipment short circuit rating.

c. Provide independently adjustable magnetic trips on 225 amps frame breakers.

C. Combination Starter Units

1. Combination starters shall include a motor circuit protector (MCP) in series with a motor controller and an overload protective device. The MCP shall have an adjustable magnetic trip range up to 1000 percent of rated continuous current and a trip-test feature. MCP's shall be labeled in accordance with UL 489.

2. Motor starters:

a. Three-pole, 600 volts, electrically operated, of the types shown on the Drawings. Provide NEMA sizes as required for the horsepower shown on the Drawings. Minimum size shall be NEMA Size 1. Fractional size starters are not acceptable. IEC rated starters shall have continuous current ratings equal to or greater than the continuous current ratings listed in Table 2-321-1 of NEMA Standard Publication ICS 2. Starters shall have 120 volts encapsulated operating coils, individual control power transformers with primary and secondary fuses, and silver cadmium oxide renewable line contacts.

3. Multi-speed and reversing starters shall include two motor rated contactors mechanically and electrically interlocked so that only one device may be energized at any time.

4. Contactors:

a. Electrically held, 120 VAC coil operator, suitable for tungsten, ballast, or resistive non-motor loads, with over current protection, control transformer and contact ratings and poles as shown on the Drawings.

5. Motor overload protection:

a. Standard adjustable, three-pole, thermal bi-metallic or melting-alloy type, with push-to-test feature. Overload relays for submersible pump motors shall be ambient-compensated, quick trip, Class 10. Overload relays shall be manually reset from outside the enclosure by means of an insulated pushbutton.

b. Provide auxiliary alarm contacts where shown on the Drawings.

6. Auxiliary contacts:

a. Form C, NEMA A600 rating, as required by the control schemes on the Drawings.

b. Provide one normally open and one normally-closed spare contacts on each starter.

c. Additional auxiliary contacts shall be furnished as shown on the Drawings or as required by the control schematic and this article.

7. Control power transformers:

a. Two-winding type, 120 VAC secondary, fused in accordance with the NEC.

b. Provide extra capacity as required or where shown on the Drawings.

D. Variable Frequency Drives

1. Refer to Section 26 29 23 for specifications of adjustable speed drives required to be factory-installed in MCCs.

E. Instrumentation and Metering

1. Instrumentation transformers: Indoor, 600 volts, butyl rubber molded, metering class designed in accordance with ANSI and NEMA standards.

a. Window type current transformers, with burden capacity as low as 50 VA, may be used where such capacity is sufficient.

b. Current and voltage transformer accuracy ratings shall be at least 0.3%.

c. Provide individual current transformer for each phase conductor.

2. Elapsed-time hour meters: Five-digit, non-reset type, with120 volts synchronous motor.

3. Electronic circuit monitors (ECM) shall be factory-installed and shall be Square D type as specified in Section 26 09 13. No alternatives are acceptable.

F. Relays and Timers

1. Control relays and timers shall be provided in accordance with Section 26 05 15, Industrial Control Panels.

G. Pilot Devices

1. Control operators:

a. Heavy duty, full-size, oiltight, with NEMA A600 contact rating.

b. Types and quantities as shown on the Drawings.

2. Indicator lights:

a. Full size, oiltight, low-voltage, LED type, with push-to-test feature.

b. Colors and quantities as shown on the Drawings.

H. General purpose transformers:

1. Open, dry-type, with primary and secondary overcurrent protection in accordance with the NEC, size and voltage ratings as shown on the Drawings. Refer to Section 26 05 15, Industrial Control Panels for additional requirements.

I. Lighting and Distribution Panelboards:

1. Main breaker, factory-wired to transformer, bolt-on branch circuit breakers, size and voltage rating as shown on the Drawings. Refer to Section 26 12 16, Panelboards, for additional requirements.

J. Main Lugs

1. Main lugs shall be rated as shown on the Drawings. Lugs shall be provided with an individual compartment and shall be isolated with a removable barrier to shield lugs from inadvertent contact when the compartment door is opened. Locate lugs for top or bottom conductor entry as shown on the Drawings.

2.04 SURFACE PREPARATION AND SHOP COATINGS

A. All non-current carrying metal parts of the control center assembly shall be cleaned of all weld spatter and other foreign material and given a heat cured, phosphatized chemical pre-treatment to inhibit rust.

B. Indoor equipment shall be finish painted with one coat of manufacturers' standard electro-coated, heat-cured enamel. Color shall be ANSI 49 or 61 light gray.

C. Outdoor equipment shall be finish painted with two coats of polyurethane or epoxy enamel, 2 to 3 mil thickness. Exterior color shall be light gray.

D. Unpainted non-current carrying parts shall receive a protective zinc plating to prevent corrosion.

2.05 SHOP TESTING

A. Perform manufacturers standard production testing and inspection in accordance with NEMA and ANSI standards. Submit certified copies of the test results and reports.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. All motor control centers shall be bolted or welded to leveled steel channels securely embedded in concrete as detailed on the Drawings. Proper anchorage of motor control centers shall be determined by the Contractor in conformance with Section 01 33 17.

B. Field-installed interior wiring shall be neatly grouped by circuit and bound by plastic tie-wraps. Circuit groups shall be supported so that circuit terminations are not stressed.

C. In general, all conduit entering or leaving a motor control center shall be stubbed up into the bottom horizontal wireway directly below the vertical section in which the conductors are to be terminated or shall enter the motor control center from the top. Conduits shall not enter the motor control center from the side unless approved in writing by the ENGINEER OF RECORD.

D. Housekeeping pads shall be included for the motor control centers as detailed on the Drawings with the exception of motor control centers which are to be installed adjacent to an existing unit. Housekeeping pads for these (if used) should match the existing installation.

E. Install the equipment in accordance with the manufacturer's instructions.

F. Remove temporary lifting angles, lugs and shipping braces. Touch-up damaged paint finishes.

G. Make wiring interconnections between shipping splits.

H. Install bus splice-plates and torque connections.

I. Seal all seams, cracks, or openings in outdoor enclosures.

3.02 FIELD TESTING

A. Engage the services of an independent testing firm to inspect and test the installed equipment prior to energizing.

1. The District will witness the field testing. Provide adequate notice prior to testing.

B. Make the following minimum tests and checks before the testing agency's representative begins testing and adjustment.

1. Megger incoming line terminals and buses, phase-to-phase and phase-to-ground after disconnecting devices sensitive to megger voltage.

2. Remove current transformer shunts after completing secondary circuit. Check polarity and continuity of metering and relaying circuits.

3. Check mechanical interlocks for proper operation.

4. Test ground connections for continuity and resistance.

5. Adjust unit compartment doors.

6. Check control circuit interlocking and continuity with starters in the TEST position. Provide external source of control power for this test.

7. Adjust motor circuit protectors and voltage trip devices to their correct settings.

8. Install overload heaters or adjust relays for actual motor nameplate currents. If capacitors are installed between starter and motor, use overload relay heaters based on measured motor current.

3.03 TRAINING

A. The motor control center manufacturer shall provide the services of a factory trained service technician for start-up and training of the District's personnel. The first trip shall be coordinated with the equipment start-up. The second trip shall include any necessary follow-up or punch list work and shall also include instructions to the District or to his/her designated personnel. The manufacturer's service technician shall demonstrate and test all operational features of the installed equipment to the satisfaction of the ENGINEER OF RECORD. Submit a certified copy of the field inspection to the CONSTRUCTION MANAGER. No equipment shall be energized without the approval of the CONSTRUCTION MANAGER.

3.04 FIELD ADJUSTMENTS AND TESTS

A. The independent testing firm specified in Section 26 05 73 shall make the following inspection, tests and adjustments:

1. Calibrate and test main and feeder circuit breaker trip devices and protective relays per the Coordination Study specified in Section 26 05 73.

2. Inspect the installation for compliance with the manufacturers recommended installation practices and report all deviations to the CONSTRUCTION MANAGER.

3.05 CLEANING

A. Remove all rubbish and debris from inside and around the control center. Remove dirt, dust, or concrete spatter from the interior and exterior of the equipment using brushes, vacuum cleaner, or clean, lint-free rags. Do not use compressed air.

END OF SECTION

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SECTION 26 29 13

SOLID STATE REDUCED VOLTAGE STARTING

PART 1 -- GENERAL

1.01 THE SUMMARY

A. The Contractor shall furnish and install the low voltage motor starters as specified herein and as shown on the contract drawings.

B. Related Sections:

1. Section 26 00 00, Electrical Work, General.

2. Section 40 91 00, General Instrumentation and Control Systems Requirements.

C. References

1. The motor starters shall be designed, manufactured and tested in accordance with the latest applicable standards of NEMA, ANSI and UL.

1.02 SUBMITTALS

A. Submittals shall be in accordance with Standard Provisions Section 7 and Section 26 00 00.

B. The following information shall be submitted to the ENGINEER OF RECORD for review and approval prior to order:

1. Dimensioned outline drawings

2. Conduit entry/exit locations

3. Cable terminal sizes

4. Wiring diagrams

5. Nameplate schedule

6. Ratings including:

7. Voltage

8. Horsepower and/or continuous current

9. Product data sheets

C. Submittals – for construction

1. The following information shall be submitted for record purposes:

2. Final as-built drawings shall incorporate all changes made during submittal review and manufacturing process.

3. Wiring diagrams

4. Seismic certification as specified

1.03 QUALIFICATIONS

A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.

B. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years.

C. Manufacturer shall certify that the equipment shall withstand Seismic 4 requirements.

1.04 DELIVERY, STORAGE AND HANDLING

A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

A. The construction drawings and this section has been based on Eaton/ Cutler Hammer Reduced Voltage Motor Starter S811. The acceptable manufacturers are Eaton, General Electric, Schneider Electric, or approved equal. Manufacturers listed above are not relieved from meeting these specifications in their entirety.

B. Products in compliance with the specification and manufactured by others not listed be considered only if pre-approved by the ENGINEER OF RECORD ten (10) days prior to bid date.

2.02 REDUCED VOLTAGE MOTOR STARTER

A. The solid-state reduced-voltage starter shall be UL and CSA listed. The solid-state reduced-voltage starter shall be an integrated unit with power SCRs, logic board, paralleling bypass contactor, and electronic overload relay enclosed in a single molded housing

B. The SCR-based power section shall consist of six (6) back-to-back SCRs and shall be rated for a minimum peak inverse voltage rating of 1500 volts PIV

C. Units using triacs or SCR/diode combinations shall not be acceptable

D. Resistor/capacitor snubber networks shall be used to prevent false firing of SCRs due to dV/dT effects

E. The logic board shall be mounted for ease of testing, service and replacement. It shall have quick disconnect plug-in connectors for current transformer inputs, line and load voltage inputs and SCR gate firing output circuits

F. The logic board shall be identical for all ampere ratings and voltage classes and shall be conformally coated to protect environmental concerns

G. The paralleling run bypass contactor shall energize when the motor reaches 90 of full speed and close/open under one (1) times motor current

H. The paralleling run bypass contactor shall utilize an intelligent coil controller to limit contact bounce and optimize coil voltage during varying system conditions

I. Digital interface module and display shall be used to program the soft starter. Display shall include six-line LED readout. Monitoring parameters shall include line currents, pole currents, pole voltages, number of starts, and DC control voltage. Soft starter shall display motor status and the previous 5 fault conditions. Refer to the drawings for mounting of the display.

J. Protection Features and Functions

1. Starter shall be provided with electronic overload protection as standard and shall be based on inverse time-current algorithm. Overload protection shall be capable of being disabled during ramp start for long acceleration loads via digital interface module

2. Overload protection shall be adjusted via the device keypad and shall have a motor full load ampere adjustment from 30 to 100% of the maximum continuous ampere rating of the starter

3. Starter shall have selectable overload class setting of 5, 10, 20 or 30 via a DIP switch setting on the device keypad

4. Starter shall be capable of either an electronic or mechanical reset after a fault

5. Units using bimetal overload relays are not acceptable

6. Overtemperature protection (on heat sink) shall be standard

7. Starters shall provide protection against improper line-side phase rotation as standard. Starter will shut down if a line-side phase rotation other than A-B-C exists. This feature can be disabled via digital interface module

8. Starters shall provide protection against a phase loss or unbalance condition as standard. Starter will shut down if a 50% current differential between any two phases is encountered. This feature can be disabled via digital interface module

9. Starter shall provide protection against a motor stall condition as standard. This feature can be disabled via digital interface module.

10. Starter shall provide protection against a motor jam condition as standard. This feature can be disabled via digital interface module

11. Starter shall be provided with a Form C normally open (NO), normally closed (NC) contact that shall change state when a fault condition exists. Contacts shall be rated 60 VA (resistive load) and 20 VA (inductive load). In addition, an LED display on the device keypad shall indicate type of fault (Overtemperature, Phase Loss, Jam, Stall, Phase Reversal and Overload)

12. The following control function adjustments from digital interface module are required:

    a. Selectable Torque Ramp Start or Current Limit Start

    b. Adjustable Kick Start Time: 0–2 seconds

    c. Adjustable Kick Start Torque: 0–85%

    d. Adjustable Ramp Start Time: 0.5–180 seconds

    e. Adjustable Initial Starting Ramp Torque: 0–85%

    f. Adjustable Smooth Stop Ramp Time: 0–60 seconds.

13. Maximum continuous operation shall be at 115% of continuous ampere rating

2.03 ELECTROMECHANICAL REDUCED VOLTAGE MOTOR CONTROL

A. The starter shall utilize an autotransformer for a reduced voltage start. The autotransformer shall have adjustable voltage taps at 50%, 65% and 80%

B. The starter shall be an open transition type. The autotransformer shall use microprocessor-based type starters

2.04 ENCLOSURE

A. The enclosure shall be NEMA 12X, stainless steel.

2.05 MOTOR CIRCUIT PROTECTOR

A. Starters shall have an adjustable instantaneous motor circuit protector HMCP type disconnecting device.

2.06 AUXILLIARY COMPONENTS

A. Each starter shall be equipped with a fused control power transformer (100 VA minimum), HOA selector switch, start-stop pushbutton, “run” pilot light, “stop” pilot light, 2 NO/2 NC auxiliary contacts, and as indicated on the contract drawings.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Install equipment per manufacturers recommendations.

B. Provide equipment with identification as shown in single line diagram and in the contract drawings.

C. Uniquely identify all wires, cables and each conductor of multi-conductor cables at each end with wire and cable markers. Refer to electrical general requirements and wires and cables sections for additional identification requirements.

3.02 FACTORY TESTING

A. Standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of UL and NEMA standards.

B. The manufacturer shall provide three (3) certified copies of factory test reports.

3.03 FIELD QUALITY CONTROL

A. Provide the services of a qualified factory-trained manufacturer's representative to assist the Contractor in installation and start-up of the equipment specified under this section. The manufacturer's representative shall provide technical direction and assistance to the Contractor in general assembly of the equipment, connections and adjustments, and testing of the assembly and components contained herein.

B. The following minimum work shall be performed by the Contractor under the technical direction of the manufacturer's service representative.

1. Inspection and final adjustments

2. Operational and functional checks of starters and spare parts.

C. The Contractor shall provide three (3) copies of the manufacturer's field startup report.

3.04 MANUFACTURER'S CERTIFICATION

A. A qualified factory-trained manufacturer's representative shall certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations.

B. The Contractor shall provide three (3) copies of the manufacturer's representative's certification.

3.05 TRAINING

A. The Contractor shall provide a training session for up to five (5) owner's representatives for one (1) normal workdays at a job site location determined by the owner.

B. The training representative shall be conducted by a manufacturer's qualified representative.

C. The training program shall consist of the following:

1. Instructions on the proper maintenance and operation of the equipment.

END OF SECTION

SECTION 26 29 23

VARIABLE FREQUENCY DRIVES

PART 1 -- GENERAL

1.01 THE SUMMARY

A. Section Includes:

1. Labor, equipment, supervision and materials for the installation, testing and start-up of the variable frequency drives (VFD) as shown on the Drawings and as specified in these Specifications.

2. This article specifies three styles of VFD, noted on the Drawings as “VFD” or “CP-VFD.” The drives shall conform to the specific requirements for the drive type as detailed in this specification article.

3. Provide a factory-trained technician to start-up each VFD. The technician shall be present during the field acceptance testing. Start-up service shall include overtime charges, travel and living expenses and replacement parts.

4. Provide on-site training on VFD operation and maintenance for the District’s personnel per Section 01 75 06.

5. The VFD manufacturer shall verify that the motor to be used is suitable for use with the VFD.

B. Related Sections:

1. Division 40, Instrumentation and Controls for Process Systems

2. Section 26 00 00, Electrical Work, General.

3. Section 26 05 10, Electric Motors.

1.02 REFERENCES

A. IEEE Standard 519, “Guide for Harmonic Control and Reactive Compensation of Static Power Converters.”

B. National Electrical Code (NFPA 70).

C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.03 SUBMITTALS

A. Submittals shall be in accordance with Standard Provisions Section 7 and Section 26 00 00. Submittals shall include shop drawings and product data, for the following:

1. Equipment outline drawings showing elevation, plan and interior views, front panel arrangement, dimensions, weight, shipping splits, conduit entrances and anchor bolt

pattern. Indicate all options, special features, ratings and deviations from the specifications.

2. Power and control schematics including external connections. Show wire and terminal numbers and color coding.

3. Drive performance specifications.

4. Instruction and replacement parts books.

5. As-built final drawings.

6. VFD Parameters and Setting

7. Software or drivers

8. Field test and inspection reports.

9. Name, address, and telephone number of the nearest service facility.

10. Training agenda and information per Section 01 75 06.

1.04 QUALITY ASSURANCE

A. Variable Frequency drives shall utilize a field-proven design. The VFD manufacturer shall demonstrate at least three (3) years of continuous field operating experience with equipment of similar size and design.

B. A factory authorized service and parts organization shall be located within 100 miles of the project location. Provide the name and address of the factory authorized service and parts organization nearest to the project location with submittals.

C. Equipment shall be UL or ETL labeled.

1.05 SYSTEM DESCRIPTION

A. Refer to the driven equipment specifications for description of system operation.

B. Refer to Section 40 90 10, Process Control Descriptions and the control schematic diagrams on the electrical Drawings for control system operation.

C. Refer to the one-line and elevation diagrams on the Drawings for ratings and size details.

1.06 DELIVERY, STORAGE AND HANDLING

A. Package the equipment for maximum protection during delivery and storage.

B. Store the equipment indoors in a clean, dry, heated storage facility until ready for installation. Do not install the equipment in its final location until the facilities are permanently weather-tight. Furnish, install and wire temporary electric space heaters in the equipment until the permanent heating equipment is operational. Protect the equipment at all times from exposure to moisture and chemicals.

C. If required in the driven equipment specifications, the VFD manufacturer shall ship equipment to the driven equipment manufacturer's testing facility for use during the factory acceptance test.

1.07 PROJECT/SITE REQUIREMENTS

A. Under normal operating conditions, harmonic currents introduced into the power system supply network from the variable frequency drives shall not exceed the distortion limits for a General System as defined in IEEE Standard 519.

B. The VFD shall not produce audible motor noise in excess of the manufacturer's published noise standards for 60 Hz operation.

1.08 MAINTENANCE

A. As a minimum, provide the following spare parts for each size drive in the quantities specified:

1. One of each type printed circuit board.

2. Two power diodes.

3. One pair power transistors.

4. 100 percent replacement fuses, all types and sizes.

B. Spare parts shall be boxed or packaged for long term storage. Identify each item with manufacturers name, description and part number on the exterior of the package.

1.09 QUALIFICATION

A. The VFD supplier shall furnish with their first submittal on this project a statement verifying that they will furnish a system for this project which will meet the specified requirements for harmonics and line notching.

1.10 OPERATING INSTRUCTION

A. After approval, during and after construction, operating manuals covering instruction and maintenance on each type of equipment shall be furnished.

B. The instructions shall be bound and shall provide at least the following as a minimum:

1. A comprehensive index.

2. A complete "as-built" set of approved shop drawings.

3. Detailed service, maintenance and operation instructions for each item supplied.

4. A table listing of the "as left" drive set up parameters and alarm and trip settings.

5. The operating instructions shall also incorporate a functional description of the entire system, with references to the systems schematic drawings and instructions.

6. Complete parts list with stock numbers, including spare parts.

PART 2 -- PRODUCTS

2.01 DRIVE TYPES

A. Drives shall be one of the following three types as identified on the Drawings:

1. Drives identified as “VFD” Type on the Drawings shall be as follows:

a. All chemical metering pumps:

1) Drives shall be Allen-Bradley PowerFlex 40, or equal for non-networked drives.

2) Drives shall be Allen-Bradley PowerFlex 525, or equal for networked drives.

b. All non-chemical metering pump VFD applications: VFDs for motors 40 HP and smaller shall be 6-pulse type.

1) Drives shall be Allen-Bradley PowerFlex 525, or equal.

2. Drives identified as “CP-VFD” type on the Drawings shall be 18-pulse type and shall be utilized for all motors 50 HP and larger.

a. CP-VFD Type shall be one of the following:

1) Drives shall be Allen-Bradley PowerFlex 755-20G, 18-pulse configured drive, or equal.

2.02 GENERAL REQUIREMENTS

A. All VFDs and CP-VFDs shall comply with the following general requirements:

1. Input power: 460 VAC, plus 10 percent, minus 5 percent, three-phase, 60 Hz.

2. Input frequency: 57 to 63 Hz.

3. Ambient temperature: 0 to 40 degrees C.

4. Elevation: Up to 3,300 feet above mean sea level.

5. Relative humidity: Up to 90 percent noncondensing.

6. Drive output:

a. One hundred percent rated current continuous, suitable for operation of the driven equipment over the required speed range without overloading. Drives shall be capable of a continuous overload up to 110 percent rated current for variable torque loads and 150 percent rated current for constant torque loads. Starting torque shall be matched to the load.

7. Drives shall withstand five cycle transient voltage dips of up to 15 percent of rated voltage without an undervoltage trip or fault shutdown, while operating a variable-torque load.

8. The general arrangement of the equipment is shown on the Drawings. All drives of the same type shall be furnished by the same manufacturer.

9. Minimum drive efficiency: 97 percent or better at 4/4 motor base speed and rated torque.

10. Displacement power factor: 95 percent or higher throughout the entire speed range, measured at drive input terminals.

11. Voltage regulation: plus, or minus 1 percent of rated value, no load to full load.

12. Output frequency drift: No more than plus or minus 0.5 percent from setpoint.

13. Provide a dV/dT filter device at the motor or VFD output per the manufacturer's recommendation. Submit documentation demonstrating where such devices are required, along with mounting and cabling requirements.

2.03 CHEMICAL METERING PUMP VFDS

A. The VFDs shall be in full compliance with all technical provisions of the paragraphs of Subsection 2.04 SIX-PULSE, NON-CHEMICAL METERING PUMP VFD, 40 HP AND SMALLER except as modified by this Subsection, 2.03, CHEMICAL METERING PUMP VFDS.

B. VFDs furnished in compliance with this article shall be factory installed into the associated chemical control panel as specified in Section 43 21 29.05 and as detailed on the Drawings.

2.04 SIX-PULSE, NON-CHEMICAL METERING PUMP VFD, 40 HP AND SMALLER

A. General Requirements

1. The VFD's shall utilize a digital pulse-width modulated (PWM) design to convert the fixed AC input to a variable voltage, variable frequency AC output. Construction shall be modular, using plug-in type component mounting or keyed ribbon cable connections wherever possible to minimize downtime during repair.

2. The VFD operate satisfactorily when connected to a bus supplying other solid-state power conversion equipment which may be causing up to 10 percent total harmonic voltage distortion and commutation notches up to 36,500-volt microseconds, or when other VFD's are operating from the same bus. The drive shall include transient voltage suppression to allow reliable operation on a typical commercial power distribution system.

3. The VFD shall consist of a full-wave diode bridge converter to convert incoming fixed voltage/frequency to a fixed DC voltage. Provide a DC link choke smoothing reactor to limit fault throughput. The PWM strategy shall be of the space-vector type

implemented through a microprocessor which generated a sinecoded output voltage.

4. The output shall be generated by power transistors which shall be controlled by six identical, optically isolated base driver circuits. The VFD shall have an output voltage regulator to maintain correct output volt/Hz despite incoming voltage variations. The VFD shall have a continuous output current rating equal to or greater than the motor full load nameplate current.

5. Each VFD shall have a molded-case, circuit breaker type main power disconnect switch, with an external operating handle. The circuit breaker shall have a short circuit rating of 65,000 Amps, RMS symmetrical and shall be labeled in accordance with UL 489.

6. The following safety features shall be provided:

   a. Provision to padlock main disconnect handle in the OFF position.

   b. Mechanical interlock to prevent opening cabinet door with disconnect in the ON position, or moving disconnect to the ON position while the unit door is open.

   c. Barriers and warning signs on terminals that are energized with the power disconnect OFF.

7. Provide an equipment ground bus or lug connectors in each enclosure, suitable for connection to the copper grounding conductors shown on the Drawings.

8. Provide one inches by three inches, nominal, engraved lamicoid equipment nameplates on each VFD fastened with epoxy adhesive and stainless-steel screws or rivets. Nameplates shall be black with white core, 3/8-inches high lettering. Nameplates shall provide the VFD name exactly as indicated on the one-line drawings.

9. Provide permanent warning signs. Sign on main power disconnect shall read “Warning! Hazard of Electric Shock. Disconnect Power Before Opening or Working on this Unit.”

B. Operator interface

1. Provide a door-mounted digital keypad/display, capable of controlling the drive and setting drive parameters. The digital display shall normally display:

   a. Speed demand in percent

   b. Output current in amperes

   c. Frequency in Hz

   d. Control mode: manual or automatic

2. The digital keypad shall allow operators to enter exact numerical settings in English engineering units. A user menu shall be provided as a guide to parameter settings.

Coded messages on keypad will not be acceptable. Parameters are to be factory set in EEPROM and resettable in the field. Parameters shall be password protected. The EEPROM stored variables shall be transferable to new and spare boards.

3. The keypad/display module shall have a key switch to control operation of the keypad. The key shall be removable in either the “Enabled” or “Disabled” positions. The keypad module shall contain a “self-test” software program that can be activated to verify proper keypad operation. The keypad display shall contain a full alphanumeric character set.

4. The following controls and indicators shall be provided, either separately or as part of the keypad/display:

   a. POWER ON, RUN, AND FAULT indication.

   b. FAULT RESET control.

   c. LOCAL-OFF-REMOTE control mode selector.

   d. Manual START/STOP controls.

   e. Manual speed adjust capability.

5. VFD controls are indicated on the Drawings as being hardware devices; however, the keypad/display is acceptable if all of the functions detailed can be performed. Functions not available via the keypad/display shall be complemented with hardware devices as required.

C. External Interface

1. Provide one set of NO/NC auxiliary dry contacts for remote indication of VFD running status.

2. Provide one set of NO/NC auxiliary dry contacts for remote indication of VFD fault.

3. Provide one set of NO/NC auxiliary dry contacts for remote indication of LOCAL-OFF-REMOTE selector switch position.

4. The LOCAL-OFF-REMOTE selector switch shall have the following functions:

   a. LOCAL position: Speed and start-stop control from VFD keypad.

   b. OFF position: VFD off.

   c. REMOTE position:

      1) Remote dry contact closure shall start and stop the drive. Remote 4-20 mADC input signal shall control the speed.

5. Input and output signals shall be isolated at the drive.

6. Zero and span adjustability shall be provided for speed signals.

7. A 4-20 mADC isolated output signal proportional to speed shall be provided for remote speed indication.

D. Protective and Operational Features

1. Field adjustment of the following parameters through the keypad/display shall be provided:

   a. Current limit and boost.

   b. Voltage (volts/Hz)

   c. Frequency (Minimum/Maximum)

   d. Independently adjustable acceleration and deceleration rates.

   e. Auto restart delay.

2. The following short circuit and input protective features shall be provided:

   a. High-speed current-limiting input fuses and line reactors.

   b. Solid-state instantaneous overcurrent trip.

   c. Undervoltage protection with automatic restart.

   d. Ground fault protection.

3. The following internal protective features shall be provided:

   a. Transient surge protection.

   b. Transistor overcurrent protection.

   c. Current-limit, inverse-time type.

   d. DC bus fuse protection and discharge circuit.

   e. DC bus overvoltage trip.

4. The following output protective features shall be provided:

   a. Inverse time motor overload protection.

E. Diagnostic and Fault Capability

1. The following conditions shall cause an orderly drive shutdown and lockout.

   a. Incorrect phase-sequence.

   b. Blown input fuse or single phasing of supply.

   c. Control power supply failure.

d. Instantaneous overcurrent.

e. Sustained overload.

f. Transistor overcurrent.

2. Provide complete built-in diagnostic and test capability to enable maintenance personnel to rapidly and accurately identify the cause of equipment failure.

F. Communication, control and signal wiring.

1. Communication, control, and signal wiring for both hard-wired configurations, and network configuration shall be available drive options and shall be wired and terminated into the closed control cabinet.

a. Only hard-wired signals shall be allowed to be on the SCADA/PLC network. Please reference 40 90 10, Part 2.B.3.

b. Signal not used for controls and alarms shall go be for Maintenance, Relay Protection, Power Monitoring and other related monitoring functions.

2. Provide Ethernet cabling from each smart drive to the control cabinet.

G. Enclosures and Mounting

1. VFD s furnished in compliance with this article shall be factory installed into the motor control centers as specified in Section 26 29 00 and as detailed on the Drawings.

H. Shop Testing

1. Perform manufacturers standard production testing and inspection.

2.05 18-PULSE VFD, 50 HP AND LARGER

A. The VFDs shall be in full compliance with all technical provisions of the paragraphs of Subsection 2.04 SIX-PULSE, NON-CHEMICAL METERING PUMP VFD except as modified by this Subsection 2.05, 18-PULSE VFD, 50 HP AND LARGER.

B. Enclosures and Mounting

1. VFDs furnished in compliance with this article shall be furnished in factory assembled floor mounted enclosures as specified in this article and as detailed on the Drawings.

2. All non-current carrying metal parts of the equipment cabinet shall be cleaned of all weld spatter and other foreign material and given a heat cured, phosphatized chemical pre-treatment to inhibit rust.

3. Equipment shall be finish painted with one coat of manufacturers standard electrocoated, heat cured enamel.

4. Unpainted non-current carrying parts shall receive a protective zinc plating to prevent corrosion. Printed circuit boards shall be coated with a protective conformal epoxy. All device contacts shall be silver cadmium plated.

5. Enclosures shall be 90 inches high and 20 inches deep, with widths as shown on the Drawings.

C. Other Requirements for 18-Pulse VFD's

1. Drives shall include an integral phase shifting transformer and 18-pulse rectifier.

2. Drives shall meet IEEE 519 current and voltage harmonic standards without additional harmonic filters, rectifiers, or similar externally mounted devices.

2.06 HARMONIC ANALYSIS FOR DRIVES

A. The CONTRACTOR shall perform a harmonic study of the facilities included in this Project.

B. The following assumptions shall be utilized for the harmonic analysis:

1. The distribution system is a "general" system as classified by IEEE 519 under low voltage systems.

2. Assume 90 percent of total plant operating load is motor load and 10 percent is resistive.

3. Assume a 70 percent plant diversity factor (i.e., 70 percent of the total plant load is operating), with motors other than VFDs operating at 90 percent of their nameplate horsepower.

4. Assume all VFDs are operating.

5. Report

a. Results of the harmonic analysis shall be submitted prior to VFD shipment.

b. Excessive harmonic distortion shall be specifically denoted.

c. Corrective measures shall be submitted for action by the ENGINEER.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Install the equipment in accordance with the manufacturer's instructions.

B. Remove temporary lifting angles, lugs and shipping braces. Touch-up damaged paint finishes.

C. Install conduit from each drive to the nearest control panel in the instrumentation and control drawings.

3.02 FIELD TESTING

A. Make the following minimum test and checks before the manufacturer's representative is called in for testing and adjustment.

1. Verify that all connections are completed in accordance with shop drawings.

2. Verify supply voltage and phase sequence are correct.

3. Check mechanical interlocks for proper operation.

4. Test ground connections for continuity and resistance.

5. Check control circuit interlocking and continuity.

B. The manufacturers service technician shall perform start-up and adjustment of the drive(s) in accordance with the manufacturer's written instructions.

C. The District will witness the field testing. Provide adequate notice prior to testing.

D. In the event of an equipment fault, notify the CONSTRUCTION MANAGER immediately. After the cause of the fault has been identified and corrected, a joint inspection of the equipment shall be conducted by the Contractor, the CONSTRUCTION MANAGER and the equipment manufacturer's factory service technician. Repair or replace the equipment as directed by the CONSTRUCTION MANAGER.

3.03 ADJUSTMENT

A. Make all VFD internal adjustments and all adjustments necessary for manual and automatic operation of the entire system of driven equipment.

3.04 CLEANING

A. Remove all rubbish and debris from inside and around the equipment. Remove dirt, dust, or concrete spatter from the interior and exterior of the equipment using brushes, vacuum cleaner, or clean, lint-free rags. Do not use compressed air.

3.05 TRAINING

A. Provide training of District staff in accordance with Section 01 75 06.

END OF SECTION

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SECTION 26 33 53

UNINTERRUPTIBLE POWER, SINGLE PHASE

PART 1 -- GENERAL

1.01 THE SUMMARY

A. The CONTRACTOR shall provide a heavy duty, industrial grade, single phase uninterruptible power system (UPS) and all accessories required, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 26 00 00 - Electrical Work, General, apply to the WORK of this Section.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards

ANSI/IEEE 241	Electric Power Systems in Commercial Buildings, Recommended Practice for
ANSI/NEMA 250	Enclosures for Electrical Equipment
EIA	Electronic Industries Association Standards
IEEE-587	Standards for Surge Withstandability
NEC	National Electrical Code; Article 700 Emergency Systems
NEMA PB2	Panelboard
UL 1012	Underwriter's Laboratory Listing

1.03 CONTRACTOR SUBMITTALS

A. Furnish Shop Drawings and catalog data in accordance with Standard Provisions Section 7 and Section 26 00 00. Submit sufficient information to indicate the scope and quality of the UPS system installation.

1. Block diagram showing system relationships of major components and quantities and interconnecting cable requirements.

2. Control console and panel arrangements, equipment outlet devices, and special mounting details.

3. Wiring diagrams showing terminal identification for field-installed wiring.

4. Catalog literature.

B. Furnish 6 copies of the operating and service manuals for the system in accordance with Article 9.02. The manuals shall be bound in flexible binders and all data contained therein shall be printed or typewritten. Each manual shall include all instruction necessary for proper operation and receiving of the system, and shall include a complete block diagram of the system, a complete circuit diagnosis of the system, and a wiring designation schedule for each amplifier as well as other major components, and a replacement parts list.

1.04 QUALITY ASSURANCE

A. Uninterruptible power system components shall be manufactured by firms that are regularly engaged in the production of UPS systems including auxiliary equipment similar to that required by this Contract and that have been in satisfactory service for at least 10 years.

B. Operation of the uninterruptible power system shall be demonstrated to the ENGINEER OF RECORD to prove that under normal conditions, UPS will provide power to the designated load without interruptions of functions and loss of stored information.

1.05 SERVICE DURING CORRECTION OF DEFECTS PERIOD

A. The CONTRACTOR shall respond to trouble calls with a competent repair person at the Site within 24 hours of notice. The CONTRACTOR shall also maintain a full inventory of replacement parts so that all routine repairs can be completed within 24 hours after the initial response.

PART 2 -- PRODUCTS

2.01 THE SYSTEM

A. The UPS shall be a continuous duty, on-line, solid-state system, utilizing line-interactive UPS topology and operating in conjunction with the plant electrical system to provide power conditioning, back-up, and distribution for critical equipment loads. The system shall consist of a solid-state inverter/charger, microprocessor controlled logic, a ferro-resonant transformer, a sealed maintenance-free battery, electromechanical bypass switch, and accessories as indicated.

B. In the line-interactive or single conversion UPS, utility power shall be fed directly to the critical load through an inductor transformer. Regulation and continuous power to the critical load shall be achieved through the use of inverter switching elements in combination with inverter magnetic components, such as inductors, linear transformers, or ferro-resonant transformers. The inverter shall interact with the transformer to provide plus or minus 3 percent load regulation under variations of line and load condition within the ratings of the UPS.

2.02 SYSTEM DESCRIPTION

A. The UPS system shall consist of the following major equipment contained in a single cabinet:

1. Inverter/charger.

2. Electromechanical bypass switch.

3. Enclosed, sealed, maintenance-free battery. Battery compartment for longer protection times.

4. Input, battery, and output breakers.

5. Microprocessor controlled logic and control panel.

6. Magnetics (ferro-resonant regulating transformer).

7. Control panel.

2.03 MODES OF OPERATION

A. The UPS shall operate as an on-line fully automatic system in the following modes:

1. Normal: For incoming utility voltage as low as 62 percent of nominal, based on the size of the load, the ferro-resonant regulating transformer shall provide regulated output voltage without drawing power from the batteries while supplying filtered ac power to the critical loads. In addition, simultaneous float-charging of the battery shall occur.

2. Emergency: Upon failure of the commercial ac power, the inverter shall continue to supply the critical load without any switching by obtaining its power from the storage battery. There shall be no interruption to the critical load upon failure or restoration of the commercial ac source.

3. Recharge: Upon restoration of the commercial ac source, the inverter/charger shall recharge the battery. This shall be an automatic function and cause no interruption to the critical load.

4. Bypass Mode: If the UPS must be taken out of service for overload, load fault, or internal failures, the bypass switch shall automatically transfer the load to the commercial ac power. Return from bypass mode to normal mode of operation shall be automatic, except for overload trip which requires manual reset. Transfer to bypass mode shall also be initiated manually by operating a key-controlled On/Off switch on the control panel.

2.04 PERFORMANCE CHARACTERISTICS

A. Power Ratings: 10 kVA/7.5 kW

B. Input

1. Nominal input voltage and frequency: 60 Hz models: 208 Vac, 1-phase.

2. Operating input voltage range: plus 15 percent to minus 20 percent of nominal without battery discharge.

3. Input power factor: 0.98 minimum at full load and nominal input voltage.

4. Output voltage THD: 5 percent maximum at rated kW load.

5. Input surge protection: 2000:1 spike attenuation using ANSI/IEEE C62.45 Category A and Category B tests.

C. Runtime (minutes): 10.0 kVA/7.5 kW for 1-hour 13 min. under full load; 2-hour 59 min. half load.

D. Output

1. Nominal output voltage: 120/240 Vac.

2. Output voltage regulation: plus and minus 3 percent for input voltages of plus 15 percent to minus 20 percent.

3. Transient voltage response: Within plus and minus 8 percent from nominal peak voltage for a 100 percent load step.

4. Transient voltage recovery: 100 msec to within plus and minus 2 percent of nominal.

5. Frequency regulation: plus and minus 0.1 Hz.

6. Output voltage harmonic distortion: 5 percent or less TDH at rated kW load.

7. Output fully isolated from input and battery.

E. Environmental

1. Efficiency at full, unity power factor load and nominal input voltage: 90 percent

2. Elevation: The maximum operating ambient temperature drops 1 degree C per 300 meters (2 degrees F per 1000 feet) above sea level, with the maximum elevation being 3000 meters (10,000 feet).

3. Acoustical noise: 65 dBA at 1.5 meters

4. EMI suppression: Electromagnetic effects shall be minimized to ensure that computer systems or other similar electronic systems are neither adversely affecting to, nor are adversely affected by the UPS. The UPS shall be certified to meet the requirements of Class A, Subpart J of Part 15 of the FCC Rules and Regulations.

F. Battery Pack

1. The battery shall consist of battery tray fully enclosed within the UPS

2. Batteries shall be sized to provide run times as indicated.

3. Battery Overcurrent Protection: A molded case breaker or fuse shall be provided for battery short circuit protection.

2.05 FUNCTIONAL DESCRIPTION

A. Inverter/Charger: The inverter shall be capable of providing the indicated quality output power while operating from the ac utility or dc source within the required operating range. In addition, the inverter shall simultaneously float charge the battery.

B. Electrical Protection

1. DC Input: DC fuse and battery charger fuse

2. Output Protection: The ferro-resonant transformer shall inherently limit current and provide overload protection. The UPS shall have high ac and low ac output voltage alarms, as well as an overload alarm. If the ac output voltage falls below the low ac output voltage alarm setpoint, the unit shall alarm after 5 seconds. If the ac output voltage falls below the low ac output shutdown setpoint, the unit shall alarm and shut down.

C. Electromechanical Bypass

1. An electromechanical bypass switch shall include transfer control logic which automatically transfers the load to bypass upon the following conditions:

   a. Output overvoltage or undervoltage.

   b. Overload condition of a duration longer than 10 minutes.

   c. Overtemperature

   d. Inverter failure

2. Return to UPS mode of operation upon restoration of normal operating conditions shall be automatic except for overload or inverter failure which requires a manual restart. Electromechanical transfers shall be break before make.

D. Microprocessor Controlled Logic: Fully automatic operation of the UPS shall be provided through the use of microprocessor controlled logic. All operating and protection parameters shall be firmware controlled to eliminate the need for manual adjustment compensation for component tolerances. The logic shall include system and battery test capability to facilitate maintenance and troubleshooting. Start-up, transfers, and battery recharge shall be all automatic functions.

E. Control Panel

1. The UPS shall be equipped with a control panel that provides the monitoring and control functions

2. Four operating modes: Auto, Inverter On (Battery Power), Line Condition, and Off. Under normal conditions, selection of the appropriate operating mode shall be automatic, however the operating mode shall be manually selectable from the control panel.

3. Front panel lights

a. AC LINE –Green– Normal AC Input Power

b. READY –Green– Battery backup power available

c. CHARGING –Green– Battery is charging

d. BATTERY POWER –Yellow– UPS is in the inverter mode with power provided from the batteries.

e. ALARM –Red– Alarm condition

4. Alarm monitoring: The control panel shall display an error message identifying the alarm condition:

ALARM MESSAGE	ALARM CONDITION
Low Battery	The battery charge is low because the system was running on battery power or the DC Switch was not on.
Near Low Battery	The battery voltage has reached the Near Low Battery setpoint.
High Battery	There may be a problem with the charging circuit or parameter settings.
Low Runtime	The unit is running on battery power, and the battery runtime remaining is low.
Low AC Output	The output voltage is below a pre-programmed setpoint.
High AC Output	The output voltage is higher than the alarm setting.
Output Overload	Equipment is drawing more power than the UPS can provide. The unit shall continue to run with overloads as high as 125 percent for 10 minutes and then shut down.
Hi Ambient Temp	The temperature inside the unit is too high. If the temperature reaches a preset point, the unit shall shut down.
Hi Heatsink Temp	The inverter temperature is too high. If the temperature reaches a preset point, the UPS shall shut down.
User Test Alarm	The user is testing the alarm feature.

Hi Transformer Temp	The transformer temperature is too high. If the temperature reaches a preset point, the UPS shall shut down.
Check Charger	The UPS has detected a charger problem.
Check Battery	The batteries have failed the automatic system test.
Check Inverter	The inverter has failed the automatic system test.
Memory Check	Possible microprocessor problem.
Emergency Power Off	The Remote Shutdown feature has been activated at the RS232 port.
Hi PFM Res Temp	The Power Factor Module's temperature is too high. If the temperature reaches a preset point, the UPS shall shut down.
Probe Missing	A temperature probe is missing or damaged.
High AC Input	The input voltage is higher than the alarm setting.
Call Service	The UPS has detected a problem that requires service.
Fan Alarm	The fan has stopped.

F. Alarm Contact: A dry type summary alarm contact shall be provided for remote indication of alarm conditions.

2.06 ENCLOSURES

A. The UPS shall be housed in a free standing double dead front (safety shields behind front door) enclosure equipped with casters and leveling feet. Enclosures shall be designed for office or computer room applications. If system consists of more than one cabinet, the cabinets shall be shipped with joining hardware to be bolted together at time of installation.

B. Ventilation: Electronics cabinets shall be designed for natural convection cooling aided by a thermostatically controlled fan. Air inlets shall be in the lower front and rear; air outlets shall be in the upper rear. Battery cabinets shall be convection cooled.

C. Cable Entry: Units equipped with input cord and plug and output receptacles shall not require any installation. Hard-wired systems shall provide for conduit entry through knockouts located in the rear of the unit. Connection between UPS and battery cabinets shall consist of cables and power plugs.

D. Front Access: Major subassemblies shall be modular and shall be replaceable from the front of the unit.

2.07 MANUFACTURERS, OR EQUAL

A. Ferrups FE Series, as manufactured by Powerware.

B. Mitsubishi

C. AMETEK SCI

PART 3 -- EXECUTION

3.01 GENERAL

A. The uninterruptible power system shall be installed as indicated and shall conform to Section 26 00 00 - Electrical Work, General and the equipment manufacturer's installation instructions.

1. The CONTRACTOR shall receive, store, and assemble all sections of the UPS to form complete units. The CONTRACTOR shall make all internal wiring interconnections as required for complete assembly of each UPS. Where wiring connectors are not supplied by the manufacturer, the CONTRACTOR shall furnish the connectors required to complete internal wiring terminations.

2. The CONTRACTOR shall take all necessary precautions to eliminate moisture and foreign material from the equipment at all times during storage and installation. Special care shall be taken to prevent corrosion of and damage to the UPS.

3. Each UPS shall be set level and plumb on its floor channels and be grouted in as indicated. The CONTRACTOR shall provide all shims necessary to accomplish these requirements.

END OF SECTION

SECTION 26 43 00

SURGE PROTECTIVE DEVICES

PART 1 -- GENERAL

1.01 THE SUMMARY

A. Section Includes:

1. All miscellaneous electrical equipment as shown on the Drawings and as specified in these Specifications.

2. This Article provides the requirements for miscellaneous equipment not specified separately and typically employed in a facility, however, not all components specified in this Article are necessarily utilized on this project.

B. Related Sections:

1. Section 26 00 00 - General Electrical Requirements.

C. The following equipment is included under this Article:

1. Surge Protective Devices (SPD)

   a. Type 1 – Line Side

   b. Type 2 and 3 - Load Side (SPD)

2. Relays

   a. Control relays.

   b. Timing relays (solid state).

3. Corrosion inhibitors.

4. Group Motor Control Panels.

5. Power Factor Capacitors

6. Harmonic Filters

1.02 SUBMITTALS

A. Submittals shall be in accordance with the Standard Provisions Section 7 and Section 26 00 00. Submittals shall contain detailed catalog information or drawings describing electrical and physical characteristics of all equipment specified.

PART 2 -- PRODUCTS

2.01 MATERIALS

A. Surge Protective Devices

1. SPD unit shall be a hybrid device utilizing SAD (Silicon Avalanche Diodes), MOV (Metal Oxide Varistors) and CAP (Capacitors) technology.

2. The SPD unit shall be listed under UL 1449-Second Edition and UL 1283 for noise attenuation devices.

3. Unit shall have the following features as a minimum:

   a. Parallel Line-Neutral, Line-Ground and Neutral-Ground connection configuration.

   b. One nanosecond or less response time.

   c. Extend noise filtration with a 10 kHZ to 100 MHZ range.

   d. Fused internal disconnect switch with 60 amps, 300,000 AIC rating.

   e. Surge current rating of 320,000 amps

   f. LED indications

   g. Six-digit surge counter

   h. Form C output contacts for malfunction indication

   i. 480/277 volts, three-phase, four-wire, grounded voltage configuration.

4. SPD units supplied for separate mounting shall have an enclosure rating based on the NEMA area classification indicated on the Drawings.

5. SPD shall be Model PDX Series as manufactured by United Power Corporation, Transvector Systems LS Series, or equal.

6. ANSI/UL 1449 minimum withstand rating shall be 20 kA per pole, and ANSI/UL 1449 voltage protection rating for SPD shall not exceed the following:

Modes	**208Y/120**	**480Y/277**
L-N,L-G, N-G	800	1200
L-L	1200	2000

B. SPD surge capacity based upon IEEE C62.41 location category shall, as a minimum, be the following:

Category	Application	Per Phase	Per Mode
C	Service entrance	240 kA	120 kA
B	High exposure locations (distribution equipment)	160 kA	80 kA
A	Branch locations	120 kA	60 kA

C. Corrosion Inhibitors

1. All equipment enclosures, terminal boxes, etc., located in a corrosive rated area (where shown on the Drawings) that contains electrical or electronic equipment or terminal strips shall be furnished with an internally mounted, chemically treated corrosion inhibitor pad.

2. The corrosion inhibitor pads shall be as manufactured by Hoffman Engineering Co., 3M, or equal.

D. Group Motor Control Panel (GMCP)

1. The GMCP shall be a modular assembly of combination starters with a main circuit breaker and other accessories as shown on the Drawings and included in these Specifications.

2. The modular enclosure shall provide space for up to six components, as required by the Drawings. If more than six components are required, or if the components are oversized, provide stacked units which are nippled together to form a combined panel. Each unit compartment shall include a separate hinged door and shall be separated from by barriers from the next compartment. The component doors shall be interlocked with the main circuit breaker to prevent opening when the breaker is in the “on” position. Empty compartments shall be furnished with a blank door. A covered wireway shall be provided for incoming power cables and shall include terminals for connection to each module and to any auxiliary panel. A separate covered wireway shall be provided for interconnecting wiring and outgoing cables.

3. The overall panel enclosure shall be painted steel, NEMA rated, suitable for rack- or wall-mounting.

4. The main circuit breaker shall be solid state circuit breaker with adjustable trip settings is a separate enclosure. Circuit breaker shall be padlockable in open and closed positions.

5. Combination MCP-type motor starters shall be similar to those specified in Section 26 05 15 except that separate enclosure is not required. MCP shall be operable without opening compartment door and shall be padlockable in the closed position.

6. Provide control stations and indicating lights as required by the control schematics on the Drawings.

7. Provide panel nameplate and nameplate for each motor, giving the equipment number and name per Section 26 00 00.

8. Group Mounted Motor Control Panel shall be Group Control Multi-Pak as manufactured by Cutler-Hammer or approved equal.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Install according to manufacturer's installation instructions.

B. Field mounted disconnects, pushbutton control stations, etc., shall be mounted on steel stands as shown on the Drawings. Where clearance requirements for stands may not be maintained, the ENGINEER OF RECORD may direct equipment to be wall mounted adjacent to the drive, but in no case shall the distance from the drive motor to the control station exceed three feet.

C. Refer to Section 26 00 00 for installation requirements for electrical equipment covered in this article.

END OF SECTION

SECTION 26 50 00

LIGHTING

PART 1 -- GENERAL

1.01 THE SUMMARY

A. Article includes lighting system ready for operation as shown on the Drawings and as specified in these Specifications.

B. Related Articles:

1. Section 26 00 00, General Electrical Requirements.

2. Section 26 12 16, Panelboards and Dry Type Transformers.

3. Section 26 09 13, Lighting Control Devices.

4. All concrete and reinforcing steel materials required for exterior lighting pole bases shall be as specified under Section 03 31 00.

1.02 REFERENCES

A. All lighting fixtures shall be in accordance with the National Electrical Code (NEC) and shall be constructed in accordance with the latest edition of the Underwriters Laboratories (UL) “Standards for Safety, Electric Lighting Fixtures.” All lighting fixtures shall be UL labeled.

B. California Title 20 Chp 4 Art 4 Public Utilities and Energy, Energy Conservation, Appliance Efficiency Regulations (CEC-140-2016-001-REV3)

C. California Title 24 Part 1 2016 California Administrative Code

D. California Title 24 Part 2 2016 California Building Code

E. California Title 24 Part 3 2016 California Electrical Code

F. California Title 24 Part 6 2016 California Energy Code

G. NEMA 250 Enclosures for Electrical Equipment (1,000 Volts Maximum)

H. International Building Code (IBC) Earthquake Requirements

I. UL-595 Standard for Safety Marine-Type Electric Lighting Fixtures

J. UL-844 Standard for Safety Electric Lighting Fixtures for Use in Hazardous (Classified Locations)

K. UL-924 Standard for Safety Emergency Lighting and Power Equipment

L. UL-1598 Luminaires

M. UL-8750 Standard for Light Emitting Diode (LED) Equipment for Use in Lighting Products

N. ANSI C136.37 LED Luminaires

O. NEMA SSL-1 Electronic Drivers for LED Devices, Arrays, or Systems

P. UL 916, Standards for Energy Management Equipment.

1.03 SUBMITTALS

A. Submittals shall be in accordance with Standard Provisions Section 7 and Section 26 00 00.

B. Submittals shall include the following product information as a minimum:

1. Fixtures:

   Manufacturer, model number, materials of construction, finish type and color, total fixture wattage (ballast plus lamp), mounting hardware.

2. Ballasts:

   a. Manufacturer, model number, total harmonic distortion, crest factor, external wiring diagram, and power factor.

3. Lamps:

   a. Manufacturer, model number, wattage, color rendition index, and lumen output.

4. Engineering calculations shall be furnished in accordance with Articles 13.05.01, Seismic Design Criteria, and 13.05.02, Wind Design Criteria. As a minimum, these shall demonstrate that all pole-mounted fixtures will adequately transfer the design wind and seismic forces from the pole to the anchor bolts at the foundation.

5. All fluorescent fixtures, excepting compact fluorescent, and ballasts shall be provided with certification from the manufacturer that they are listed in the latest edition of the California “Directory of Certified Luminaires and Ballasts.”

PART 2 -- PRODUCTS

2.01 LUMINAIRES

A. General

1. Additional WORK requirements are indicated in the Luminaire Schedule on the Drawings.

2. LED luminaires that utilize separate drivers that can be serviced in place shall be provided with a disconnecting means either internal or external to each luminaire, in accordance with the requirements of Article 410.130 (G) (1) of the NEC.

B. Provide a feed-through type or separate junction box.

C. Provide redundant drivers where noted.

D. Provide minimum 18 AWG wire leads.

E. Provide components that are accessible and replaceable without removing the LED luminaire from the ceiling.

F. Soffit Installations

1. Installations shall be UL-labeled as "Suitable for Damp Locations."

2. Provide removable and prewired drivers where applicable.

G. Exterior Installations

1. Installations shall be UL-labeled as "Suitable for Wet Locations."

2. Provide removable and prewired drivers wherer applicable.

3. When factory-installed photocells are provided, the entire assembly shall be UL-labeled.

H. Marine Environments

1. Installations shall be UL-labeled as "Marine, Outside Type."

2. Provide a copper-free aluminum housing in accordance with the requirements of UL-595.

I. Emergency Lighting

1. Power Pack

a. self-contained

b. 120/240 V

c. dual voltage

d. selectable input transformer

e. 6 V sealed nickel-cadmium battery

f. indicator switch in accordance with the requirements of UL 924

2. lighted, push-to-test pushbutton and indicator

3. capability of providing full illumination for 1-1/2 hours in emergency mode

4. capability of full recharge in 24 hours, automatically initiated upon resumption of normal line voltage

5. capability of protecting against excess charging and discharging

6. twin LED lighting heads field adjustable

7. solid state charger

8. normal and emergency LED indicating lights

9. Provide conduit hub for hardwired installations.

10. mounting stand or bracket

11. time delay relays in order to maintain emergency lighting in areas illuminated by LED luminaires for 5 minutes after normal power has been restored.

12. Provide NEMA-rated enclosures in accordance with the area classifications in which they are installed.

J. Exit Signs

1. internally illuminated

2. universal mounting type

3. internal 6 V nickel-cadmium battery

4. battery charger

5. LED-type emergency and normal indicating lights

6. press-to-test button

7. directional arrows

8. red letters on a white panel

K. Hazardous Classified Areas

1. UL-labeling shall be CLASS I, DIVISION 1, GROUPS C AND D; CLASS II, DIVISION 1, GROUPS F AND G.

2. Provide copper-free cast aluminum luminaire enclosures and fittings, in accordance with the requirements of UL-844.

2.02 LIGHT SOURCE

A. LED

1. White light

2. Color Temperature: 4000K or 4100K as indicated on Luminaire Schedule drawing E-10

B. Manufacturer, or Equal

1. As indicated on the Luminaire Schedule drawing E-10

2.03 LED DRIVER

A. General

1. UL-Listed, ETL-certified

2. high power factor, energy-efficient type

3. Low harmonic emissions less than or equal to 10 percent

4. Driver shall meet luminaire requirements.

2.04 POLES

A. Rating (with luminaire): 125-mph steady winds without incurred damage to the assembly

B. Material: steel

C. one-piece stationary type

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Each fixture shall be a completely finished unit with all components, mounting and/or hanging devices necessary, for the proper installation of the particular fixture in its designated location and shall be completely wired ready for connection to the branch circuit wires at the outlet.

B. All flush-mounted fixtures shall be supported from the structure and shall not be dependent on the hung ceilings for their support.

C. Fixtures indicated to be installed flush in suspended ceilings shall be of mounting types suited for the type ceiling involved. The contractor shall be responsible for verifying the ceiling types prior to ordering fixtures.

D. Flexible fixture hangers shall be used for all pendant-mounted fixtures. Fixtures two-feet long and larger shall be supported with a minimum of two fixture hangers.

E. Conduit run in areas with hung ceilings shall be installed in the space above the hung ceiling as close to the structure as possible. Conduits shall be supported from the structure.

F. Exterior lighting poles shall be mounted plumb.

G. Fixture locations are shown on the Drawings in approximate locations; however exact locations shall be coordinated so as to avoid conflicts with HVAC ducts, equipment and other obstacles.

3.02 LAMPS

A. Within each luminaire, review the manufacturer's instructions in case the LEDs do not all operate properly and emit the required light. Request replacement for damaged units.

3.03 BALLASTS & POWER SUPPLIES

A. Install in accordance with the manufacturer's recommendations.

B. Use ballast and power supply mounting holes to fasten the ballast and power supply securely within the luminaire.

C. Replace noisy or defective ballasts and power supplies.

3.04 CLEANING UP

A. Plastic dust cover bags, to be provided with new parabolic reflector lighting fixtures, shall be removed after all construction activity that may cause dust formation on reflector surfaces has been completed.

B. All fixtures shall be left in a clean condition, free of dirt and defects, before acceptance by the CONSTRUCTION MANAGER.

END OF SECTION

SECTION 27 15 23

FIBER-OPTIC CABLES

PART 1 -- GENERAL

1.01 THE SUMMARY

A. Section Includes:

1. Fiber-optic (FO) cables for Operator Interface System (OIS) Network.
2. Fiber-optic cables for PLC data communication network.
3. Network accessories.

B. Related Sections:

1. Section 26 05 33 Electrical Raceway Systems
2. Section 26 05 43 Underground Electrical Raceway Systems
3. Section 40 95 10, Programmable Logic Controller (PLC) Hardware and Software.

1.02 SUBMITTALS

A. Shop Drawings and Product Data:

1. Submit in accordance with Standard Provisions Section 7 and Technical Specifications Section 26 00 00. Include description of components, methods of connecting components, and the following:
   a. Product data.
   b. Installation drawings and instruction.
   c. Local fiber optic jumpers and cable descriptive product information including transmission parameters, jacket properties, and physical attributes (maximum short term and long term tensile loads).

B. Test data: Submit results of field acceptance tests and installation tests for review.

C. Statement of Installation Engineer's Training and Experience:

1. Submit in accordance with requirements for and with Product Data.

D. Refer to Section 01 75 06 for additional requirements.

1.03 QUALITY ASSURANCE

A. Provide FO cables by a reputable manufacturer in this field, with at least three years in this field, and who has supplied FO cables at a minimum of five major installations.

B. FO installer shall be specialized in this field and have a minimum of ten years previous experience.

1.04 ENVIRONMENTAL REQUIREMENTS

A. Humidity: Maximum 95 percent, non-condensing.

B. Ambient Temperature:

1. Operational: Zero to 60 degrees Celsius.

2. Storage: Minus 40 to 80 degrees Celsius.

1.05 WARRANTY

A. Submit manufacturer's standard warranty to correct defective products for a minimum of three years.

PART 2 -- PRODUCTS

2.01 FIBER OPTIC CABLE

A. Provide fiber-optic cables in the following size ranges in accordance with the Drawings and Specifications:

1. 24 fibers.

B. Optical fibers shall be coated with a suitable material to preserve the intrinsic strength of the glass.

C. FO cable fibers shall be protected by a protective tube, a jacketed strength member, and an exterior jacket.

D. FO cable shall be loose-tube type with dielectric central member.

E. FO cable shall be approved for underground ductbank and shall be waterproof.

F. FO cables shall be single-mode (dual fiber TX and RX), graded-index, solid-glass wave guides with the following characteristics:

1. Nominal core diameter: 8.2 microns.

2. Minimum ellipicity: 2.0 percent.

3. Outside clad diameter: 125 microns.

4. Minimum numerical aperture (NA): 0.14.

5. Maximum attenuation (1550 nm): 0.20 db/Km.

6. Maximum attenuation (1310 nm): 0.35 db/Km.

G. Glass-cladding shall be nominally concentric with the fiber core.

H. Each fiber shall be continuous with no factory splices.

I. Mechanical stresses present in the cable shall not be transmitted to the optical fibers.

J. Loose-tube construction shall allow for thermal expansions and free movement of the fiber within the protective container.

K. All protective coverings in any single length of cable shall be continuous and of the same material. Protective coverings shall be free from holes, splices, blisters and other imperfections.

L. A flooding compound shall be applied into the interior of the fiber buffer tubes.

M. Strength members shall constitute an integral part of the cable construction. The combined strength of all the strength members shall be sufficient to support the stress of installation and shall protect the cable in service.

N. The outer cable jacket shall be made of polyethylene (PE).

O. FO cable shall be FDDI compatible and shall meet the requirements of ANSI X3T9.5 for FDDI cable.

P. Fiber optic cable shall be manufactured by Siecor, Belden, Corning or equal.

2.02 FIBER OPTIC TERMINATIONS

A. Connectors:

1. General:

a. Provide “LC” type stainless steel or ferrule bayonet, keyed connectors for all fiber terminations. Use the same type of connectors for all fiber-optic equipment and cable.

2. Provide the following:

a. Attenuation (typical/maximum): 0.3 db/0.4 db.

b. Fiber nominal outside diameter: 125 micron.

c. Cable nominal outside diameter: 2.4 mm, 3.0 mm.

2.03 LOCAL AREA NETWORK ACCESSORY

A. UTP to fiber-optic media converter. UTP speed should match existing Ethernet network. Manufactured by Allied Telesyn, Black Box, or equal.

PART 3 -- EXECUTION

3.01 FIBER-OPTIC SPLICING

A. Provide a fiber optic cable plant installation which includes a minimum of splices.

B. Where splices are necessary, fusion splice or mechanical splice the optical fibers with a splice loss not to exceed 0.15 db.

C. Test all splices with an Optical Time Domain Reflectometer (OTDR) bi-directionally to verify splice loss at the time of splicing. Re-splice any splices not conforming to these Specifications.

D. During the splicing operations, protect the un-spliced portions of the cable from the intrusion of moisture and other foreign matter.

E. Notify and obtain approval from the ENGINEER OF RECORD prior to implementation of all required splices not identified in the Submittal.

3.02 FIBER-OPTIC TERMINATION

A. Fan out all fiber-optic cable fibers to allow direct connectorization of the fiber- optic cable. Sleeve over each individual fiber with a Kevlar-reinforced furcation tube. At the convergence point of all furcation tubes, provide strain relief with a high-density plastic fan-out collar. Additionally, provide a minimum of 6.0-feet coil of spare fiber at each wiring closet.

3.03 FIBER-OPTIC ON-SITE TESTING

A. General:

1. Provide all equipment, instrumentation, and supplies necessary to perform all testing. The CONSTRUCTION MANAGER shall have the option to witness and participate actively in the on-site tests performed by the installer.

B. Pre-Testing:

1. Prior to the physical placement of the fiber optic cable, test each fiber while on the spool with an Optical Time Domain Reflectometer (OTDR) at a wavelength of 1310 to 1550 nm. Document the OTDR tests and show that the fibers conform to the manufacturer's attenuation specifications and that no damage occurred to the cable during shipping. Provide hard copy plots of the tests to the CONSTRUCTION MANAGER prior to receiving approval for the placement to proceed.

C. Post-Testing:

1. After installing connectors, test all installed fibers from both ends of the cable using the OTDR. Provide test documentation that includes the cable tested, fiber number, total length of fiber, attenuation of the fiber, and splice loss if fiber has been spliced. Perform the tests at the wavelength used for the network being tested, either 1310 nm or 1550 nm. Provide a permanent hard copy and diskette copy of all OTDR signature traces documentation.

2. After installing connectors, perform fiber end-to-end attenuation testing on all installed fibers from both ends of the cable, using a stabilized light source and an optical power meter. Perform attenuation tests at wavelengths of 1310 nm and 1550 nm. Demonstrate and document specified gain margin. Document results including the cable tested, fiber number, direction of tests, wavelength, and reference power reading.

3.04 STAGING SITE DEMONSTRATION TEST

A. General:

1. Test the communication system as a part of the entire Computer-Based Monitoring and Control System testing specified in Section 40 95 10 PLC Control Systems Hardware and Softward. Include all components in the test except the inter-building fiber optic cables. Use temporary fiber-optic interconnect cables for the test, in place of the inter-building cables. The ISS shall provide all services to terminate and test the fiber-optic cables.

B. Test all functions including, but not limited to, the following:

1. PLC-to-PLC communications.

a. Communications timing.

b. Communication signal level margins (assume manufacturer's maximum signal loss for cable lengths and maximum specified signal loss for splices, terminations, and other components not tested).

3.05 TRAINING

A. Provide a minimum of one day of communication system hardware maintenance training at the jobsite for District personnel. Training shall include testing, fault analysis, switchover to backup cable, and other topics required for system maintenance.

B. Provide a minimum of two days of fiber-optic cable splicing training at the jobsite for District personnel.

END OF SECTION

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SECTION 31 10 00

SITE PREPARATION

PART 1 -- GENERAL

1.01 THE SUMMARY

A. In its initial move onto the Site, the CONTRACTOR shall protect existing fences, houses and associated improvements, streets, and utilities downslope of construction areas from damage due to boulders, trees, or other objects dislodged during the construction process and clear, grub, strip; and regrade certain areas, in accordance with the Contract Documents.

1.02 SITE INSPECTION

A. Prior to moving onto the Site, the CONTRACTOR shall inspect the Site conditions and review maps of the Site and off-Site pipeline routes and facilities delineating the OWNER's property and right-of-way lines.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION

3.01 PRIMARY PLANT SITE ACCESS

A. The CONTRACTOR shall develop any necessary access to the Site, including access barriers to prohibit entry of unauthorized persons.

B. **Utility Interference:** Where existing utilities interfere with the WORK, notify the utility owner and the CONSTRUCTION MANAGER before proceeding in accordance with the General Conditions.

3.02 CLEARING, GRUBBING, AND STRIPPING

A. Construction areas shall be cleared of grass and weeds to at least a depth of 6-inches and cleared of structures, pavement, sidewalks, concrete or masonry debris, trees, logs, upturned stumps, loose boulders, and any other objectionable material of any kind which would interfere with the performance or completion of the WORK, create a hazard to safety, or impair the subsequent usefulness of the WORK, or obstruct its operation. Loose boulders within 10-feet of the top of cut lines shall be incorporated in landscaping or removed from the Site. Trees and other natural vegetation outside the actual lines of construction shall be protected from damage during construction.

B. Within the limits of clearing, the areas below the natural ground surface shall be grubbed to a depth necessary to remove stumps, roots, buried logs, and other objectionable material. Septic tanks, drain fields, and connection lines and any other underground structures, debris or waste shall be removed if found on the Site. Objectionable material from the clearing and grubbing process shall be removed from the Site and wasted in approved safe locations.

C. The entire area to be affected by construction shall be stripped to a depth of 1 foot below the existing ground contours. The stripped materials shall be stockpiled and incorporated into landscaped areas or other non-structural embankments.

D. Unless otherwise indicated, native trees larger than 3-inches in diameter at the base shall not be removed without the CONSTRUCTION MANAGER's approval. The removal of any trees, shrubs, fences, or other improvements outside of rights-of-way, if necessary for the CONTRACTOR's choice of means and methods, shall be arranged with the owner of the property, and shall be removed and replaced, as part of the WORK.

3.03 OVEREXCAVATION, REGRADING, AND BACKFILL UNDER FILL AREAS

A. After the fill areas have been cleared, grubbed, and excavated, the areas to receive fill will require overexcavation, regrading, and backfill, consisting of the removal and/or stockpiling of undesirable soils. The ground surface shall be recontoured for keying the fill and removing severe or abrupt changes in the topography of the Site. The overexcavated volumes to a level **1** foot below the existing ground contours shall be backfilled.

B. After removal of organic laden soil, the remaining soils that will require removal from the Washwater Recovery Basin are any soils not suitable for use as structural fill. Soil shall be removed to an elevation 1 foot below structure footings at this location and replaced with structural fill or structural base as required in contract documents.

C. Any undesirable topsoil and colluvium shall be removed to the level designated by the CONSTRUCTION MANAGER and stockpiled for subsequent use as the first material to be placed in the compacted fill.

D. Any steep, very abrupt rock faces and irregularly shaped rock outcrops of bedrock shall be regraded as directed by the CONSTRUCTION MANAGER.

END OF SECTION

SECTION 31 23 19

DEWATERING

PART 1 -- GENERAL

1.01 SUMMARY

A. Perform all dewatering necessary or required for the construction of the Work as required by these Specifications and indicated on the Drawings. Dewatering work shall include the control of water, sediment removal, and disposal of water, sediment and sludge.

1.02 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Special Provisions Section 20.

B. Prior to commencement of excavation, the CONTRACTOR shall submit a detailed plan and operation schedule for dewatering of excavations. The detailed plan shall include mitigation measures to prevent settlement of nearby structures and a contingency plan for restoring nearby structures if settlement is observed as a result of the CONTRACTOR’s dewatering operations. The CONTRACTOR may be required to demonstrate the system proposed and to verify that adequate equipment, personnel, and materials are provided to dewater the excavations at all locations and times. The CONTRACTOR's dewatering plan is subject to review by the CONSTRUCTION MANAGER.

1.03 QUALITY CONTROL

A. It shall be the sole responsibility of the CONTRACTOR to control the rate and effect of the dewatering in such a manner as to avoid all objectionable settlement and subsidence.

B. All dewatering operations shall be adequate to assure the integrity of the finished project and shall be the responsibility of the CONTRACTOR.

C. All structures or facilities that are located within the radius of influence of the CONTRACTOR’s dewatering operation shall have reference points established and observed at frequent intervals to detect any settlement which may develop. The responsibility for conducting the dewatering operation in a manner which will protect adjacent structures and facilities rests solely with the CONTRACTOR. The CONTRACTOR shall survey, record and report the reference points on a daily basis, and submit the written log to the CONSTRUCTION MANAGER at the completion of construction. The CONSTRUCTION MANAGER shall be immediately notified should any sign of settlement is observed. The cost of repairing any damage to adjacent structures and restoration of facilities shall be the responsibility of the CONTRACTOR.

PART 2 -- PRODUCTS

2.01 EQUIPMENT

A. Dewatering, where required, may include the use of well points, sump pumps, temporary pipelines for water disposal, rock or gravel placement, and other means. Standby pumping equipment shall be maintained on the Site.

PART 3 -- EXECUTION

3.01 GENERAL REQUIREMENTS

A. Contractor's attention is directed to the Special Provisions, Article 19.02, regarding certain allowable non-storm water discharges. Allowable non-storm-water discharges are subject to the same water quality requirements as stipulated for the Risk Level 2 NPDES Requirement. District retains right not to reintroduce wasted waters from the Contractor's operations back into the treatment process due to upsetting the overall treatment process or capacity constraints for storage. Contractor must comply with all federal, state and local laws for disposal of waters not recycled back into the District's treatment process, and not suitable for discharge into the storm drain system under the NPDES permit.

B. Other non-storm discharges not cited in Article 19.02 are prohibited under the General NPDES Permit to be discharged into Smith Creek or other off-site storm drainage systems. Other non-storm discharges not already authorized in the General NPDES Permit shall be hauled off and disposed of in accordance with local, state and federal laws. Otherwise, Contractor shall be required to obtain and pay for necessary discharge permits from the Regulatory Agency(ies) having jurisdiction. Contractor shall provide all copies of applications for permit(s) and permits acquired and fill out and provide the District with a "Notice of Temporary Discharge (Notice)." An electronic version of the Notice may be transmitted to the Contractor upon request. The form must be filled out and sent via email to the CONSTRUCTION MANAGER for review. The Notice must be submitted 5 working days prior to discharge. Failure to submit the Notice of Temporary Discharge shall be grounds for temporary suspension of all or a portion of the work in accordance with Article 7.05.B. Suspension of work for noncompliance will not be grounds for additional time or compensation. A Notice of Discharge shall be submitted similarly for each occurrence, unless specifically approved otherwise by the CONSTRUCTION MANAGER.

3.02 DISCHARGES TO SMITH CREEK

A. Contractor must implement the dewatering operation in adherence of these Specifications and under the conditions set forth by permit(s) obtained and paid for by the Contractor from the agency(ies) having jurisdiction for "Other Discharges" as defined in Article 18.01 and, meet the discharge requirements stipulated in Article 19.02.

B. Contractor must implement the dewatering operations in adherence of the Contractor's BMP Action Plan, if applicable, for discharges covered under the NPDES General Permit as defined in Article 19.01.

C. If chlorinated or chloraminated water is to be discharged into Smith Creek or any storm drain systems, Contractor shall pump water to be discharged into a holding tank which is equipped with an outlet valve for flow control and pipes and/or hose necessary to discharge the tank content. The Contractor shall add de-chlorination agents (such as Sodium Bisulfite) to the tank using a metering pump or other device approved by the CONSTRUCTION MANAGER. The holding tank shall be mixed to allow for adequate mixing and reaction of de-chlorination agents with water. The Contractor shall take water samples from the holding tank and test them for chlorine content, turbidity, and pH. One sample shall be collected at 6 inches, 1 foot 6 inches, and 2 feet 6 inches from the bottom of the holding tank, respectively. If the test results of all samples in each tank meet the specified requirements, the content of the tank can then be discharged. Contractor shall provide initial monitoring results of the dechorination / chloramination process to the CONSTRUCTION MANAGER before any discharges are made to Smith Creek or the storm drain systems. A log of the monitoring and sampling results shall be provided to the CONSTRUCTION MANAGER on a daily basis and discharges must be monitored in accordance with Risk Level 2 Requirements.

D. Contractor's discharges to the on-site storm drain and/or Smith Creek are subject to water quality monitoring, testing and reporting requirements set forth in Risk Level 2 Requirements.

1. The Contractor shall measure the water for turbidity at the point where the discharge water exits the Contractor's water control system or as required. Measurements shall be made with a portable turbidimeter, Model No. DRT-15CE, by HF Scientific, Fort Meyers, Florida, or equivalent method approved by the CONSTRUCTION MANAGER. Turbidity measurements shall be performed on a sample immediately after the sample is collected per instrument manufacturer's specifications.

2. Chlorine shall be measured using a Hach Company portable chlorimeter or equivalent instrument approved by the CONSTRUCTION MANAGER by the Contractor. Instruments shall have a detection limit of 0.08 mg/L or less.

3. Discharge sampling shall be performed for chlorine residual, turbidity, temperature, and pH at 1-hour intervals for 4 hours for the first day of discharge and twice daily thereafter for potable water. If groundwater is discharged, sampling shall be performed for turbidity, temperature, and pH at 1-hour intervals for 4 hours for the first day of discharge and twice daily thereafter. If samples taken indicate the discharge exceeds one of the criterions, the discharge will be suspended immediately, until the water can meet all of the discharge criteria. More testing and sampling may be required.

4. Contractor shall conduct visual monitoring at the creek outfall through which water is discharged to ensure erosion is not occurring. If erosion of the stream channel banks or bottom is evident, the Contractor shall adjust the discharge flow rate or modify the discharge system to eliminate the effects of erosion.

5. Contractor shall conduct any required baseline testing and monitoring in accordance with Article 19.01 prior to and during the discharge operation of stream conditions, i.e., turbidity, temperature, pH and chlorine levels where discharges from construction would be routed.

END OF SECTION

SECTION 31 30 00

EARTHWORK

PART 1 -- GENERAL

1.01 THE SUMMARY

A. The CONTRACTOR shall perform earthwork as indicated and required for construction of the WORK, complete and in place, in accordance with the Contract Documents.

1.02 CONTRACTOR SUBMITTALS

A. The CONTRACTOR's attention is directed to the provisions for "Shoring and Bracing Drawings" in Section 6705 of the California Labor Code.

B. CONTRACTOR's Detailed Plan

1. The CONTRACTOR, prior to beginning any trench or structure excavation 5 feet deep or deeper, shall submit to the OWNER and shall be in receipt of the OWNER's written acceptance of the CONTRACTOR's detailed plan showing the design of shoring, bracing, sloping of the sides of excavation, or other provisions for worker protection against the hazard of caving ground during the excavation of such trenches or structure excavation.

2. The CONTRACTOR’s plan shall be prepared and signed and sealed by a Professional Engineer experienced in the field of geotechnical engineering and licensed in the State where the WORK is being performed.

3. The OWNER’s acceptance of said plan will be for verification of submittal of the plan with this requirement.

4. If such plan varies from the shoring system standards established in the Construction Safety Orders of the State of California, such alternative systems plans shall be prepared by a civil or structural engineer licensed in the State of California.

C. The CONTRACTOR shall submit a copy of the excavation permit issued by the California Department of Industrial Safety.

D. Samples

1. The CONTRACTOR shall submit samples of materials proposed for the WORK in conformance with the requirements of Special Provisions Section 20.

2. Sample sizes shall be as determined by the testing laboratory.

PART 2 -- PRODUCTS

2.01 FILL AND BACKFILL MATERIAL REQUIREMENTS

A. General

1. Fill, backfill, and embankment materials shall be selected or shall be processed and clean fine earth, rock, gravel, or sand, free from grass, roots, brush, other vegetation and organic matter.

2. Fill and backfill materials that are to be placed within 6 inches of any structure or pipe shall be free of rocks or unbroken masses of earth materials having a maximum dimension larger than 3 inches.

B. Suitable Materials

1. Materials not defined below as unsuitable will be considered as suitable materials and may be used in fills, backfilling, and embankment construction, subject to the indicated requirements.

2. If acceptable to the CONSTRUCTION MANAGER, some of the material listed as unsuitable may be used when thoroughly mixed with suitable material to form a stable composite.

3. Mixing or blending of materials to obtain a suitable composite is the CONTRACTOR's option but is subject to the approval of the CONSTRUCTION MANAGER.

4. The CONTRACTOR shall submit certification to the CONSTRUCTION MANAGER that the chloride concentration in imported materials within the pipe zone does not exceed 100 ppm, when tested in accordance with the requirements of AASHTO T291-94 – Standard Method of Test for determining Water-Soluble Chloride Ion Content in Soil.

5. Suitable materials may be obtained from on-Site excavations, may be processed on-Site materials, or may be imported.

6. If imported materials are required by this Section or are required in order to meet the quantity requirements of the WORK, the CONTRACTOR shall provide the imported materials as part of the WORK.

C. The following types of materials are defined:

1. Type A (three-quarters inch minus granular backfill): Crushed rock or gravel, and sand with the gradation requirements below. The material shall have a minimum sand equivalent value of 28 and a minimum R-value of 78. If the sand equivalent value exceeds 35 the R-value requirement is waived.

Sieve Size	Percentage Passing
3/4-inch	100
No. 4	30 - 50
No. 200	0 - 12

2. Type B (Class I crushed stone): Manufactured angular, crushed stone, crushed rock, or crushed slag with the following gradation requirements. The material shall have a minimum sand equivalent value of 75.

Sieve Size	Percentage Passing
3/4-inch	100
No. 4	30 - 50
No. 200	0 - 5

3. Type C (sand backfill): Sand with 100 percent passing a 3/8-inch sieve, at least 90 percent passing a Number 4 sieve, and a sand equivalent value not less than 30.

4. Type D: Not used

5. Type E (pea gravel backfill): Crushed rock or gravel with 100 percent passing a 1/2-inch sieve and not more than 10 percent passing a Number 4 sieve.

6. Type F (coarse drainrock): Crushed rock or gravel meeting the following gradation requirements:

Sieve Size	Percentage Passing
2-inch	100
1-1/2 inch	90 - 100
1-inch	20 - 55
3/4-inch	1 - 15
No. 200	0 - 3

7. Type G (aggregate base): Crushed rock aggregate base material of such nature that it can be compacted readily by watering and rolling to form a firm, stable base for pavements. At the option of the CONTRACTOR, the grading for either the 1-1/2 inch maximum size or 3/4-inch maximum size gradation shall be used. Material shall have a liquid limit less than 35 and a plasticity index less than 15. The sand equivalent value shall be not less than 22, and the material shall meet the following gradation requirements:

	Percentage Passing	
Sieve Size	**1-1/2 inch Max Gradation**	**3/4-inch Max Gradation**
2-inch	100	-
1-1/2-inch	90 - 100	-
1-inch	-	100
3/4-inch	50 - 85	90 – 100
No. 4	25 - 45	35 – 55
No. 30	10 - 25	10 – 30
No. 200	2 - 9	2 – 9

8. Type H (graded drainrock): Drainrock shall be crushed rock or gravel, durable and free from slaking or decomposition under the action of alternate wetting or drying. Material shall have a liquid limit less than 35 and a plasticity index less than 15. The material shall be uniformly graded and shall meet the following gradation requirements:

Sieve Size	**Percentage Passing**
1-inch	100
3/4-inch	90 – 100
3/8-inch	40 – 100
No. 4	25 – 40
No. 8	18 – 33
No. 30	5 – 15
No. 50	0 – 7

No. 200	0 – 3

9. The drainrock shall have a sand equivalent value not less than 75. The finish graded surface of the drainrock immediately beneath hydraulic structures shall be stabilized to provide a firm, smooth surface upon which to construct reinforced concrete floor slabs. The CONTRACTOR shall use, at its option, one of the asphalt types listed below. If the surface remains tacky, sufficient sand shall be applied to absorb the excess asphalt.

	Type 1	**Type 2**	**Type 3**
Designation	SC-800	SC-250	RS-1
Spray Temperature, deg F	175-255	165-200	70-120
Coverage, gal/sq yd	0.50	0.50	0.50

10. Type I: Any other suitable material as defined herein.

11. Type J (cement-treated backfill): Material which consists of Type H material, or any mixture of Types B, C, G, and H materials which has been cement-treated so that the cement content of the material is not less than 5 percent by weight when tested in accordance with ASTM D 2901 - Standard Test Method for Cement Content of Freshly Mixed Soil Cement. The ultimate compressive strength at 28 days shall be not less than 400 psi when tested in accordance with ASTM D 1633 - Standard Test Method for Compressive Strength of Molded Soil - Cement Cylinders.

12. Type K (topsoil): Stockpiled topsoil material which has been obtained at the Site by removing soil to a depth not exceeding 2 feet. Removal of the topsoil shall be done after the area has been stripped of vegetation and debris.

13. Type L (controlled low strength material): Controlled low strength material shall be in accordance with Cement for production of soil-cement shall conform to ASTM C 150 requirements for Type II Cement, and, in addition shall meet the requirements for "Type II Modified" as specified in Caltrans Standard Specification Section 90-2.01. Material shall be a flowable, non-segregating, self-consolidating, low-shrink slurry having an unconfined 28 day compressive strength of 100 psi to 250 psi and a unit weight no greater than 130 lbs/cf.

14. Aggregates shall be selected from excavation to minimize the inclusion of clay and organic materials, shall be subject to field approval by the CONSTRUCTION MANAGER and shall conform to the following gradation when tested in the stockpile in accordance with ASTM D 422:

Sieve Size	Percent Passing
3-inches	100
No. 4	80 - 100
No. 40	25 – 85
No. 200	0 – 15

15. Type M (aggregate subbase): Crushed rock aggregate subbase material that can be compacted readily by watering and rolling to form a firm stable base. The sand equivalent value shall be not less than 18 and the material shall meet the following gradation requirements:

Sieve Size	Percentage Passing
3-inch	100
2-1/2 inch	87 - 100
No. 4	35 - 95
No. 200	0 - 29

16. Type N (trench plug): Low permeable fill material, a non-dispersible clay material having a minimum plasticity index of 10.

17. Soils which, when classified under ASTM D 2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System), fall in the classifications of Pt, OH, CH, MH, or OL shall be classified as unsuitable.

18. Schedule: Materials shall be used as indicated below:

Embankment Fills	I or mixture of I and A through H
Pipe	
Mortar coated, concrete, uncoated DIP	A, B
Dielectrically coated steel, polyethylene encased, non-mortar (rockshield) coated	C
PVC, VCP	B

Pipes on grades >4% where backfills are graded with <10% passing No. 4 sieve	Trench plugs of types J, L, or N at intervals of 200 feet or less.
Trench zone backfill except as identified below	I, A through H or mixture thereof.
Trench zone in agriculture areas	I, A through H or mixture thereof or K
Final backfill under paved areas	G
Final backfill unpaved areas	K
Trench and final backfill under structures	Same as pipe zone except where concrete encasement is required
Replace pipeline trench over excavation	F with 6-inch top layer of E, or non-woven filter fabric, or same as pipe zone backfill if trench is above water table.
Aggregate base materials	G
Aggregate subbase	M
Backfill around structures	I, A through H or mixture thereof
Under hydraulic or water retaining structures with underdrains	H
Under hydraulic or water retaining structures without underdrains	G,H
Under structures where ground water is removed to allow placement of concrete	F, underlain by non-woven filter fabric
All other structures	G,H
Top 6-inches of reservoir roofs, embankment fills, or backfills around structures	K

D. In addition to the materials identified as unsuitable in the table above a material shall be classified as unsuitable if one of the following conditions is present:

E. Soils which cannot be compacted sufficiently to achieve the density specified for the intended use.

F. Materials that contain hazardous or designated waste materials including petroleum hydrocarbons, pesticides, heavy metals, and any material which may be classified as hazardous or toxic according to applicable regulations.

2.02 MATERIALS TESTING

A. Samples

1. Soils testing of samples submitted by the CONTRACTOR will be performed by a testing laboratory of the OWNER's choice and at the OWNER's expense.

2. The CONSTRUCTION MANAGER may direct the CONTRACTOR to supply samples for testing of any material used in the WORK.

B. Particle size analysis of soils and aggregates will be performed using ASTM D 422 - Standard Test Method for Particle-Size Analysis of Soils.

C. Determination of sand equivalent value will be performed using ASTM D 2419 - Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate.

D. Unified Soil Classification System

1. References in this Section to soil classification types and standards shall have the meanings and definitions indicated in ASTM D 2487.

2. The CONTRACTOR shall be bound by applicable provisions of ASTM D 2487 in the interpretation of soil classifications.

E. Testing for sulfate, resistivity, and pH shall be performed in accordance with California Test Methods 532 and 643 of the California Department of Transportation.

F. Testing for chloride shall be performed in accordance with AASHTO T291-94 – Standard Method of Test for determining Water-Soluble Chloride Ion Content in Soil.

2.03 IDENTIFICATION TAPE

A. Unless otherwise indicated, identification tape shall be placed above buried pipelines that are not comprised of magnetic components at least in part.

B. Identification tape shall be 6-inches wide, yellow in color, composed of polyethylene, and provided with an integral metallic wire.

C. Tape shall be labeled with CAUTION – BURIED UTILITIES

PART 3 -- EXECUTION

3.01 EXCAVATION AND BACKFILLING - GENERAL

A. General

1. Except when specifically provided to the contrary, excavation shall include the removal of materials, including obstructions, that would interfere with the proper execution and completion of the WORK.

2. The removal of such materials shall conform to the lines and grades indicated or ordered.

3. Unless otherwise indicated, the entire Site shall be stripped of vegetation and debris and shall be grubbed, and such material shall be removed from the Site prior to performing any excavation or placing any fill.

4. The CONTRACTOR shall furnish, place, and maintain supports and shoring that may be required for the sides of excavations.

5. Excavations shall be sloped or otherwise supported in a safe manner in accordance with applicable state safety requirements and the requirements of OSHA Safety and Health Standards for Construction (29CFR1926).

6. The CONTRACTOR shall provide quantity surveys where so required to verify quantities for Unit Price Contracts.

7. Surveys shall be performed prior to beginning WORK and upon completion by a surveyor licensed in the state where the Site is located.

B. Removal and Exclusion of Water

1. The CONTRACTOR shall remove and exclude water, including stormwater, groundwater, irrigation water, and wastewater, from excavations.

2. Dewatering wells, wellpoints, sump pumps, or other means shall be used to remove water and continuously maintain groundwater at a level at least 2 feet below the bottom of excavations before the excavation WORK begins at each location.

3. Water shall be removed and excluded until backfilling is complete and field soils testing has been completed.

3.02 OVER-EXCAVATION

A. Indicated

1. Where areas are indicated to be over-excavated, excavation shall be to the depth indicated, and backfill shall be installed to the grade indicated.

B. Not Indicated

1. When ordered to over-excavate areas deeper and/or wider than required by the Contract Documents, the CONTRACTOR shall over-excavate to the dimensions ordered and backfill to the indicated grade.

C. Neither Indicated nor Ordered

1. Any over-excavation carried below the grade that is neither ordered or nor indicated shall be backfilled and compacted to the required grade with the indicated material as part of the WORK

3.03 EXCAVATION IN LAWN AREAS

A. Where excavation occurs in lawn areas, the sod shall be carefully removed, dampened, and stockpiled in order to preserve it for replacement.

B. Excavated material may be placed on the lawn, provided that a drop cloth or other suitable method is employed to protect the lawn from damage, but the lawn shall not remain covered for more than 72 hours.

C. Immediately after completion of backfilling and testing of the pipeline, the sod shall be replaced and lightly rolled in a manner as to restore the lawn as near as possible to its original condition.

D. The CONTRACTOR shall provide new sod if the stockpiled sod has not been replaced within 72 hours.

3.04 EXCAVATION IN VICINITY OF TREES

A. Except where trees are indicated to be removed, trees shall be protected from injury during construction operations.

B. No tree roots larger than 2 inches in diameter shall be cut without the express permission of the CONSTRUCTION MANAGER.

C. Trees shall be supported during excavation by any means previously reviewed and accepted by the CONSTRUCTION MANAGER.

3.05 ROCK EXCAVATION

A. Rock excavation shall include removal and disposal of the following items:

1. boulders measuring 1/3 of a cubic yard or more in volume;

2. rock material in ledges, bedding deposits, and un-stratified masses that cannot be removed using conventional equipment as defined herein and which require systematic drilling and blasting for removal;

3. concrete or masonry structures that have been abandoned; and,

4. conglomerate deposits that are so firmly cemented that they possess the characteristics of solid rock and cannot be removed using conventional equipment as herein defined and require systematic drilling and blasting for removal.

   It is expected that nearly all excavation can be accomplished using conventional equipment.

B. Scope and Payment

1. Rock excavation shall be performed by the CONTRACTOR, provided that if the quantity of rock excavation is affected by any change in the scope of the WORK an appropriate adjustment of the Contract Price will be made under a separate Bid Item if such Bid Item has been established.

2. Otherwise, payment will be made in accordance with a negotiated price.

C. Explosives and Blasting: Blasting will not be permitted.

3.06 DISPOSAL OF EXCESS EXCAVATED MATERIAL

A. Unless otherwise indicated, excess excavated material shall be the property of the CONTRACTOR.

B. The CONTRACTOR shall be responsible for the removal and disposal of excess excavated material.

C. Material shall be disposed of at an approved on-Site disposal area or off-Site at a location arranged by the CONTRACTOR in accordance with laws and regulations regarding the disposal of such material.

3.07 BACKFILL

A. General

1. Backfill shall not be dropped directly upon any structure or pipe.

2. Backfill shall not be placed around or upon any structure until the concrete has attained sufficient strength to withstand the loads imposed.

3. Backfill around water-retaining structures shall not be placed until the structures have been tested, and the structures shall be full of water while backfill is being placed.

B. Except for drainrock materials being placed in over-excavated areas or trenches, backfill shall be placed after water is removed from the excavation and the trench sidewalls and bottom have been dried to a moisture content suitable for compaction.

C. Pre-Placement Conditions

1. Immediately prior to placement of backfill materials, the bottoms and sidewalls of trenches and structure excavations shall have any loose, sloughing, or caving soil and rock materials removed.

2. Trench sidewalls shall consist of excavated surfaces that are in a relatively undisturbed condition before placement of backfill materials.

D. Layering

1. Backfill materials shall be placed and spread evenly in layers.

2. When compaction is achieved using mechanical equipment, the layers shall be evenly spread such that when compacted each layer shall not exceed 6 inches in thickness.

E. During spreading, each layer shall be thoroughly mixed as necessary in order to promote uniformity of material in each layer.

F. Moisture Content

1. Where the backfill material moisture content is below the optimum moisture content, water shall be added before or during spreading until the proper moisture content is achieved.

2. Where the backfill material moisture content is too high to permit the indicated degree of compaction, the material shall be dried until the moisture content is satisfactory.

3.08 SETTLEMENT MONITORING AND CONTINGENCY PLANNING – Not Required

3.09 STRUCTURE, ROADWAY, AND EMBANKMENT EXCAVATION AND BACKFILL

A. Excavation Beneath Structures and Embankments

1. Except where indicated otherwise for a particular structure or where ordered by the CONSTRUCTION MANAGER, excavation shall be carried to an elevation 6 inches below the bottom of the footing or slab and brought back to grade with compacted materials acceptable for placement beneath structures.

2. The area where a fill or embankment is to be constructed shall be cleared of vegetation, roots, and foreign material.

3. Where indicated or ordered, areas beneath structures or fills shall be over-excavated.

4. The subgrade areas beneath embankments shall be excavated to remove not less than the top 6 inches of native material and where such subgrade is sloped, the native material shall be benched.

5. When such over-excavation is indicated, both the over-excavation and the subsequent backfill to the required grade shall be performed by the CONTRACTOR.

6. After the required excavation or over-excavation for fills and embankments has been completed, the exposed surface shall be scarified to a depth of 6 inches, brought to optimum moisture content, and rolled with heavy compaction equipment to obtain 95 percent of maximum density.

B. Excavation Beneath Concrete Reservoirs

1. Excavation under reservoirs shall extend to the bottom of the drainrock layer.

2. After such excavation has been completed, the exposed surface shall be rolled with heavy compaction equipment to 95 percent of maximum density and then graded to provide a reasonably smooth surface for placement of the drainrock.

3. Areas under the reservoir upon which fill, not drain rock, is to be placed, shall be scarified to a depth of 6 inches, brought to optimum moisture content, and compacted to obtain 95 percent of maximum density.

C. Excavation Beneath Paved Areas

1. Excavation under areas to be paved shall extend to the bottom of the aggregate base or subbase, if such base is called for; otherwise it shall extend to the paving thickness.

2. After the required excavation has been completed, the top 12 inches of exposed surface shall be scarified, brought to optimum moisture content, and rolled with heavy compaction equipment to obtain 95 percent of maximum density.

3. The finished subgrade shall be even, self-draining, and in conformance with the slope of the finished pavement.

4. Areas that could accumulate standing water shall be regraded to provide a self-draining subgrade.

D. Notification of CONSTRUCTION MANAGER

1. The CONTRACTOR shall notify the CONSTRUCTION MANAGER at least 3 Days in advance of completion of any structure or roadway excavation and shall allow the CONSTRUCTION MANAGER a review period of at least one day before the exposed foundation is scarified and compacted or is covered with backfill or with any construction materials.

E. Compaction of Fill, Backfill, and Embankment Materials

1. Each layer of backfill materials as defined herein, where the material is graded such that 10 percent or more passes a No. 4 sieve, shall be mechanically compacted to the indicated percentage of density.

2. Equipment that is consistently capable of achieving the required degree of compaction shall be used, and each layer shall be compacted over its entire area while the material is at the required moisture content.

3. Each layer of coarse granular backfill materials with less than 10 percent passing the No. 4 sieve shall be compacted by means of at least 2 passes from a vibratory compactor that is capable of obtaining the required density in 2 passes.

F. Roofs

1. Fill on reservoir and structure roofs shall be deposited not sooner than 30 Days after the concrete roof slab has been placed.

2. Equipment weighing more than 10,000 pounds when loaded shall not be used on a roof.

3. A roller weighing not more than 8,000 pounds shall be used to compact fill on a roof.

G. Flooding, ponding, and jetting shall not be used for fill on roofs, backfill around structures, backfill around reservoir walls, for final backfill materials, or aggregate base materials.

H. Heavy Equipment

1. Equipment weighing more than 10,000 pounds shall not be used closer to walls than a horizontal distance equal to the vertical depth of the fill above undisturbed soil at that time.

2. Hand-operated power compaction equipment shall be used where the use of heavier equipment is impractical or restricted due to weight limitations.

I. Layering

1. Embankment and fill material shall be placed and spread evenly in approximately horizontal layers.

2. Each layer shall be moistened and aerated as necessary.

3. Unless otherwise approved by the CONSTRUCTION MANAGER, no layer shall exceed 6 inches of compacted thickness.

4. The embankment and fill shall be compacted in conformance with Paragraph K, below.

J. Embankments and Fills

1. When an embankment or fill is to be constructed and compacted against hillsides or fill slopes steeper than 4:1, the slopes of the hillsides or fills shall be horizontally benched in order to key the embankment or fill to the underlying ground.

2. A minimum of 12 inches perpendicular to the slope of the hillside or fill shall be removed and re-compacted as the embankment or fill is brought up in layers.

3. Material thus cut shall be re-compacted along with the new material.

4. Hillside or fill slopes 4:1 or flatter shall be prepared in accordance with Paragraph A, above.

K. Compaction Requirements

1. The following compaction requirements shall be in accordance with ASTM D 1557 - Test Method for Laboratory Compaction Characteristics of Soils Using Modified Effort (56,000 ft - lbf/ft^3) (2,700 kN-m/m^3) where the material is graded such that 10 percent or more passes a No. 4 sieve and in accordance with ASTM D 4253 - Test Method for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table, and D 4254 - Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density, where the material is coarse granular backfill materials with less than 10 percent passing the No. 4 sieve:

Location or Use of Fill or Backfill	Percentage of Maximum Dry Density
Embankments and fills not identified otherwise	90
Embankments and fills beneath paved areas or structures	95
Backfill beneath structures and hydraulic structures	95
Backfill on reservoir or structure roof	90
Topsoil	80
Aggregate base or subbase	95

3.10 PIPELINE AND UTILITY TRENCH EXCAVATION AND BACKFILL

A. Exploratory Excavations

1. The CONTRACTOR shall excavate and expose buried points of connection to existing utilities.

2. Excavation shall be performed prior to the preparation of Shop Drawings for connections and before the fabrication of the pipe

3. The data obtained from exploratory excavations shall be used in preparing the Shop Drawings.

4. Data, including dates, locations excavated, and dimensioned sketches, shall be submitted to the CONSTRUCTION MANAGER within one week of excavation.

5. Damage to utilities from excavation activities shall be repaired by the CONTRACTOR in accordance with the General Conditions.

B. General

1. Unless otherwise indicated or ordered, excavation for pipelines and utilities shall be open-cut trenches with minimum widths as indicated.

C. Trench Bottom

1. Except where pipe bedding is required, the bottom of the trench shall be excavated uniformly to the grade of the bottom of the pipe.

2. Excavations for pipe bells and welding shall be made as required.

3. Where pipe bedding is required, the bottom of the trench shall be excavated uniformly to the grade of the bottom of the pipe bedding.

D. Open Trenches

1. The maximum amount of open trench permitted in any one location shall be 500 feet or the length necessary to accommodate the amount of pipe installed in a single Day, whichever is greater.

2. Trenches shall be fully backfilled at the end of each Day or, in lieu thereof, shall be covered by heavy steel plates adequately braced and capable of supporting vehicular traffic in those locations where it is impractical to backfill at the end of each Day.

3. These requirements for backfilling or use of steel plate will be waived in cases where the trench is located further than 100 feet from any traveled roadway or occupied structure; in such cases, however, barricades and warning lights meeting appropriate safety requirements shall be provided and maintained.

E. Embankments, Fills and Structural Backfills

1. Where pipelines are to be installed in embankments, fills, or structure backfills, the fill shall be constructed to a level at least one foot above the top of the pipe before the trench is excavated.

2. Upon completion of the embankment or structural backfill, a trench conforming to the appropriate detail may be excavated and the pipe may be installed.

F. Trench Shield

1. If a moveable trench shield is used during excavation operations, the trench width shall be wider than the shield such that the shield is free to be lifted and then moved horizontally without binding against the trench sidewalls and causing sloughing or caving of the trench walls.

2. If the trench walls cave or slough, the trench shall be excavated as an open excavation with sloped sidewalls or with trench shoring, as indicated and as required by the pipe structural design.

3. If a moveable trench shield is used during excavation, pipe installation, and backfill operations, the shield shall be moved by lifting the shield free of the trench bottom or backfill and then moving the shield horizontally.

4. The CONTRACTOR shall not drag trench shields along the trench causing damage or displacement to the trench sidewalls, the pipe, or the bedding and backfill.

G. Placing and Spreading Of Backfill Materials

1. Each layer of coarse granular backfill materials with less than 10 percent passing the No. 4 sieve shall be compacted by means of at least 2 passes from a vibratory compactor that is capable of achieving the required density in 2 passes and that is acceptable to the CONSTRUCTION MANAGER.

2. Where such materials are used for pipe zone backfill, vibratory compaction shall be used at vertical intervals of the lesser of:

   a. one-half the diameter of the pipe; or

   b. 24 inches, measured in the uncompacted state.

3. In addition, these materials shall be subjected to vibratory compaction at the springline of the pipe and the top of the pipe zone backfill, regardless of whether that dimension is less than 24 inches or not.

4. Each layer of backfill material with greater than 10 percent passing the No. 4 sieve shall be compacted using mechanical compactors suitable for the WORK.

5. The material shall be placed and compacted under the haunch of the pipe and up each side evenly so as not to move the pipe during the placement of the backfill.

6. The material shall be placed in lifts that will not exceed 6 inches when compacted to the required density.

H. Mechanical Compaction

1. Backfill around and over pipelines that is mechanically compacted shall be compacted using light, hand-operated vibratory compactors and rollers that do not damage the pipe.

2. After completion of at least 2 feet of compacted backfill over the top of pipeline, compaction equipment weighing no more than 8,000 pounds may be used to complete the trench backfill.

I. Pipe And Utility Trench Backfill

1. Pipe Zone Backfill

a. Definitions

1) The pipe zone is defined as that portion of the vertical trench cross-section lying between a plane below the bottom surface of the pipe and a plane at a point above the top surface of the pipe as indicated.

2) The bedding is defined as that portion of pipe zone backfill material between the trench subgrade and the bottom of the pipe.

3) The embedment is defined as that portion of the pipe zone backfill material between the bedding and a level line as indicated.

b. Final Trim

1) After compacting the bedding, the CONTRACTOR shall perform a final trim using a stringline for establishing grade, such that each pipe section when first laid will be continually in contact with the bedding along the extreme bottom of the pipe.

2) Excavation for pipe bells and welding shall be made as required.

c. The pipe zone shall be backfilled with the indicated backfill material.

d. Pipe zone backfill materials shall be manually spread evenly around the pipe, maintaining the same height on both sides of the pipe such that when compacted the pipe zone backfill will provide uniform bearing and side support.

e. The CONTRACTOR shall exercise care in order to prevent damage to the pipeline coating, cathodic bonds, and the pipe itself during the installation and backfill operations.

2. Trench Zone Backfill

a. After the pipe zone backfill has been placed, backfilling of the trench zone may proceed.

b. The trench zone is defined as that portion of the vertical trench cross-section lying as indicated between a plane above the top surface of the pipe and a plane at a point 18 inches below the finished surface grade, or if the trench is under pavement, 18 inches below the roadway subgrade.

3. Final Backfill

   a. Final backfill is defined as backfill in the trench cross-sectional area within 18 inches of finished grade, or if the trench is under pavement, backfill within 18 inches of the roadway subgrade.

J. Identification Tape

1. Install identification tape as indicated.

2. Terminate the tape in a precast concrete box either adjacent to or part of the valve box, manhole, vault, or other structure into which the non-metallic pipe enters or at the end of the non-metallic pipeline.

3. The termination box shall be covered with a cast iron lid.

4. The box shall be located at grade in paved areas or 6 inches above grade in unpaved areas.

K. Trench Shield

1. If a moveable trench shield is used during backfill operations, the shield shall be lifted to a location above each layer of backfill material prior to compaction of the layer.

2. The CONTRACTOR shall not displace the pipe or backfill while the shield is being moved.

L. Compaction Requirements

1. The following compaction test requirements shall be in accordance with ASTM D 1557 - Test Method for Laboratory Compaction Characteristics of Soils Using Modified Effort (56,000 ft - lbf/ft^3) (2,700 kN-m/m^3) where the material is graded such that 10 percent or more passes a No. 4 sieve, and in accordance with ASTM D 4253 - Standard Test Method for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table, and D 4254 - Standard Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density where the material is coarse granular backfill materials with less than 10 percent passing the No. 4 sieve.

Location or Use of Fill or Backfill	Percentage of Maximum Dry Density
Pipe embedment backfill for flexible pipe.	90
Pipe bedding and over-excavated zones under bedding for flexible pipe, including trench plugs.	90

Pipe embedment backfill for steel yard piping	---
Pipe zone backfill portion above embedment for flexible pipe	90
Pipe embedment backfill for rigid pipe	90
Pipe zone backfill portion above embedment for rigid pipe.	90
Pipe bedding and over-excavated zones under bedding for rigid pipe.	90
Final backfill, beneath paved areas or structures.	95
Final backfill, not beneath paved areas or structures.	85
Trench zone backfill, beneath paved areas and structures, including trench plugs.	95
Trench zone backfill, not beneath paved areas or structures, including trench plugs.	90

3.11 FIELD TESTING

A. General:

1. Field soils testing will be performed by a testing laboratory of the OWNER's choice at the OWNER's expense, except as indicated below.

B. Density

1. Where soil material is required to be compacted to a percentage of maximum density, the maximum density at optimum moisture content will be determined in accordance with Method C of ASTM D 1557.

2. Where cohesionless, free draining soil material is required to be compacted to a percentage of relative density, the calculation of relative density will be determined in accordance with ASTM D 4253 and D 4254.

3. Field density in-place tests will be performed in accordance with ASTM D 1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method, ASTM D 2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place By Nuclear Methods (Shallow Depth), or by such other means acceptable to the CONSTRUCTION MANAGER.

C. Remediation

1. In case the test of the fill or backfill shows non-compliance with the required density, the CONTRACTOR shall accomplish such remedy as may be required to ensure compliance.

2. Subsequent testing to show compliance shall be by a testing laboratory selected by the OWNER and paid by the CONTRACTOR.

D. CONTRACTOR's Responsibilities

1. The CONTRACTOR shall provide test trenches and excavations, including excavation, trench support and groundwater removal for the OWNER's field soils testing operations.

2. The trenches and excavations shall be provided at the locations and to the depths as required by the OWNER.

3. Lawn areas destroyed by test trenching and excavation shall be regraded and re-landscaped with hydroseeding.

END OF SECTION

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SECTION 31 34 19

GEOTEXTILES

PART 1 -- GENERAL

1.01 THE SUMMARY

A. The CONTRACTOR shall provide geotextiles, complete and in place, in accordance with the Contract Documents.

B. Definitions: The following definitions apply to the WORK of this Section:

1. Fabric: Geotextile, a permeable geosynthetic comprised solely of textiles.

2. Minimum Average Roll Value (MinARV): Minimum of series of average roll values representative of geotextile provided.

3. Maximum Average Roll Value (MaxARV): Maximum of series of average roll values representative of geotextile provided.

4. Nondestructive Sample: Sample representative of finished geotextile, prepared for testing without destruction of geotextile.

5. Overlap: Distance measured perpendicular from overlapping edge of one sheet to underlying edge of adjacent sheet.

6. Seam Efficiency: Ratio of tensile strength across seam to strength of intact geotextile, when tested according to ASTM D 4884.

7. Woven geotextile: A geotextile fabric composed of polymeric yarn interlaced to form a planar structure with uniform weave pattern.

8. Nonwoven geotextile: A geotextile fabric composed of a pervious sheet of polymeric fibers interlaced to form a planar structure with uniform random fiber pattern.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. The following standards are referenced in this Section:

ASTM D 4355	Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture, and Heat in a Xenon-Arc Type Apparatus
ASTM D 4491	Standard Test Methods for Water Permeability of Geotextiles by Permittivity
ASTM D 4533	Standard Test Method for Trapezoid Tearing Strength of Geotextiles

ASTM D 4595	Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method
ASTM D 4751	Standard Test Method for Determining Apparent Opening Size of a Geotextile
ASTM D 4833	Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
ASTM D 4884	Standard Test Method for Strength of Sewn or Thermally Bonded Seams of Sewn Geotextiles
ASTM D 4886	Standard Test Method for Abrasion Resistance of Geotextiles (Sand Paper/Sliding Block Method)

1.03 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Special Provisions Section 20.

B. Shop Drawings

1. Manufacturer material specifications and product literature.

2. Installation drawings showing geotextile sheet layout, location of seams, direction of overlap, and sewn seams.

3. Description of proposed method of geotextile deployment, sewing equipment, sewing methods, and provisions for holding geotextile temporarily in place until permanently secured.

C. Samples

1. Geotextile: One-piece, minimum 18-inches long, taken across full width of roll of each type and weight of geotextile. Label each with brand name and furnish documentation of lot and roll number from which each sample was obtained.

2. Field Sewn Seam: 5-foot length of seam, 12-inches wide with seam along center, for each type and weight of geotextile.

3. Securing Pin and Washer: 1 each.

D. Certifications

1. Certification from geotextile manufacturer that products satisfy the indicated requirements.

2. Field seam efficiency test results.

PART 2 -- PRODUCTS

2.01 WOVEN GEOTEXTILE

A. Woven geotextile shall be composed of polymeric yarn interlaced to form a planar structure with uniform weave pattern. Products shall be calendared or finished so that yarns will retain their relative position with respect to each other.

B. Polymeric yarn shall be long-chain synthetic polymers (polyester or polypropylene) with stabilizers or inhibitors added to make filaments resistant to deterioration due to heat and ultraviolet light exposure.

C. Sheet Edges: Selvaged or finished to prevent outer material from separating from sheet.

D. Unseamed Sheet Width: Minimum 12 feet.

E. Nominal Weight per Square Yard: 6.

F. Physical Properties: Conform to requirements below.

PHYSICAL PROPERTY REQUIREMENTS FOR WOVEN GEOTEXTILE

Property	Requirement	Test Method
Apparent Opening Size (AOS)	No. 10 to No. 100 U.S. Standard Sieve Size	ASTM D 4751
Water Permittivity	0.02 to 3.34 $sec.^{-1}$, MinARV	ASTM D 4491 (Falling Head)
Vertical Waterflow Rate	10 to 150 gpm/sq ft, MinARV	
Wide Width Strip Tensile Strength	60 to 1,500 lb/in.-width, MinARV	ASTM D 4595
Wide Width Strip Elongation	14 to 60 percent, MaxARV	
Trapezoidal Tear Strength	30 to 200 lb, MinARV	ASTM D 4533
Puncture Strength	50 to 250 lb, MinARV	ASTM D 4833
Abrasion Resistance	5 to 25 percent loss, 250 cycles, MaxARV	ASTM D 4886
Ultraviolet Radiation Resistance	70 to 90 percent strength retention, MinARV after 500 hours	ASTM D 4355

2.02 NONWOVEN GEOTEXTILE

A. Nonwoven geotextile shall be composed of a pervious sheet of polymeric fibers interlaced to form a planar structure with uniform random fiber pattern. Products shall be calendared or finished so that yarns will retain their relative position with respect to each other.

B. Polymeric yarn shall be long-chain synthetic polymers (polyester, polypropylene, or polyethylene) with stabilizers or inhibitors added to make filaments resistant to deterioration due to heat and ultraviolet light exposure.

C. Geotextile Edges: Selvaged or finished to prevent outer material from separating from sheet.

D. Unseamed Sheet Width: Minimum 6-feet.

E. Nominal Weight per Square Yard: 12 ounces.

F. Physical Properties: Conform to requirements below.

PHYSICAL PROPERTY REQUIREMENTS FOR NONWOVEN GEOTEXTILE		
Property	Requirement	Test Method
Apparent Opening Size (AOS)	No. 100 to No. 140 U.S. Standard Sieve Size	ASTM D 4751
Water Permittivity	1.2 $sec.^{-1}$, MinARV	ASTM D 4491 (Falling Head)
Vertical Waterflow Rate	90 gpm/sq ft, MinARV	
Wide Width Strip Tensile Strength	300 MinARV	ASTM D 4595
Wide Width Strip Elongation	70 percent, MaxARV	ASTM D 4595
Trapezoidal Tear Strength	120 lb, MinARV	ASTM D 4533
Puncture Strength	130 lb, MinARV	ASTM D 4833
Ultraviolet Radiation Resistance	90 percent strength retention, MinARV after 500 hours	ASTM D 4355

2.03 SEWING THREAD

A. Sewing thread shall be polypropylene, polyester, or Kevlar thread with durability equal to or greater than durability of geotextile sewn.

2.04 SECURING PINS

A. Securing pins shall be steel rods or bars conforming to the following:

1. 3/16-inch diameter.

2. Pointed at one end; head on other end, sufficiently large to retain washer.

3. Minimum Length: 12-inches.

B. Steel washers for securing pins shall be:

1. Outside Diameter: Not less than 1-1/2 inches.

2. Inside Diameter: 1/4-inch.

3. Thickness: 1/8-inch.

C. Steel Wire Staples

1. U-shaped.

2. 10-gauge.

3. Minimum 6-inches long.

PART 3 -- EXECUTION

3.01 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver each roll with sufficient information attached to identify manufacturer and product name or number.

B. Handle products in manner that maintains undamaged condition.

C. Do not store products directly on ground. Ship and store geotextile with suitable wrapping for protection against moisture and ultraviolet exposure. Store geotextile in a way that protects it from elements. If stored outdoors, elevate and protect geotextile with waterproof cover.

3.02 LAYING GEOTEXTILE

A. Notify the CONSTRUCTION MANAGER whenever geotextiles are to be placed. Do not place geotextile prior to obtaining CONSTRUCTION MANAGER's approval of underlying materials.

B. Lay and maintain geotextile smooth and free of tension, folds, wrinkles, or creases.

3.03 ORIENTATION ON SLOPES

A. Orient geotextile with long dimension of each sheet parallel to direction of slope.

B. Geotextile may be oriented with long dimension of sheet transverse to direction of slope only if sheet width, without unsewn seams, is sufficient to cover entire slope and anchor trench and extend at least 18-inches beyond toe of slope.

3.04 JOINTS

A. Unseamed Joints

1. Unseamed joints shall be overlapped to the following dimensions unless otherwise indicated:

   a. Foundation/Subgrade Stabilization: Minimum 18-inches.

   b. Riprap: Minimum 18-inches.

   c. Drain Trenches: Minimum 18-inches, except overlap shall equal trench width if trench width is less than 18-inches.

   d. Other Applications: Minimum 12-inches.

B. Sewn seams shall be used wherever stress transfer from one geotextile sheet to another is necessary. Sewn seams, as approved by CONSTRUCTION MANAGER, also may be used instead of overlap at joints for applications that do not require stress transfer.

1. Seam efficiency shall be minimum 70 percent, verified by preparing and testing minimum of one set of nondestructive samples per acre of each type and weight of geotextile provided. Test according to ASTM D 4884.

2. Type: "J" type seams are preferred, but flat or butterfly seams are acceptable.

3. Stitch Count: Minimum 3 to maximum 7 stitches per inch.

4. Stitch Type: Double-thread chainstitch, Type 401, Federal Standard No. 751a.

5. Stitch Location: 2-inches from geotextile sheet edges, or more if necessary to develop required seam strength.

6. Sewing Machines: Capable of penetrating 4 layers of geotextile.

3.05 SECURING GEOTEXTILE

A. Secure geotextile during installation as necessary with sand bags or other means approved by CONSTRUCTION MANAGER.

B. Securing Pins

1. Insert securing pins with washers through geotextile, midway between edges of overlaps and 6-inches from free edges.

2. Spacing

Slope	Maximum Pin Spacing, feet
Steeper than 3:1	2
3:1 to 4:1	3
Flatter than 4:1	5

3. Install additional pins across each geotextile sheet as necessary to prevent slippage of geotextile or to prevent wind from blowing geotextile out of position.

4. Push each securing pin through geotextile until washer bears against geotextile and secures it firmly to subgrade.

3.06 PLACING PRODUCTS OVER GEOTEXTILE

A. Notify CONSTRUCTION MANAGER before placing material over geotextile,. Do not cover installed geotextile prior to receiving authorization from the CONSTRUCTION MANAGER to proceed.

B. If tears, punctures, or other geotextile damage occurs during placement of overlying products, remove overlying products as necessary to expose damaged geotextile. Repair damage as indicated below.

3.07 INSTALLING GEOTEXTILE IN TRENCHES

A. Place geotextile in a way that will completely envelope granular drain material to be placed in trench and with indicated overlap at joints. Overlap geotextile in direction of flow. Place geotextile in a way and with sufficient slack for geotextile to contact trench bottom and sides fully when trench is backfilled.

B. After granular drain material is placed to grade, fold geotextile over top of granular drain material, unless otherwise indicated. Maintain overlap until overlying fill or backfill is placed.

3.08 RIPRAP APPLICATIONS

A. Overlap geotextile at each joint with upstream sheet of geotextile overlapping downstream sheet.

B. Sew joints where wave runup may occur.

3.09 GEOTEXTILE-REINFORCED EARTH WALL APPLICATIONS

A. Sew exposed joints; extend sewn seams minimum 3-feet behind face of wall.

B. Protect exposed geotextile from damage and deterioration until permanent facing is applied.

3.10 SILT FENCE APPLICATIONS

A. Install geotextile in one piece or continuously sewn to make one piece, for full length and height of fence, including portion of geotextile buried in toe trench.

B. Install bottom edge of sheet in toe trench and backfill in a way that securely anchors geotextile in trench.

C. Securely fasten geotextile to a wire mesh backing and each support post in a way that will not result in tearing of geotextile when fence is subjected to service loads.

D. Promptly repair or replace silt fence that becomes damaged.

3.11 REPAIRING GEOTEXTILE

A. Repair or replace torn, punctured, flawed, deteriorated, or otherwise damaged geotextile. Repair damaged geotextile by placing patch of undamaged geotextile over damaged area plus at least 18-inches in all directions beyond damaged area. Remove interfering material as necessary to expose damaged geotextile for repair. Sew patches or secure them with pins and washers, as indicated above for securing geotextile, or by other means approved by CONSTRUCTION MANAGER.

3.12 REPLACING CONTAMINATED GEOTEXTILE

A. Protect geotextile from contamination that would interfere, in CONSTRUCTION MANAGER's opinion, with its intended function. Remove and replace contaminated geotextile with clean geotextile.

END OF SECTION

SECTION 32 11 13

A.C. PAVEMENT AND BASE

PART 1 -- GENERAL

1.01 THE SUMMARY

A. The CONTRACTOR shall provide A.C. pavement and base, complete and in place, in accordance with the Contract Documents.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards

AASHTO M 82	Cut-Back Asphalt (Medium Curing Type)
AASHTO M 140	Emulsified Asphalt
AASHTO M 208	Cationic Emulsified Asphalt
AASHTO M 226	Viscosity Graded Asphalt Cement
ASTM D 242	Mineral Filler for Bituminous Paving Mixtures
ASTM D 692	Coarse Aggregate for Bituminous Paving Mixtures
ASTM D 977	Emulsified Asphalt
ASTM D 1073	Fine Aggregate for Bituminous Paving Mixtures
ASTM D 1188	Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens
ASTM D 1557	Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf per cu ft)
ASTM D 2027	Cutback Asphalt (Medium Curing Type)
ASTM D 2397	Cationic Emulsified Asphalt
ASTM D 2726	Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures.
ASTM D 3381	Viscosity-Graded Asphalt Cement for Use in Pavement Construction
ASTM D 3515	Hot-Mixed, Hot-Laid Bituminous Paving Mixtures

1.03 CONTRACTOR SUBMITTALS

A. Submittals shall be in accordance with Standard Provisions Section 7. Include materials testing reports, job-mix formulas, and other pertinent information satisfactory to the CONSTRUCTION MANAGER.

B. Suitability Tests of Proposed Materials: Tests for conformance with the Specifications shall be performed prior to start of the WORK. The samples shall be identified to show the name of the material, aggregate source, name of the supplier, contract number, and the segment of the WORK where the material represented by the sample is to be used. Results of all tests shall be submitted to the CONSTRUCTION MANAGER for approval. Materials to be tested shall include aggregate base, coarse and fine aggregate for paving mixtures, mineral filler, and asphalt cement.

C. Trial Batch: Before placing any paving material, a testing laboratory acceptable to the ENGINEER OF RECORD shall prepare a trial batch of asphalt concrete for each job-mix formula to be used by the CONTRACTOR for the work. The trial batch shall be prepared using the aggregates and asphalt cement proposed by the CONTRACTOR, and approved by the ENGINEER OF RECORD. The compacted trial batch shall provide a basis for computing the voids ratio, provide an indication of the optimum asphalt content, and establish a basis for controlling compaction during construction. The cost of not more than 2 laboratory trial batch tests will be paid by the OWNER but the CONTRACTOR shall be responsible for the materials. Performing and paying for any additional trial batch testing shall be the CONTRACTOR's responsibility.

PART 2 -- PRODUCTS

2.01 AGGREGATE BASE

A. Materials for aggregate base shall be Type G material in accordance with Section 31 30 00 - Earthwork.

2.02 TACK COAT

A. Tack coat shall be emulsified asphalt Grade SS-1 or SS-1h, CSS-1 or CSS-1h diluted with one part water to one part emulsified asphalt, undiluted asphalt Grade RS-1 or CRS-1, or paving asphalt Grade AR-1000. Emulsified asphalt shall comply with the requirements of AASHTO M 140 (ASTM D 977) or M 208 (ASTM D 2397); paving asphalt shall comply with the requirements of AASHTO M 226 (ASTM D 3381).

2.03 ASPHALT CEMENT

A. Asphalt Cement shall be Grade AR-4000 complying with the requirements of AASHTO M226 (ASTM D 3381).

2.04 MINERAL AGGREGATE

A. Mineral aggregate shall be crushed stone, crushed slag, crushed gravel, stone or slag screening, sand, mineral filler, or a combination of two or more of these materials. Coarse and fine aggregates shall comply with all the quality requirements, except soundness, of ASTM D 692 and D 1073, respectively. Coarse aggregate failing to

comply with abrasion requirements may be used if experience has demonstrated it to be satisfactory.

B. Mineral filler shall comply with ASTM D 242.

C. Combinations of aggregates having a history of polishing shall not be used in surface courses.

2.05 ASPHALT-AGGREGATE MIXTURE

A. Base Course Mixture: The CONTRACTOR shall submit for approval a job-mix formula for each mixture. The job-mix formula for the asphalt-aggregate base course mixture shall be within the following limits:

Sieve Size	Total Percent Passing by Weight
2-inch	-
1-1/2 inch	100
1-inch	90 – 100
3/4-inch	-
1/2-inch	56 – 80
3/8-inch	-
No. 4	29 – 59
No. 8	19 – 45
No. 50	5 – 17
No. 200	1 – 7
Asphalt Content	**3 to 9** percent by weight of total mix

B. Base Course Mixture Test Criteria: The asphalt-aggregate surface course mixture shall meet the following test criteria:

Stability (Marshall)(Hveem)	3336 N/750 lbs min.; 35 min
Flow (Marshall Method)	8 – 18
Swell (Hveem Method)	0.762 mm max, 0.030 in

	max
Air Voids	3 – 5 percent
Voids in Mineral Aggregate	14 percent

C. Surface Course Mixture: The job-mix formula for the asphalt-aggregate surface course mixture shall be within the following limits:

Sieve Size	Total Percent Passing by Weight
2-inch	-
1-1/2 inch	-
1-inch	-
3/4-inch	-
1/2-inch	100
3/8-inch	90 – 100
No. 4	55 - 85
No. 8	32 – 67
No. 50	7 – 23
No. 200	2 – 10

Asphalt Content **5 - 12** percent by weight of total mix

D. Surface Course Mixture Test Criteria: The asphalt-aggregate surface course mixture shall meet the following test criteria:

Stability (Marshall)**(**Hveem)	3336 N/750 lbs min.; 35 min
Flow (Marshall Method)	8 – 18
Swell (Hveem Method)	0.762 mm max, 0.030 in max
Air Voids	3 – 5 percent
Voids in Mineral Aggregate	14 percent

E. Asphalt-Aggregate Mixture Tolerances: The following tolerances for the job-mix formula will be allowed per single test:

Passing Sieve	Percent
1/2-inch and larger	plus and minus 8
3/8-inch and No. 4	plus and minus 7
No. 8	plus and minus 6
No. 50	plus and minus 5
No. 200	plus and minus 3
Asphalt Content, percent by weight of total mixture	plus and minus 0.5

F. Results of single extraction and sieve tests shall not be used as the sole basis for acceptance or rejection of the mixture. Any variation from the job-mix formula greater than the tolerances shown above shall be investigated and the conditions causing the variations corrected.

2.06 PAVEMENT MARKING PAINT

A. Pavement marking paint shall be a product specifically formulated for use on asphalt

2.07 SOIL STERILANT

A. Soil sterilant or chemical weed control agent shall be a commercial product manufactured specifically to sterilize the subgrade soil to prevent the growth of weeds, plants or any type of vegetation.

PART 3 -- EXECUTION

3.01 SUBGRADE PREPARATION

A. The subgrade shall be prepared in accordance with Section 31 30 00 - Earthwork as applicable to roadways and embankments. The surface of the subgrade after compaction shall be hard, uniform, smooth and true to grade and cross-section. Subgrade for pavement shall not vary more than 0.02-foot from the indicated grade and cross section. Subgrade for base material shall not vary more than 0.04-foot from the indicated grade and cross section.

3.02 AGGREGATE BASE

A. Aggregate base shall be provided where indicated to the thickness indicated. Imported aggregate bases shall be delivered to the Site as uniform mixtures and each layer shall be spread in one operation. Segregation shall be avoided and the base shall be free of pockets of coarse or fine material. Where the required thickness is 6-inches or less, the

base materials may be spread and compacted in one layer. Where the required thickness is more than 6-inches; the base material shall be spread and compacted in two or more layers of approximately equal thickness, and the maximum compacted thickness of any one layer shall not exceed 6-inches. The relative compaction of each layer of aggregate base shall be not less than 95 percent of maximum density when measured in accordance with ASTM D 1557. The compacted surface of the finished aggregate shall be hard, uniform, smooth and at any point shall not vary more than 0.02 foot from the indicated grade or cross-section.

3.03 TACK COAT

A. A tack coat shall be applied to existing paved surfaces where new asphalt concrete is to be placed on existing pavement. It shall also be applied to the contact surfaces of all cold pavement joints, curbs, gutters, manholes and the like immediately before the adjoining asphalt pavement is placed. Care shall be taken to prevent the application of tack coat material to surfaces that will not be in contact with the new asphalt concrete pavement. Diluted emulsified asphalt shall be applied at the rate of 0.05 to 0.15 gal/sq yd. Undiluted emulsified asphalt shall be applied at the rate of 0.025 to 0.075 gal/sq yd. Paving asphalt shall be applied at the rate of approximately 0.05 gal/sq yd.

3.04 ASPHALT CONCRETE

A. At the time of delivery to the Site, the temperature of mixture shall not be lower than 260 degrees F or higher than 320 degrees F, the lower limit to be approached in warm weather and the higher in cold weather.

B. Asphalt concrete shall not be placed when the atmospheric temperature is below 40 degrees F or during unsuitable weather.

C. The asphalt concrete shall be evenly spread upon the subgrade or base to such a depth that, after rolling, it will be of the required cross section and grade of the course being constructed.

D. The depositing, distributing, and spreading of the asphalt concrete shall be accomplished in a single, continuous operation by means of a self-propelled mechanical spreading and finishing machine designed specially for that purpose. The machine shall be equipped with a screed or strike-off assembly capable of being accurately regulated and adjusted to distribute a layer of the material to a definite pre-determined thickness. When paving is of a size or in a location that use of a self-propelled machine is impractical, the CONSTRUCTION MANAGER may waive the self-propelled requirement.

E. Spreading, once commenced, shall be continued without interruption.

F. The mix shall be compacted immediately after placing. Initial rolling with a steel-wheeled tandem roller, steel three-wheeled roller, vibratory roller, or a pneumatic-tired roller shall follow the paver as closely as possible. If needed, intermediate rolling with a pneumatic-tired roller shall be done immediately behind the initial rolling. Final rolling shall eliminate marks from previous rolling. In areas too small for the roller, a vibrating plate compactor or a hand tamper shall be used to achieve thorough compaction.

G. Upon completion the pavement shall be true to grade and cross-section. When a 10-ft straightedge is laid on the finished surface parallel to the center of the roadway, the surface shall not vary from the edge of the straightedge more than 1/8-in except at intersections or changes of grade. In the transverse direction, the surface shall not vary from the edge of the straightedge more than 1/4-in.

H. The relative density after compaction shall be 95 percent of the density obtained by using ASTM D 1188 or D 2726. A properly calibrated nuclear asphalt testing device shall be used for determining the field density of compacted asphalt concrete, or slabs or cores may be laboratory tested in accordance with ASTM D 1188.

3.05 PAVEMENT MARKING

A. Pavement marking paint shall be applied where indicated only when the pavement surface is dry and clean, and when the air temperature is above 40 degrees F. All equipment used in the application of pavement marking shall produce stripes and markings of uniform quality with clean and well-defined edges that conform to the details and dimensions indicated. Drips, overspray, improper markings, and paint material tracked by traffic shall be immediately removed from the pavement surface by methods previously reviewed by the CONSTRUCTION MANAGER.

END OF SECTION

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SECTION 32 13 13

CONCRETE PAVEMENT, BASE, CURB AND SIDEWALK

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall provide Portland Cement pavement, curbs and sidewalks constructed to the lines and grades and dimensions required for a complete installation in accordance with the Contract Documents.

1.02 CONTRACTOR SUBMITTALS

A. Shop drawings for reinforcing, joint material and mix designs shall be submitted for review in accordance with Special Provisions, Section 20. Include materials testing reports, job-mix formulas, and other pertinent information satisfactory to the Contracting Officer.

1.03 QUALITY ASSURANCE

A. Concrete testing shall be in accordance with Section 03 31 00 – Cast-in-Place Concrete.

PART 2 -- PRODUCTS

2.01 CONCRETE

A. Concrete shall be “Regular Mix”, conforming to Section 03 31 00 – Cast-in-Place Concrete.

2.02 REINFORCEMENT

A. Reinforcing Bars shall conform to ASTM A 615, Grade 60 deformed.

B. Reinforcing shall comply with CRSI’s “Manual of Standard Practice” for fabricating, placing, and supporting reinforcement.

2.03 JOINT SEALER FOR PAVEMENT

A. Joint sealer shall be one- or two-part polysulfide base self-leveling sealant for horizontal surfaces that has been developed for foot and vehicular traffic.

2.04 PREFORMED JOINT FILLER

A. Preformed joint filler shall be sponge rubber or cork and conform to the requirements of AASHTO Designated M148, Type 1.

PART 3 -- EXECUTION

3.01 SUBGRADE CONDITION

A. The finished subgrade shall be maintained in a smooth, compact condition and any areas that are disturbed prior to placing of the concrete shall be restored at the Contractor's expense. The subgrade shall be moist at the time the concrete is placed. Water shall be uniformly applied ahead of the paving operations as directed by the Contracting Officer. If the Contractor does not maintain the subgrade in the required moist condition, a vapor barrier sheet will be required between the subgrade and the concrete.

3.02 SETTING FORMS

A. The forms shall be accurately set to line and grade and such that they rest firmly throughout their entire length upon the compacted subgrade surface. Forms shall be joined neatly and tightly and braced to test the pressure of the concrete and finishing operations. The alignment and grade of all forms shall be acceptable to the Contracting Officer's Representative before and immediately prior to the placing of concrete. The Contracting Officer's acceptance of the finished forms does not alleviate the Contractor of the overall responsibility for the integrity of the work.

3.03 MIXING CONCRETE

A. The concrete shall be mixed in accordance with the Section 03 31 00 – Cast-in-Place Concrete.

3.04 PLACING CONCRETE

A. The concrete shall be distributed on the subgrade to such a depth that when it is consolidated and finished the slab thickness required by the drawings will be obtained at all points with no point be below the grade specified for the finished surface within the allowable tolerance. The concrete shall be deposited on the subgrade in a manner that will require as little handling as possible.

B. Reinforcement shall be placed at mid slab depth and the reinforcement shall be maintained at this location during the placing and finishing operations.

C. Concrete shall be thoroughly consolidated against and along faces of all forms by means of hand-operated, spud-type vibrators. Vibrators shall not be permitted to come in contact with the subgrade or the sides of the forms. Vibration at any one location shall not continue so long as to produce puddling or the accumulation of excessive lean concrete on the surface. In no case shall the vibrator be operated longer than 15 seconds at any single location.

3.05 STRIKING OFF, CONSOLIDATING AND FINISHING CONCRETE

A. Immediately after placing the concrete, it shall be struck off, consolidated and finished to produce a finished pavement conforming to the cross-section width and surface. The sequence of operations shall be as follows: strike-off; vibratory consolidation; screeding; floating; removal of laitance; straight-edging; and final surface finish.

3.06 STRAIGHT-EDGING AND SURFACE CORRECTIONS

A. After floating has been completed and the excess water removed but while the concrete is still in a plastic state, the surface of the concrete shall be tested for trueness with an accurate 10-feet long straightedge. The straightedge shall be furnished by the Contractor. The straightedge shall be held in successive positions parallel to the road tested from one side of the slab to the other as necessary. Any depressions shall be immediately filled with freshly mixed concrete and struck off, consolidated and refinished. High areas shall be cut down and refinished. Straightedge testing and surface correction shall continue until the entire surface appears to conform to the required grade and cross section.

3.07 FINAL FINISH

A. As soon as the water sheen has disappeared from the surface of the pavement and just before the concrete becomes non-plastic, a light broom finish shall be given to the surface.

3.08 EDGING

A. After the final finish has been applied but before the concrete has become non-plastic, the edges of the pavement along each side of the strip being placed shall be carefully rounded to a ¼-inch radius. On each side of the construction joints and along any structure extending into the pavement, the joint shall be carefully rounded to a ¼-inch radius except as otherwise indicated. A well-defined and continuous radius shall be produced and a smoother dense mortar finish obtained. All concrete shall be completely removed from the top of the joint filler.

B. All joints shall be checked with a straightedge before the concrete has become non-plastic and if one side of the joint is higher or lower than the adjacent slabs; corrections shall be made as necessary.

3.09 JOINTS

A. Construction joints shall be identified in Contractor submittals for approval by Contracting Officer.

B. Construction joints shall be spaced at a maximum distance of 15 feet. Where new concrete pavement abuts existing pavement the joint spacing and pattern shall match the existing pavement to provide a uniform appearance between the new and existing work.

C. Expansion joints shall be formed by placing premolded expansion joint material about all structures and features projecting through into or against the pavement. Unless otherwise indicated such joints shall be ½-inch in width.

D. Expansion joints shall be placed at a distance no greater than 100 feet.

E. Open type transverse expansion joints shall be provided at all sidewalk returns and at 50 feet intervals and wherever indicated on the Drawings. Open type joints shall be formed by staking a ¼-inch metal bulkhead in place and placing concrete on both sides. After the concrete has set sufficiently to preserve the width and shape of the joint the bulkhead shall be removed. After the sidewalk has been finished over the joint the slot shall be opened and edged with a tool having a ½ -inch radius. Transverse expansion joints shall be cleaned and filled with joint filler strips ¼-inch thick conforming to the requirements of AASHTO M-153.

F. Scored joints shall either be formed or sawed at 5-feet intervals and shall extend to a depth of at least one fourth or the thickness of the slab.

3.10 CURING

A. After the finishing operations have been completed and as soon as the concrete has hardened sufficiently that marring of the surface will not occur the entire surface and the edges of the newly placed concrete shall be covered and cured with membrane forming curing compound.

B. Curing compound shall be uniformly applied to the surfaces to be cured in a single coat continuous film at the rate of one gallon to not more than 200 square feet using a mechanical sprayer.

C. Curing compound shall not be applied during periods of rainfall. Curing compounds shall not be applied to the inside faces of joints to be sealed. Should the film become damaged from any cause within the required curing period the damaged portions shall be repaired immediately with additional compound. Upon removal of side forms the sides of the slabs exposed shall be coated to provide a curing treatment equal to that provided for the surface.

3.11 CURB AND SIDEWALK CONSTRUCTION

A. The concrete curbs and sidewalks shall be constructed on a prepared smooth subgrade of uniform density. Large boulders and other obstructions shall be removed to a minimum depth of 6 inches below the finished subgrade elevation and the replaced with suitable material that shall be thoroughly compacted by rolling or tamping. The Contractor shall furnish a template and shall thoroughly check the subgrade prior to depositing concrete.

B. Concrete for curbs and sidewalks shall be formed mixed placed and finished in conformance with the requirements of Division 03 except as modified herein. Concrete shall be cured with a clear membrane curing compound that shall be applied at a uniform rate of one gallon per 200 square feet in accordance with the requirements

specified hereinbefore under pavement construction. Sidewalks shall be given a light broom finish.

3.12 CURBS

A. Curbs shall be constructed in uniform sections ten feet in length except where shorter sections are necessary for closure or arcs along curves. The sections shall be separated by sheet metal templates set perpendicular to the face and tip of the curve and not less than 2 inches longer than the depth of the curb. The templates shall be held firmly during the placing of the concrete and shall be allowed to remain in place until the concrete has set sufficiently to hold its shape but shall be removed while the forms are still in place.

B. After the concrete has sufficiently set for a minimum of 12 hours the Contractor shall remove the forms and backfill the spaces on each side. The earth shall be compacted in a satisfactory manner without damage to the concrete work. Minor defects shall be filled with a mortar composed of one-part Portland Cement and two parts fine aggregate.

END OF SECTION

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SECTION 33 05 16

PRECAST CONCRETE MANHOLES AND VAULTS

PART 1 -- GENERAL

1.01 THE SUMMARY

A. The CONTRACTOR shall provide precast concrete manholes and vaults, complete and in place, in accordance with the Contract Documents.

1.02 SPECIFICATIONS, CODES AND STANDARDS

ASTM A 48	Gray Iron Castings
ASTM C 150	Portland Cement
ASTM C 443	Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
ASTM C 478	Precast Reinforced Concrete Manhole Sections
ASTM C 890	Standard Practice for Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures
ASTM C 913	Standard Specification for Precast Concrete Water and Wastewater Structures
ASTM C 923	Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals

1.03 CONTRACTOR SUBMITTALS

A. General: Furnish submittals in accordance with Special Provisions Section 20.

B. Shop Drawings

1. Show dimensions, locations, lifting inserts, reinforcement, and joints.

2. Structural design calculations for vaults, signed by a registered engineer.

C. Manufacturer’s Certification for Vaults: Written certification that the vault complies with the requirements of this Section.

1.04 QUALITY ASSURANCE

A. Inspection: After installation, the CONTRACTOR shall demonstrate that manholes and vaults have been properly installed, level, with tight joints, at the correct elevations and

orientations, and that the backfilling has been carried out in accordance with the Contract Documents.

PART 2 -- PRODUCTS

2.01 MANHOLES

A. The CONTRACTOR shall provide precast manhole sections and conical sections conforming to ASTM C 478 and the requirements of this Section. Adjusting rings shall be standard items from the manufacturer of the manhole sections. Minimum wall thickness of rings shall be 4-inches if steel reinforced and 6-inches if not reinforced.

B. Axial length of sections shall be selected to provide the correct total height with the fewest joints.

C. Conical sections shall be designed to support cast iron frames and covers under an H-20 loading, unless indicated otherwise.

D. Where the manhole barrel diameter is greater than 48-inches, a flat slab-transition, either concentric or eccentric, shall be used to transition to 48-inch diameter riser sections. Underside of the transition shall be at least 7-feet above the top of the bench.

E. Where indicated on the Drawings, manholes supplied for 48-inch and larger pipes shall be of a ”T” Base-style fabrication. The pipeline portion of the “Base T” section shall conform to ASTM C-76 and be of the same pipe class as the deepest connected sewer. The riser section shall conform to ASTM C-478.

F. Design Criteria: Manhole walls, transitions, conical sections, and base shall be designed per ASTM C 478 for the depths indicated and the following:

1. AASHTO H-20 loading applied to the cover.

2. Unit weight of soil of 120 pcf located above all portions of the manhole.

3. Lateral soil pressure based on saturated soil producing 100 pcf acting on an empty manhole.

4. Internal fluid pressure based on unit weight of 63 pcf with manhole filled from invert to cover with no balancing external soil pressure.

5. Dead load of manhole sections fully supported by the base and transition.

6. Additional reinforcing steel in walls to transfer stresses at openings.

7. The minimum clear distance between the edges of any 2 wall penetrations shall be 12-inches or one-half of the diameter of the smaller penetration, whichever is greater.

G. Joints shall be sealed with o-ring gaskets conforming to ASTM C 443.

H. Concrete for base and channel formation shall be 4000 psi concrete conforming to Section 03 31 00 - Cast-In-Place Concrete.

I. Except were otherwise indicated on the Drawings, manholes shall have a precast concrete base and a factory installed bench.

J. Barrel section to sewer pipe connections shall be sealed with resilient connectors complying with ASTM C 923. Mechanical devices shall be stainless steel.

K. Manhole steps shall be comprised of 1/2-inch grade 60 steel reinforcement rod encased in polypropylene copolymer plastic. Steps shall have tread width of 14-inches. Furnish test results demonstrating step capability to resist a pull out force of 2200 pounds. Provide **PS2-PF Manhole Step** by **M.A. Industries,** or equal.

L. Manhole Manufacturers, or Equal

1. **Atlantic Concrete Products, Inc.**

2. **Hanson Concrete Products, Inc.**

3. **Hardwall Fabricators, Inc**.

4. **Teichert Precast**

2.02 FRAMES AND COVERS

A. Castings: Castings for manhole frames and covers shall be non-rocking and shall conform to the requirements of ASTM A 48, Class 30. Unless otherwise indicated, cast iron covers and frames shall be heavy traffic type, 30 inches in diameter, with embossed lettering saying "Sewer" **or** "Storm"to meet the requirements of the City or the local utility company. Frame and cover shall be designed for H-20 traffic loading.

B. Castings Manufacturers, or Equal

1. **Alhambra Foundry Co., Ltd.**

2. **Neenah Foundry Co.**

3. **Vulcan Foundry, Inc**

2.03 VAULTS

A. The CONTRACTOR shall provide precast vaults designed for the indicated applications and of the sizes indicated.

B. The minimum structural member thickness for vaults shall be 5-inches. Cement shall be Type V portland cement as specified in ASTM C 150. The minimum 28-day concrete compressive strength shall be 4,000 psi. All reinforcing steel shall be embedded in the concrete with a minimum clear cover as recommended by ACI 318.

C. Design Loading: Vaults in areas subject to vehicular traffic shall be designed for H-20 traffic loading. Vaults in other areas shall be designed for a vertical live load of 300 psf. Lateral loads on vaults in all areas shall be calculated from:

	L	=	100 h, plus surcharge of 240 psf in areas of vehicular traffic
Where	L	=	loading in psf
	h	=	depth of fill in feet

D. Where joints are designed in pre-cast concrete vaults, such joints shall be interlocking to secure proper alignment between members and prevent migration of soil through the joint. Structural sections at joints shall be sized sufficiently to reinforce the section against localized distress during transportation and handling and against excess contact bearing pressures through the joint.

E. Where openings for access to the vault are required, the full clear space opening indicated shall be provided, without obstructions from brackets or supports. For large openings where brackets or supports are designed to protrude into the opening for support of required covers, such brackets or supports shall be designed to be easily removed and replaced with a minimum of effort and without cutting or welding.

F. Covers for access openings shall be provided. Frames for covers shall be fabricated from steel, galvanized after fabrication, and shall be integrally cast into the vault concrete sections. All covers shall be tight fitting to prevent the entrance of dirt and debris. Where edge seams are permitted, no gaps greater than 1/16-inch between edges will be accepted. All covers, except round, heavy-weight, cast iron manhole covers, shall have securing mechanisms to hold the covers firmly in place against the effects of repetitious live loads such as pedestrian or vehicle traffic.

G. Where penetration of the pre-cast concrete vault are required for piping, conduit, or ducts, such penetrations shall be accommodated through pre-cast openings or thin-wall knock-out sections. All openings for penetrations shall be smooth and free of surface irregularities and without exposed steel reinforcing. Vaults need not be designed to resist thrust from piping passing through the vault.

H. Warning Signs

1. The entrance to every manhole and vault shall be fitted with a permanently affixed, plastic warning sign, located above and centered on the top step. Each sign shall be in accordance with Special Provisions Section 14.

2. Sign Manufacturer, or Equal

   a. W. H. Brady Company

   b. Seton Nameplate Corporation

PART 3 -- EXECUTION

3.01 GENERAL

A. Pre-cast concrete sections shall be transported and handled with care in accordance with the manufacturer's written recommendations. Where lifting devices are provided in pre-cast sections, such lifting devices shall be used as intended. Where no lifting devices are provided, the CONTRACTOR shall follow the manufacturer's recommendations for lifting procedures to provide proper support during lifting.

B. Buried pre-cast concrete vaults shall be assembled and placed in excavations on properly compacted soil foundations as indicated. Pre-cast concrete vaults shall be set to grade and oriented to provide the required dimensions and clearances from pipes and other structures.

C. Prior to backfilling, all cracks and voids in pre-cast concrete vaults shall be filled with non-shrink grout or polyurethane sealant, or both. Around pipe and conduit penetrations, openings shall be sealed with polyurethane sealant. With the authorization of the CONSTRUCTION MANAGER, grout or a closed-cell flexible insulation may be used as filler material prior to placing a final bed of polyurethane sealant.

D. Steps shall be driven into tapered holes formed in the concrete by inserts from the step manufacturer or 1-inch holes drilled 3-3/4 inches deep into the manhole wall in the field. No more than 6-1/8 inches of plastic arm, measured on the inside of the step, shall be exposed outside the concrete.

E. Steps shall be installed 12-inches on centers vertically, not more than 1/2 inch out of plumb. The top step shall be no more then 12-inches below the manhole cover.

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SECTION 33 92 10

STEEL PIPE, SPECIALS, AND FITTINGS

PART 1 -- GENERAL

1.01 THE SUMMARY

A. The CONTRACTOR shall provide steel pipe, specials, and fittings, complete and in place, in accordance with the Contract Documents.

B. A single pipe manufacturer shall be made responsible for furnishing steel pipe, specials, fittings, and appurtenances such as bolts and gaskets for the WORK.

1.02 REFERENCE STANDARDS

A. AWWA C200 - Steel Water Pipe 6 in and Larger,

B. AWWA C205 - Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 in and Larger-Shop Applied,

C. AWWA C207 - Steel Pipe Flanges for Waterworks Service - Sizes 4 In Through 144 In,

D. AWWA C208 - Dimensions for Fabricated Steel Water Pipe Fittings,

E. AWWA C214 – Tape Coating for Steel Pipe

F. AWWA C219 - Bolted, Sleeve-Type Couplings for Plain-End Pipe,

G. AWWA C221 - Fabricated Steel Mechanical Slip-Type Expansion Joints

H. ISO 9000,

I. Steel Plate Fabricator’s Association (SPFA)

J. Lloyd’s Register Quality Assurance (LRQA),

1.03 RELATED SECTIONS

A. Section 01 75 05 Field Testing

B. Section 40 05 00 Piping, General

C. Section 40 05 24 Steel Pipe (small steel pipe)

1.04 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Special Provision Section 20.

B. Furnish the following information with Shop Drawings:

1. certified dimensional drawings of fittings and appurtenances

2. joint and pipe/fitting wall construction details which indicate the type and thickness of cylinder; the position, type, size, and area of reinforcement; coating and lining holdbacks, manufacturing tolerances, and other pertinent information required for the manufacture of the product

3. joint details where deep bell or butt strap joints are required for control of temperature stresses

4. details for elbows, wyes, tees, outlets, connections, test bulkheads, and nozzles or other specials that indicate amount and position of reinforcement

5. fittings and specials, showing proper reinforcement to withstand the internal pressure, both circumferential and longitudinal, and the external loading conditions as indicated

6. material lists and steel reinforcement schedules that describe materials to be utilized, including metallurgical, chemical, and physical test reports from each heat of steel to verify the steel conforms to the indicated requirements

7. line layout and marking diagrams which indicate the specific number of each pipe and fitting, the location of each pipe, the direction of each fitting in the completed line, and the following:

   a. the pipe station and invert elevation at every change in grade or horizontal alignment

   b. the station and invert elevation to which the bell end of each pipe will be laid

   c. elements of curves and bends, both in horizontal and vertical alignment

   d. the limits within each reach of restrained and/or welded joints or of concrete encasement

   e. location and dimensional allocations for each indicated valve, fitting, and appurtenance

8. Welds

   a. Submit full and complete information regarding location, type, size, and extent of welds.

   b. The Shop Drawings shall distinguish between shop and field welds.

   c. Shop Drawings shall indicate by welding symbols or sketches the details of the welded joints and the preparation of parent metal required to make them.

d. Joints or groups of joints in which welding sequence or technique are especially important shall be carefully controlled to minimize shrinkage stresses and distortion.

9. rubber gasket joint design and details

10. drawings showing the location, design, and details of bulkheads for hydrostatic testing of the pipeline, and details for removal of test bulkheads and repair of the lining

11. details and locations of closures for length adjustment and for construction convenience

12. detail drawings indicating the type, number, and other pertinent details of the slings, strutting, and other methods proposed for pipe handling during manufacturing, transport, and installation

C. Certifications

1. The CONTRACTOR shall furnish a certified affidavit of compliance for pipe and other products or materials in AWWA C200 - Steel Water Pipe 6 in and Larger, AWWA C205 - Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 in and Larger-Shop Applied, AWWA C207 - Steel Pipe Flanges for Waterworks Service - Sizes 4 In Through 144 In, AWWA C208 - Dimensions for Fabricated Steel Water Pipe Fittings, AWWA C219 - Bolted, Sleeve-Type Couplings for Plain-End Pipe, AWWA C221 - Fabricated Steel Mechanical Slip-Type Expansion Joints, and the following supplemental requirements:

a. physical and chemical properties of steel

b. hydrostatic test reports

c. results of production weld tests

d. sand, cement, and mortar tests

e. rubber gasket tests

2. Performance and payment for sampling and testing necessary for certification are the CONTRACTOR's responsibility as part of the WORK.

D. Manufacturer’s Qualifications

1. Furnish a copy of manufacturer’s certification to ISO 9000, SPFA, or LRQA, and documentation of manufacturer’s experience in fabricating AWWA C200 pipe.

E. Design Calculations of Fittings and Specials

1. Furnish a copy of the design calculations for fittings and specials including miters, welds, and reinforcement, prior to manufacture of the pipe, fittings, and specials.

1.05 QUALITY ASSURANCE

A. Pipe Manufacturer Qualifications

1. The pipe manufacturer shall be certified to ISO 9000, the Steel Plate Fabricator's Association (SPFA), or Lloyd's Register Quality Assurance (LRQA), and shall be experienced in fabrication of AWWA C200 pipe of similar diameters, lengths, and wall thickness to this WORK.

2. Experience shall be in the production facilities and personnel, not the name of the company that owns the production facility or employs the personnel.

B. Inspection

1. Pipe shall be subject to inspection at the place of manufacture in accordance with the provisions of AWWA C200, C205, and C214, as supplemented by the indicated requirements.

2. The CONTRACTOR shall notify the CONSTRUCTION MANAGER in writing of the manufacturing start date not less than 14 Days prior to the start of any phase of the pipe manufacture.

C. Tests

1. Except as indicated otherwise, materials used in the manufacture of the pipe shall be tested in accordance with the requirements of AWWA C200, C205, and C214 as follows and as applicable:

   a. Joint gaskets shall be tested in accordance with AWWA C200.

   b. Shop Tests

      1) After the joint configuration is completed and prior to lining with cement mortar, each length of pipe of each diameter and pressure class shall be shop-tested and certified to a pressure of at least 75 percent of the yield strength of the steel.

      2) The test pressure shall be held for 2 minutes and the pipe visually inspected to confirm that welds are sound and leak-free.

   c. In addition to the tests required in AWWA C200, weld tests shall be conducted on each 5,000-feet of production welds and at any other times there is a change in the grade of steel, welding procedure, or welding equipment.

   d. Fittings fabricated from straight pipe previously passing a hydrostatic test need not have an additional hydrostatic test, provided that the welds are tested by nondestructive means and are demonstrated to be sound.

D. Shop Testing of Steel Plate Specials

1. If any special has been fabricated from straight pipe not previously tested and is of the type listed below, the special shall be hydrostatically tested with a pressure equal to 1-1/2 times the design working pressure: bends, wyes, crosses, tees with side outlet diameter greater than 30 percent of the main pipe diameter, and manifolds.

2. Specials not required to be hydrostatically tested shall be tested by liquid dye penetrant inspection method in accordance with ASTM E 165 - Standard Test Methods for Liquid Penetrant Examination, Method A, or the magnetic particle method in ASME Section VIII, Division 1, Appendix VI.

3. Reinforcing plates shall be tested by the solution method using approximately 40 psig air pressure introduced between the plates through a threaded test hole; the test hole shall be properly plugged following successful testing.

4. Weld Imperfections

    a. Weld defects, cracks, leaks, distortion, or signs of distress during testing shall require corrective measures.

    b. Weld defects shall be gouged out and re-welded.

    c. After corrections, the special shall be retested.

5. Test Heads

    a. Where welded test heads or bulkheads are used, extra length shall be provided to each opening of the special.

    b. After the removal of each test head, the special shall be trimmed back to the design points with finished plate edges ground smooth, straight, and prepared for the field joint.

6. Testing shall be performed before joints have been coated or lined.

7. Ultrasonic examination shall be performed in accordance with the following:

    a. Steel plate that will be in welded joints or welded stiffener elements shall be examined ultrasonically for laminar discontinuities where both of the following conditions exist:

        1) any plate in the welded joint has a thickness exceeding 1/2 inch

        2) any plate in the welded joint is subject to transverse tensile stress through its thickness during the welding or service

    b. Ultrasonic examination may be waived where joints are designated to minimize potential laminar tearing.

c. The ultrasonic examination shall be in accordance with ASTM A 578 - Straight Beam Ultrasonic Examination of Plain and Clad Steel Plates for Special Applications, with a Level I acceptance standard.

8. Plates that are not in conformance with the acceptance criteria in ASTM A 578 may be used in the WORK if the areas that contain the discontinuities are a distance at least 4 times the greatest dimension of the discontinuity away from the weld joint.

E. The CONTRACTOR shall be responsible for performing and paying for the indicated material tests.

F. The CONSTRUCTION MANAGER has the right to witness testing conducted by the CONTRACTOR, provided that the CONTRACTOR's schedule is not delayed for the convenience of the CONSTRUCTION MANAGER.

G. Additional Testing

1. In addition to those tests specifically required, the CONSTRUCTION MANAGER may request additional samples of any material including mortar lining and coating for testing by the OWNER.

2. The additional samples shall be furnished as part of the WORK.

H. Field Testing

1. Field testing shall be in accordance with the requirements of Section 01 74 30 – Pressure Pipe Testing and Disinfection and Section 01 75 06 Field Testing

I. Welding Requirements

1. Welding procedures used to fabricate and install pipe shall be prequalified under the provisions of ANSI/AWS D1.1 - Structural Welding Code-Steel, or the ASME Boiler and Pressure Vessel Code, Section 9.

2. Welding procedures shall be required for longitudinal and girth or spiral welds for pipe cylinders, spigot and bell ring attachments, reinforcing plates and ring flange welds, and plates for lug connections.

J. Welder Qualifications

1. Welding shall be performed by skilled welders, welding operators, and tackers who have had adequate experience in the methods and materials to be used.

2. Welders shall be qualified under the provisions of ANSI/AWS D1.1 or the ASME Boiler and Pressure Vessel Code, Section 9 by an independent local, approved testing agency not more than 6 months prior to commencing WORK on the pipeline.

3. Machines and electrodes similar to those used in the WORK shall be used in qualification tests.

PART 2 -- PRODUCTS

2.01 GENERAL

A. Lined and coated steel pipe and specials shall conform to AWWA C200, C205, subject to the following supplemental requirements:

1. The pipe, specials, and fittings shall be of the diameter and class indicated and shall be provided complete with rubber gaskets or welded joints as indicated.

2. For pipe, specials, and fittings 14-inch diameter and larger, the nominal inside diameter after lining shall be not less than the indicated diameter, allowing for tolerances according to AWWA C200 and C205.

3. Pipe, specials, and fittings smaller than 14-inch diameter may be furnished in standard outside diameters.

4. When indicated as a minimum, wall thickness tolerance shall be as allowed by AWWA C200 or the ASTM nominal sheet or plate tolerance, whichever is less.

B. Markings

1. The manufacturer shall legibly mark pipe, specials, and fittings in accordance with the laying schedule and marking diagram.

2. Each pipe, special, and fitting shall be numbered in sequence and said number shall appear on the laying schedule and marking diagram in its proper location for installation.

3. Each pipe, fitting, and special shall be marked at each end with top field centerline.

C. Handling and Storage

1. The pipe, specials, and fittings shall be handled by use of wide slings, padded cradles, or other devices designed and constructed to prevent damage to the pipe coating and exterior.

2. The use of chains, hooks, or other equipment that might injure the pipe coating or exterior will not be permitted.

3. Stockpiled pipe, specials, and fittings shall be supported on padded skids, sand or earth berms free of rock exceeding 3 inches in diameter, sand bags, or suitable means so that the pipe including coating and lining coating will not be damaged.

4. Pipe, specials, and fittings shall not be rolled and shall be secured to prevent accidental rolling.

D. The CONTRACTOR shall replace or repair damaged pipe, specials, and fittings.

E. Strutting

1. Adequate strutting shall be provided on specials, fittings, and straight pipe in order to avoid damage to the pipe, specials, and fittings during handling, storage, hauling, and installation.

2. For mortar-lined steel pipe, specials, or fittings the following requirements shall apply:

   a. The strutting shall be placed as soon as practicable after the mortar lining has been applied and shall remain in place while the pipe, special, or fitting is loaded, transported, unloaded, installed, and backfilled at the Site.

   b. The strutting materials, size, and spacing shall be adequate to support the earth backfill plus any greater loads that may be imposed by the backfilling and compaction equipment.

   c. Any pipe, special, or fitting damaged during handling, hauling, storage, or installation due to improper strutting shall be repaired or replaced.

F. Laying Length

1. The maximum pipe laying length shall be 48 feet, with shorter lengths to be provided as indicated and required.

G. Lining

1. The pipe, specials, and fittings shall have smooth, dense interior surfaces and shall be free from fractures, excessive interior surface crazing, and roughness.

H. Closures and Correction Pieces

1. Closures and correction pieces shall be provided as required such that closures may be made due to different headings in the pipe laying operation and such that corrections may be made to adjust the pipe laying to conform to the indicated pipe stationing.

2.02 MATERIALS

A. Mortar

1. Materials for mortar shall conform to the requirements of AWWA C205; provided that cement for mortar coating shall be Type II, and mortar lining shall be Type II or V.

2. Cement in mortar lining and coating shall not originate from kilns that burn metal-rich hazardous waste fuel, nor shall a fly ash or pozzolan be used as a cement replacement.

3. Admixtures shall contain no calcium chloride.

B. Steel for Cylinder and Fittings

1. Pipe, specials, and fittings manufactured under AWWA C200 shall satisfy the following requirements:

   a. minimum yield strength of steel: 42,000 psi

   b. manufactured by a continuous casting process

   c. fully kilned

   d. fine grain practice

   e. maximum carbon content: 0.25 percent

   f. maximum sulfur content: 0.015 percent

   g. minimum elongation: 22 percent in a 2-inch gauge length

   h. in accordance with one of the following Standards:

      1) ASTM A 1011 - Steel Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability

      2) ASTM A 283 - Low and Intermediate Tensile Strength Carbon Steel Plates

      3) ASTM A 572 - High Strength Low-Alloy Columbium-Vanadium Structural Steel

      4) ASTM A 1018 - Steel, Sheet and Strip, Heavy Thickness Coils, Hot-Rolled Carbon, Structural, High-Strength Low-Alloy Columbium or Vanadium, and High-Strength Low-Alloy with Improved Formability

2. Testing

   a. Steel equal to or greater than 1/2 inch thick used in fabricating pipe shall be tested for notch toughness using the Charpy V-Notch test in accordance with ASTM A 370 - Test Methods and Definitions for Mechanical Testing of Steel Products.

   b. The frequency of testing shall be one impact test (set of 3 specimens - transverse, not longitudinal) for each coil used in manufacturing the pipe.

   c. The testing frequency for sheets and plates shall be one impact test (set of 3 specimens) for each 200 tons of product.

   d. The steel shall withstand a minimum impact of 25 ft-lb at a temperature of 30 degrees F.

2.03 DESIGN OF PIPE

A. General

1. The pipe shall be suitable to transmit potable water**,** raw water, or treatment process waste water under the indicated conditions.

2. The steel pipe shall have rubber-gasketed or field-welded joints as indicated below and as required for pressure service condition.

3. The pipe shall consist of a steel cylinder, shop-lined with Portland cement mortar and an exterior coating of cement mortar in accordance with C205**.**

B. The pipe shall be designed, manufactured, tested, inspected, and marked according to applicable requirements as indicated and, except as indicated, shall conform to AWWA C200.

C. Pipe Dimensions

1. The pipe shall be of the diameter and minimum wall thickness indicated.

D. Fitting Dimensions

1. Fittings shall be of the diameter and class indicated.

E. Joint Design

1. Butt-strap joints shall be used only where required for closures or where indicated.

2. Unless indicated otherwise, the standard field joint for steel pipe shall be as indicated in the following table:

Pipe Diameter	Application	Joint Type
60 inches and less	non-restrained areas	rolled gasket joint, Carnegie gasket joint
	non-restrained and restrained areas	lap-welded joint, butt joint
	closures, restrained and non-restrained	butt strap joint
greater than 60 inches	non-restrained areas	Carnegie gasket joint
	non-restrained and restrained areas	lap-welded joint, butt Joint

	closures, restrained and non-restrained	butt strap joint

F. Lap Joints for Field Welding

1. Lap joints prepared for field welding shall be in accordance with AWWA C200.

2. The method used to form, shape, and size bell ends shall be such that the physical properties of the steel are not substantially altered.

3. Unless otherwise approved by the ENGINEER, bell ends shall be formed by an expanding press or by being moved axially over a die in such a manner as to stretch the steel plate beyond its elastic limit to form a truly round bell of suitable diameter and shape.

4. Faying surfaces of the bell and spigot shall be essentially parallel except for mitered bells, but the bell slope shall not vary more than 2 degrees from the longitudinal axis of the pipe.

G. Bell-and Spigot Ends with Rubber Gaskets:

1. For bell-and-spigot ends with rubber gaskets, the clearance between the bells and spigots shall be such that when combined with the gasket groove configuration and the gasket itself, it will provide watertight joints under every operating condition.

2. The CONTRACTOR shall require the pipe manufacturer to submit details complete with significant dimensions and tolerances and also to submit performance data indicating that the proposed joint has performed satisfactorily under similar conditions.

3. In the absence of a history of field performance, the results of a test program shall be submitted.

4. Unless otherwise approved by the ENGINEER OF RECORD, bell ends shall be formed by an expanding press or by being moved axially over a die in such a manner as to stretch the steel plate beyond its elastic limit to form a truly round bell of suitable diameter and shape.

5. No process will be permitted in which the bell is formed by rolling.

6. Spiral weld seams shall be tested by the visible penetrant method of ASTM E 165 - Methods for Liquid Penetrant Inspection, or by the magnetic particle inspection method of ASME Section VIII, Division 1, Appendix VI, for a minimum distance of 12 inches from each end of each joint after the spigot and bell are formed.

7. Defects shall be repaired.

H. Field Joints

1. Field joints for steel pipe shall be steel joint rings with rubber gaskets (Carnegie joint) in accordance with AWWA C303.

2. The joints shall have the same or higher pressure rating as the adjoining pipe.

3. The clearance between faying surfaces shall be less than 1/8 inch.

I. Shop-applied interior linings and exterior coatings shall be held back from the ends of the pipe as indicated or as otherwise acceptable to the ENGINEER OF RECORD.

J. Restrained Joints

1. Restrained joints shall be located where indicated

2. Restrained joints shall be field-welded joints, either single, or inside and outside lap-weld, or butt-weld, or butt-straps as indicated.

3. Designs shall include stresses created by the greater of:

a. a temperature differential of 30 degrees F plus Poisson's effect in combination with hoop stress, or;

b. thrust due to bulkheads, bends, reducers, and line valves resulting from working pressure in combination with hoop stress.

4. For field-welded joints, design stresses shall not exceed 50 percent of the specified minimum yield strength of the grade of steel utilized, or 21,000 psi, whichever is less, for the part being examined when longitudinal thrust is assumed to be uniformly distributed around the circumference of the joint.

2.04 SPECIALS AND FITTINGS

A. Design

1. Except as otherwise indicated, materials, fabrication and shop testing of specials and fittings shall conform to the requirements stated above for pipe and shall conform to the dimensions of AWWA C208.

2. The minimum thickness of plate for pipe from which specials are to be fabricated shall be the greatest of those determined by the following 3 criteria.

a. Working and Transient Pressure Design

$$T = \frac{P_w D/2}{Y/S_w} \qquad T = \frac{P_t D/2}{Y/S_t}$$

Where:

T = Steel cylinder thickness in inches
D = Outside diameter of steel cylinder in inches
P_w = Design working pressure in psi
P_t = Design transient pressure in psi
Y = Specified minimum yield point of steel in psi
S_w = Safety factor of 2.5 at design working pressure
S_t = Safety factor at design transient pressure; for elbows 1.875 and 2.0 for other specials

b. Mainline Pipe Thickness: Plate thickness for specials shall be not less than the adjacent mainline pipe.

c. Thickness Based on Pipe Diameter

Nominal Pipe Diameter, inches	Pipe Manifolds Piping Above Ground Piping Structures
24 and under	3/16 inch
25 to 48	1/4 inch
over 48	5/16 inch

B. Specials

1. Specials installed on saddle supports shall be designed to limit the longitudinal bending stress to a maximum of 10,000 psi.

2. Design shall be in accordance with the provisions of Chapter 7 of AWWA Manual M11.

C. Deflections and Angles

1. Moderate deflections and long radius curves may be constructed by means of beveled joint rings, by pulling standard joints, by using short lengths or pipe, or a combination of these methods provided that pulled joints shall not be used in combination with bevels.

2. The maximum total allowable angle for beveled joints shall be 5 degrees per pipe joint.

3. Bevels shall be provided on the bell ends.

4. Mitering of the spigot ends will not be accepted.

5. The maximum allowable angle for pulled joints shall be in accordance with the manufacturer's recommendations, or the angle which results from a 3/4-inch pull-out from normal joint closure, whichever is less.

6. Horizontal deflections or fabricated angles shall fall on the alignment.

7. In congested city streets or at other locations where underground obstructions may be encountered, the chord produced by deflecting the pipe shall be no further than 6 inches from the indicated alignment.

8. Vertical Deflections

   a. Vertical deflections shall fall on the alignment and shall be at locations adjacent to underground obstructions, points of minimum earth cover, and pipeline outlets and structures.

   b. The pipe angle points shall match the indicated angle points.

D. Outlets, Tees, Wyes, Crosses, and Nozzles

1. Outlets 12 inches and smaller may be fabricated from Schedule 30 or heavier steel pipe in the standard outside diameters, that is, 12-3/4-inch, 10-3/4-inch, 8-5/8-inch, 6-5/8-inch, and 4-1/2-inch.

2. The minimum plate thickness for reinforcements shall be 10-gauge.

3. The outlet reinforcement design shall be in accordance with the procedures given in Chapter 13 of AWWA Manual M11, and the design pressures and factors of safety indicated above.

4. In lieu of saddle or wrapper reinforcement as provided by the design procedure in Manual M11, pipe or specials with outlets may be fabricated entirely of steel plate having a thickness equal to the sum of the pipe wall plus the required reinforcement.

5. Where Manual M11 requires the design procedure for crotch plate reinforcement, such reinforcement shall be provided.

6. Reinforcing Plates

   a. Outlets shall be fabricated such that there is always at least a 12-inch distance between the outer edge of the reinforcing plate and any field-welded joints.

   b. For outlets without reinforcing plates, outlets shall penetrate the steel cylinders so that there is at least a 12-inch clearance between the outlet and any field-welded joints.

7. Tees, wyes, crosses, elbows, and manifolds shall be fabricated such that the outlet clearances and reinforcing plates from any weld joints are a minimum of 5 times cylinder thickness or 2 inches, whichever is greater.

8. Longitudinal weld joints in adjacent cylinder sections shall be oriented such that there is a minimum offset of 5 times cylinder thickness or 2 inches, whichever is greater.

9. Reinforcement

   a. Reinforcement for wyes, tees, outlets, and nozzles shall be designed in accordance with AWWA Manual M11.

   b. Reinforcement shall be designed for the design pressure indicated and shall be as indicated.

10. Specials and fittings shall be equal in pressure design strength and shall have the same lining and coating as the adjoining pipe.

11. Unless otherwise indicated, the minimum radius of elbows shall be 2.5 times the pipe diameter and the maximum miter angle on each section of the elbow shall not exceed 11-1/4 degrees.

E. Steel welding fittings shall conform to ASTM A 234 - Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.

F. Ends for Mechanical-Type Couplings

1. Except as otherwise indicated, where mechanical-type couplings are indicated the ends of pipe shall be banded with Type C collared ends using double fillet welds.

2. Where pipe 12-inch and smaller is furnished in standard schedule thickness and where the wall thickness equals or exceeds the coupling manufacturer's minimum wall thickness, the pipe ends may be grooved.

2.05 CEMENT-MORTAR LINING

A. Cement-Mortar Lining for Shop Application

1. Unless indicated otherwise, interior surfaces of pipe, specials, and fittings shall be cleaned and lined in the shop with cement mortar lining applied centrifugally in conformity with AWWA C205.

2. During the lining operation and thereafter, the pipe, specials, and fittings shall be maintained in a round condition by suitable bracing or strutting.

3. The lining machines shall be of a type that has been used successfully for similar WORK.

4. Every precaution shall be taken to prevent damage to the lining.

5. If the lining is damaged or found defective at the Site, the damaged or unsatisfactory portions shall be replaced with lining conforming to the indicated requirements.

B. The minimum lining thickness and tolerance shall be in accordance with AWWA C205.

C. Field Joints

1. The pipe shall be left bare as indicated where field joints occur.

2. Ends of the linings shall be left square and uniform.

3. Feathered or uneven edges will not be accepted.

D. Defective Linings

1. Defective linings, as determined by the CONSTRUCTION MANAGER, shall be removed from the pipe wall and shall be replaced to the full thickness required.

2. Defective linings shall be cut back to a square shoulder in order to avoid feather-edged joints.

E. The progress of the application of mortar lining shall be regulated in order that handwork, including the repair of defective areas, is cured in accordance with the provisions of AWWA C205.

F. Cement mortar for patching shall be the same materials as the mortar for machine lining, except that a finer grading of sand and mortar richer in cement shall be used when field inspection indicates that such mix will improve the finished lining of the pipe.

G. Hand-Applied Linings

1. Specials and fittings that cannot be mechanically lined and coated shall be lined and coated by hand-application using the same materials as used for the pipe and in accordance with the applicable AWWA or ASTM standards and as indicated.

2. Coating and lining applied in this manner shall provide protection equal to that for the pipe.

3. Fittings may be fabricated from pipe that has been mechanically lined and/or coated.

4. Areas of lining and coating that have been damaged by such fabrication shall be repaired by hand-application.

H. Cement-Mortar Lining for Field Application

1. Unless otherwise indicated, steel pipe shall be mortar-lined.

2. The materials and design of in-place cement mortar lining shall be in accordance with AWWA C602 and the following supplementary requirements:

a. Pozzolanic material shall not be used in the mortar mix.

b. Admixtures shall contain no calcium chloride.

c. The minimum lining thickness shall be as indicated for shop-applied cement mortar lining, and finished inside diameter after lining shall be as indicated.

d. Temperature and shrinkage cracks in the mortar less than 1/16 inch wide need not be repaired, whereas pipe, specials, or fittings with mortar cracks wider than 1/16 inch shall be rejected.

I. Protection of Pipe Lining/Interior

1. For pipe, specials, and fittings with plant-applied cement-mortar linings, the CONTRACTOR shall provide a 12-mil polyethylene sheet or other suitable bulkhead on the ends of the pipe and on each opening to prevent the lining from drying out.

2. Bulkheads shall be substantial enough to remain intact during shipping and storage until the pipe is installed.

2.06 EXTERIOR COATING OF PIPE

A. Exterior Coating of Exposed Piping

1. The exterior surfaces of pipe, specials, and fittings that will be exposed to the atmosphere inside structures or above ground shall be thoroughly cleaned and then given a shop coat of primer compatible with the finish coating required by Section 09 96 00 – Protective Coating.

B. Exterior Coating of Buried Piping

1. Pipe for buried service, including bumped heads, shall be coated with a minimum one-inch thickness of reinforced cement-mortar coating.

2. Unless otherwise indicated, exterior surfaces of pipe or fittings passing through structure walls shall be cement-mortar coated from the center of the wall or from the wall flange to the end of the underground portion of pipe or fitting.

3. The coating shall be reinforced with a spiral wire reinforcement or welded wire fabric in accordance with AWWA C205.

4. The welded wire fabric shall be securely fastened to the pipe with welded clips or strips of steel.

5. The wire shall be spaced 2 inches on centers and shall extend circumferentially around the pipe.

6. The ends of reinforcement strips shall be lapped 4 inches, and the free ends shall be tied or looped to assure continuity of the reinforcement.

2.07 PIPE APPURTENANCES

A. Pipe appurtenances shall be in accordance with the requirements as indicated.

B. Access manholes with covers shall be as indicated, installed during fabrication and not in the field.

C. Threaded outlets shall be forged steel suitable for 3000-psi service, and shall be as manufactured by **Vogt**, or equal.

PART 3 -- EXECUTION

3.01 INSTALLATION OF PIPE

A. Handling and Storage

1. Pipe, specials, and fittings shall be carefully handled and protected against damage to lining and coating/interior and exterior surfaces, and impact shocks and free fall.

2. Pipe, specials, and fittings shall not be placed directly on rough ground but shall be supported in a manner that will protect the pipe against injury whenever stored at the Site or elsewhere.

3. Pipe, specials, and fittings shall be handled and stored at the Site in accordance with the requirements indicated in Part 2, above.

4. No pipe shall be installed when the lining or coating, or interior or exterior surfaces show cracks that may be harmful as determined by the CONSTRUCTION MANAGER.

5. Such damaged lining and coating, and interior and exterior surfaces shall be repaired or a new undamaged pipe, special, or fitting shall be provided.

B. Pipe damaged prior to Substantial Completion shall be repaired or replaced.

C. The CONTRACTOR shall inspect each pipe, special, and fitting for damage.

D. The CONTRACTOR shall remove or smooth out any burrs, gouges, weld splatter, or other small defects prior to laying the pipe, special, or fitting.

E. Cleaning

1. Before the placement of pipe, specials, or fittings in the trench, each shall be thoroughly cleaned of any foreign substance that may have collected thereon and shall be kept clean thereafter.

2. For this purpose, the openings of pipes, specials, and fittings in the trench shall be closed during any interruption to the WORK.

F. Placement

1. Pipe, specials, and fittings shall be laid directly on the imported bedding material.

2. No blocking will be permitted, and the bedding shall be such that it forms a continuous, solid bearing for the full length of the pipe, special, or fitting.

3. Excavations shall be made as needed to facilitate removal of handling devices after the item has been laid.

4. Bell holes shall be formed at the ends of the pipe to prevent point loading at the bells or couplings.

5. Excavation outside the normal trench section shall be made at field joints as needed to permit adequate access to the joints for field connection operations and for application of coating on field joints.

6. Except for short runs that may be permitted by the ENGINEER OF RECORD, pipes shall be laid uphill if on grades exceeding 10 percent.

7. Pipe that is laid on a downhill grade shall be blocked and held in place until sufficient support is furnished by the following pipe to prevent movement.

8. Bends shall be installed as indicated.

G. Installation Tolerances

1. Each section of pipe, special, or fitting shall be laid in the order and position on the laying diagram and in accordance with the following:

   a. Each section of pipe, special, or fitting having a nominal diameter less than 48 inches shall be laid to line and grade, within plus or minus 2 inches horizontal deviation and plus or minus one inch vertical deviation.

   b. Each section of pipe, special, or fitting having nominal diameter 48 inches and larger shall be laid to line and grade, within plus or minus 5 percent of diameter horizontal deviation and plus or minus 2.5 percent of diameter vertical deviation.

   c. In addition to the horizontal and vertical tolerances above, the pipe shall be laid so that no high or low points other than those on the laying diagram are introduced.

   d. After installation, the pipe, specials, and fittings shall not show deflection greater than:

      1) mortar-lined and mortar-coated pipe, specials, and fittings: 1.5 percent

      2) mortar-lined and flexible-coated pipe, specials, and fittings: 2.25 percent

      3) flexible-lined and flexible-coated or bare pipe, specials, and fittings: 3.0 percent

   e. The allowable deflection shall be based on the design inside diameter.

H. Test Section

1. At the beginning of pipe laying operations, the CONTRACTOR shall perform a test section to demonstrate that the methods and materials to be used will satisfy the pipe zone backfill compaction and pipe deflection criteria.

2. The maximum length of the test section shall be 500 feet.

3. The CONTRACTOR shall not proceed with production pipe laying beyond the test section without the CONSTRUCTION MANAGER's approval.

4. The entire test section length that does not comply with the Contract Documents shall be reworked as necessary to comply.

5. The CONSTRUCTION MANAGER will observe construction of the test section.

6. The OWNER will take measurements and keep records for quality assurance purposes.

7. Any change in means, methods, and trench conditions, including excavation, bedding, and pipe zone materials, in situ soils, water conditions, and backfill and compaction methods shall require another successful test section before additional production pipe installation.

I. Changes in Alignment and/or Grade

1. Where necessary to raise or lower the pipe, specials, or fittings due to unforeseen obstructions or other causes, the CONSTRUCTION MANAGER may change the alignment and/or the grade.

2. Such change shall be made by the deflection of joints, by the use of bevel adapters, or by the use of additional fittings, although in no case shall the deflection in a joint exceed 75 percent of the maximum deflection recommended by the pipe manufacturer.

3. No joint shall be misfit any amount that will be detrimental to the strength and water tightness of the finished joint.

4. In each case the joint opening, before finishing with the protective mortar inside the pipe, shall be the controlling factor.

J. Struts

1. Struts in pipe 42-inch diameter and larger shall be left in place until backfilling operations have been completed.

2. Struts in pipe smaller than 42-inch may be removed immediately after laying.

3. A laboratory selected and paid by the OWNER may monitor pipe deflection by measuring pipe inside diameter before struts are removed and 24 hours after struts are removed.

4. Pipe deflection shall not exceed 3 percent 24 hours after the struts have been removed.

5. After the backfill has been placed, the struts shall be removed and shall remain the property of the CONTRACTOR.

K. Cold Weather Protection

1. No pipe, special, or fitting shall be installed upon a foundation into which frost has penetrated or at any time that there is a danger of the formation of ice or penetration of frost at the bottom of the excavation.

2. No pipe, special, or fitting shall be laid unless it can be established that the trench will be backfilled before the formation of ice and frost occurs.

L. Pipe, Specials, and Fitting Protection

1. The openings of pipe, specials, and fittings with shop-applied mortar lining shall be protected with suitable bulkheads to maintain a moist atmosphere and to prevent unauthorized access by persons, animals, water, or any undesirable substance.

2. The bulkheads shall be designed to prevent the drying out of the interior of the pipe, specials, and fittings.

3. The CONTRACTOR shall introduce water into the pipe to keep the mortar moist if moisture has been lost due to damaged bulkheads.

4. Means shall be provided to prevent the pipe from floating due to water in the trench from any source.

5. Pipe that has floated shall be repaired, including restoration to original condition and profile.

M. Pipe Cleanup

1. As pipe laying progresses, the CONTRACTOR shall keep the pipe interior free of debris.

2. The CONTRACTOR shall completely clean the interior of the pipe of sand, dirt, mortar splatter, and any other debris following completion of pipe laying, pointing of joints, and any necessary interior repairs prior to testing and disinfecting of the completed pipeline.

3.02 RUBBER GASKETED JOINTS

A. Rubber Gasketed Joints

1. Immediately before jointing pipe, the spigot end of the pipe shall be thoroughly cleaned, and a clean rubber gasket lubricated with a non-toxic vegetable-based lubricant shall be placed in the spigot groove.

2. The lubricant shall be a compound listed as in compliance with NSF Standard 61.

3. The volume of the gasket shall be "equalized" by moving a metal rod between the gasket and the spigot ring around the full circumference of the spigot ring.

4. The bell of the pipe already in place shall be carefully cleaned and lubricated with the vegetable-based lubricant.

5. The spigot of the pipe section shall then be inserted into the bell of the previously laid joint and telescoped into its proper position.

6. Tilting of the pipe to insert the spigot into the bell will not be permitted.

7. After the pipe units have been joined, a feeler gauge shall be inserted into the recess and moved around the periphery of the joint to detect any irregularity in the position of the rubber gasket.

8. If the gasket cannot be "felt" all around, the joint shall be disassembled and the joint shall be reassembled with a new gasket.

B. Double Gasket Lap Joints

1. Double gasket lap joints shall be air-tested by shop drilling and tapping for 1/8-inch or 1/4-inch national pipe thread in the lap or bell end of the pipe.

2. Apply 40 psig of air or other satisfactory gas into the connection between the 2 gaskets.

3. Test pressure shall be measured with a minimum 4-inch diameter pressure gauge with a range no greater than 0 to 100 psig.

4. The air test shall consist of holding the test pressure undiminished for 5 minutes.

5. If the test fails, the joint shall be disassembled and reassembled with new gaskets.

6. After the repair is made, the joint shall be checked by repeating the original test procedure.

7. After a successful test, close the threaded opening with a pipe plug or by welding.

3.03 WELDED JOINTS

A. General

1. Prior to beginning the welding procedure, any tack welds used to position the pipe during laying shall be removed.

2. Any annular space between the faying surfaces of the bell and spigot shall be equally distributed around the circumference of the joint by shimming, jacking, or other suitable means.

3. Where more than one pass is required, each pass except the first and final ones shall be peened to relieve shrinkage stresses, and dirt, slag, and flux shall be removed before the succeeding bead is applied.

4. Prior to butt welding, the pipe and joint shall be properly positioned in the trench using line up clamps so that, in the finished joint, the abutting pipe sections shall not be misaligned more than 1/16 inch.

5. Unless double fillet welds are indicated, field welded lap joints may, at the CONTRACTOR'S option, be made on either the inside or the outside of the pipe.

6. Field welded joints shall be in accordance with AWWA C206 - Field Welding of Steel Water Pipe.

7. Where exterior welds are performed, adequate space shall be provided for welding and inspection of the joints.

8. Butt straps shall be as indicated.

9. A heat resistant shield shall be draped over at least 24-inches of coating beyond the holdback on both sides of the weld during welding to avoid damage to the coating by hot weld splatter.

10. Welding grounds shall not be attached to the coated part of the pipe.

B. Backfilling

1. After the pipe and joint are properly positioned in the trench, the length of pipe between joints shall be backfilled to at least one foot above the top of the pipe.

2. Care shall be exercised during the initial backfilling to prevent movement of the pipe and to prevent any backfill material from being deposited on the joint.

C. Temperature Stresses

1. To control temperature stresses, the unbackfilled joint areas of the pipe shall be shaded from the direct rays of the sun by the use of properly supported awnings, umbrellas, tarpaulins, or other suitable materials for a minimum period of 2 hours prior to the beginning of the welding operation and until the weld has been completed.

2. Shading materials at the joint area shall not rest directly on the pipe but shall be supported to allow air circulation around the pipe.

3. Shading of the pipe joints need not be performed when the ambient air temperature is below 45 degrees F.

D. Shrinkage Control Joints

1. At intervals not exceeding 250 feet along welded reaches of the pipeline and at the first regular lap-welded field joints outside concrete encasements and structures, the pipe shall be laid with an initial lap of not less than one inch greater than the minimum lap dimension.

2. The welding of each such shrinkage control joint shall be performed when the temperature is approximately the lowest during the 24 hour day, after at least 250 feet of pipe have been laid and the joints have been welded ahead of and in back of the shrinkage control joint, and after backfill has been completed to at least one foot above the top of the pipe ahead of and in back of the shrinkage control joint.

3. Where shrinkage control joints occur in a traveled roadway or other inconvenient location, the location of the shrinkage control joint may be adjusted, as acceptable to the CONSTRUCTION MANAGER.

E. Inspection of Field-Welded Joints

1. An independent testing laboratory acceptable to the CONSTRUCTION MANAGER but paid by the CONTRACTOR shall inspect the joints.

2. Inspection shall be as soon as practicable after the welds are completed.

3. Fillet welds shall be tested by the Magnetic Particle Inspection Method in accordance with ASME Section VIII, Division 1, Appendix VI.

4. Double-Welded Lap Joints

a. Double-welded lap joints shall be air-tested by shop drilling and tapping for 1/8-inch or 1/4-inch national pipe thread in the lap or bell end of the pipe.

b. Apply 40 psig of air or other satisfactory gas into the connection between the 2 fillet welds.

c. Test pressure shall be measured with a minimum 4-inch diameter pressure gauge with a range no greater than 0 to 100 psig.

d. The air test shall consist of holding the test pressure undiminished for 5 minutes.

e. If the air test fails, paint the welds with a soap solution and mark any leaks indicated by the escaping gas bubbles.

f. Leaking portions of the welds or defective welds shall be removed and re-welded.

g. The amount of material removed shall be limited to that required to correct the defect.

h. After the repair is made, the joint shall be checked by repeating the original test procedure.

i. Close the threaded openings with pipe plugs or by welding.

5. Butt welds shall be inspected by radiographic methods in accordance with API Standard 1104.

F. Following tests of the joint, the exterior joint spaces shall be coated as indicated, after which backfilling may be completed.

G. Repair of Welds

1. Defective welds shall be repaired by the CONTRACTOR to meet the indicated requirements.

2. Defects in welds or defective welds shall be removed, and that section of the joint shall then be re-welded.

3. Only sufficient removal of defective material that is necessary to correct the defect shall be required.

4. After the repair is made, the joint shall be checked by repeating the original test procedure.

5. Welds deficient in size shall be repaired by adding weld metal.

3.04 JOINT COATING AND LINING

A. General

1. The interior and exterior joint recesses shall be thoroughly wiped clean.

2. Remove water, loose scale, dirt, and other foreign material from the inside surface of the pipe.

B. Testing

1. The CONSTRUCTION MANAGER will test each joint with an electrical detector, furnished by the CONTRACTOR and capable of at least a 12,000 volt output.

2. The tests will be performed using 6,000 to 7,000 volts.

3. The CONTRACTOR shall repair any holidays.

4. Re-Testing

a. When a visual inspection indicates that a portion of the coating system has sustained physical damage, the CONTRACTOR shall perform an electrical holiday test of 6,000 to 7,000 volts.

b. When the test indicates no holiday, a notation shall be applied to the area indicating the test is satisfactory.

C. Coating Repair

1. Mortar-Coated Pipe: Perform coating repairs on mortar-coated pipe in accordance with the requirements of AWWA C205.

2. Tape-Coated Pipe

a. Perform coating repairs on tape-coated pipe tape and primer in accordance with the requirements of AWWA C209.

b. If the holiday re-test indicates a holiday still exists after re-testing, the inner wrap shall be exposed and the exposed area shall be wiped clean with xylol solvent or equal, and the area shall be coated with tape primer.

c. A patch of 35-mil thick cold-applied tape of sufficient size to cover the damaged area plus a minimum lap of 2-inches shall then be applied.

d. The patched area shall again be tested for holidays.

e. If none are detected, a second layer of 35-mil thick tape shall then be applied over the first patch, overlapping the first layer a minimum of 2 inches.

D. Coating of Fittings and Specials: Fittings and specials shall be coated in accordance with Section 09 96 12 – Polyethylene Tape Coating.

E. Joint Lining

1. After the backfill has been completed to final grade, the interior joint recess shall be filled with mortar.

2. Materials of construction for mortar shall be in accordance with the requirements of AWWA C602.

3. The mortar shall be tightly packed into the joint recess and troweled flush with the interior surface, and excess shall be removed.

4. At no point shall there be an indentation or projection of the mortar exceeding 1/16 inch.

5. With pipe smaller than 24-inch in diameter, before the spigot is inserted into the bell, the bell shall be daubed with mortar.

6. The joint shall be completed and excess mortar on the inside of the joint shall be swabbed out.

3.05 INSTALLATION OF PIPE APPURTENANCES

A. Protection of Appurtenances: Where the joining pipe is tape-coated, buried appurtenances shall be coated with cold-applied tape in accordance with Section 09 96 12 – Polyethylene Tape Coating.

B. Installation of Valves

1. Valves shall be handled in a manner to prevent any injury or damage to the valve or any part of it.

2. Joints shall be thoroughly cleaned and prepared prior to installation.

3. The CONTRACTOR shall adjust stem packing and operate each valve prior to installation to verify proper operation.

4. Valves shall be installed so that the valve stems are plumb and in the location indicated.

5. Buried valves and flanges shall be coated and protected in accordance with Section 09 96 00 – Protective Coating.

C. Installation of Flanged Joints

1. Before the joint is assembled, the flange faces shall be thoroughly cleaned of foreign material with a power wire brush.

2. The gasket shall be centered and the connecting flanges drawn up watertight without unnecessarily stressing the flanges.

3. Bolts shall be tightened in a progressive diametrically opposite sequence and torqued with a suitable and calibrated torque wrench.

4. Clamping torque shall be applied to the nuts only.

5. Full-face reinforced rubber gaskets shall be applied to the inside face of blind flanges with adhesive.

D. Insulated Joints

1. Insulated joints and appurtenant features shall be provided as indicated.

2. The CONTRACTOR shall exercise special care when installing these joints in order to prevent electrical conductivity across the joint.

3. After the insulated joint is completed, an electrical resistance test shall be performed by the CONTRACTOR.

4. If the resistance test indicates a short circuit, the CONTRACTOR shall remove the insulating units to inspect for damage, replace all damaged portions, and reassemble the insulating joint.

5. The insulated joint shall then be retested to assure proper insulation.

E. Flexible Coupled Joints

1. When installing flexible couplings, care shall be taken that the connecting pipe ends, couplings, and gaskets are clean and free of dirt and foreign matter, with special attention given to the contact surfaces of the pipe, gaskets, and couplings.

2. The couplings shall be assembled and installed in conformance with the recommendations and instructions of the coupling manufacturer.

F. Bolting

1. Wrenches used in bolting couplings shall be of a type and size recommended by the coupling manufacturer.

2. Coupling bolts shall be tightened in such a manner as to secure a uniform annular space between the follower rings and the body of the pipe.

3. Bolts shall be tightened approximately the same amount.

4. Diametrically opposite bolts shall be tightened progressively and evenly.

5. Final tightening shall be performed with a suitable and calibrated torque wrench set for the torque recommended by the coupling manufacturer.

6. Clamping torque shall be applied to the nut only.

3.06 CORROSION CONTROL

A. Joint Bonding/Electrolysis Test Stations

1. Except where otherwise indicated, joints shall be bonded.

2. The pipe shall be cleaned to bare bright metal at the point where the bond is to be installed.

3. Electrolysis test stations shall be installed where indicated.

B. Cathodic Protection: Corrosion mitigation and testing materials, such as an impressed current cathodic protection system, magnesium anodes, reference electrodes, and test lead wires shall be provided where indicated.

END OF SECTION

SECTION 33 92 20

DUCTILE IRON PIPING

PART 1 -- GENERAL

1.01 THE SUMMARY

A. The CONTRACTOR shall provide ductile iron pipe and appurtenant WORK, complete and in place, in accordance with the Contract Documents.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

AWWA C104	Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C105	Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C110	Ductile-Iron and Gray-Iron Fittings, 3 in through 48 in for Water
AWWA C111	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115	Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
AWWA C116	Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings for Water Supply Service.
AWWA C150	Thickness Design of Ductile-Iron Pipe
AWWA C151	Ductile-Iron Pipe, Centrifugally Cast for Water
AWWA C153	Ductile-Iron Compact Fittings. for Water Service
AWWA C600	Installation of Ductile Iron Water Mains and Their Appurtenances
AWWA C606	Grooved and Shouldered Joints
ASTM C 150	Portland Cement

1.03 RELATED SECTIONS

A.	Section 01 75 06	Field Testing
B.	Section 09 96 00	Protective Coatings
C.	Section 40 05 00	Piping, General

1.04 CONTRACTOR SUBMITTALS

A. Furnish Submittals in accordance with Special Provisions Section 20 and the following supplemental requirements:

B. Shop Drawings

1. Certified dimensional drawings of valves, fittings, and appurtenances.

2. For pipe 24-inches diameter and larger, line layout and marking diagrams which indicate the specific number of each fitting and the location and the direction of each fitting in the completed line. In addition, the line layouts shall include: the pipe station and invert elevation at changes in grade or horizontal alignment; elements of curves and bends, both in horizontal and vertical alignment; and the limits of each reach of restrained joints, or of concrete encasement.

C. Certifications: Certified affidavit of compliance for pipe and other products or materials furnished under this Section and as specified in the referenced standards and the following supplemental requirements:

1. Physical and chemical properties.

2. Hydrostatic test reports.

D. The CONTRACTOR shall be responsible for performing and paying for sampling and testing as necessary for the certifications.

1.05 QUALITY ASSURANCE

A. Tests: Except as modified herein, materials used in the manufacture of the pipe shall be tested in accordance with the requirements of the referenced standards as applicable.

B. The CONTRACTOR shall perform said material tests as part of the WORK. The CONSTRUCTION MANAGER shall have the right to witness testing conducted by the CONTRACTOR; provided, that the CONTRACTOR's schedule is not delayed for the convenience of the CONSTRUCTION MANAGER.

C. In addition to those tests specifically required, the CONSTRUCTION MANAGER may request additional samples of any material including lining and coating samples for testing by the OWNER. The additional samples shall be furnished as a part of the WORK.

D. Inspection: Pipe shall be subject to inspection at the place of manufacture in accordance with the provisions of the referenced standards, as supplemented by the requirements herein. The CONTRACTOR shall notify the CONSTRUCTION MANAGER in writing of the manufacturing starting date not less than 14 Days prior to the start of any phase of the pipe manufacture.

E. During the manufacture of the pipe, the CONSTRUCTION MANAGER shall be given access to areas where manufacturing is in process and shall be permitted to make inspections necessary to confirm compliance with the Specifications.

PART 2 -- PRODUCTS

2.01 PIPE GENERAL

A. Mortar-lined and asphaltic-coated ductile iron pipe shall conform to AWWA C151, C104, and C105, subject to the supplemental requirements in this Section. The pipe shall be of the diameter and class indicated, shall be provided complete with rubber gaskets, specials, and fittings as required under the Contract Documents.

B. Markings: The CONTRACTOR shall legibly mark specials 24-inches diameter and larger in accordance with the laying schedule and marking diagram. Each fitting shall be marked at each end with top field centerline.

C. Handling and Storage: The pipe shall be handled as a minimum at the 1/3 points by use of wide slings, padded cradles, or other devices designed and constructed to prevent damage to the pipe coating/exterior. The use of chains, hooks, or other equipment that might injure the pipe coating/exterior will not be permitted. Stockpiled pipe shall be supported on padded skids, sand or earth berms free of rock exceeding 3-inches diameter, sand bags, or suitable means so that the coating will not be damaged. The pipe shall not be rolled and shall be secured to prevent accidental rolling

D. Asphaltic-coated pipe shall have the following additional requirements:

1. It shall be the responsibility of the CONTRACTOR to prevent damage of the coating that might be caused by handling and/or storage of the completed pipe at low temperature.

E. Laying Lengths: Nominal pipe laying lengths shall be 20-feet.

F. Finish: The pipe shall have smooth dense interior surfaces and shall be free from fractures, excessive interior surface crazing, and roughness.

G. Bonding and Electrical Conductivity: Pipe joints shall be prepared for bonding for electrical conductivity in accordance with the details indicated. The CONTRACTOR shall furnish materials required for joint bonding and electrolysis test station installations.

H. Closures and Correction Pieces: Closures and correction pieces shall be provided as required so that closures may be made due to different headings in the pipe laying operation and so that correction may be made to adjust the pipe laying to conform to pipe stationing on the Drawings. The locations of correction pieces and closure assemblies are indicated. Any change in location or number of said items shall only be as accepted by the CONSTRUCTION MANAGER.

2.02 SPECIALS AND FITTINGS

A. Fittings for ductile iron pipe shall conform to the requirements of AWWA C153 or AWWA C110 and shall have a minimum pressure rating of 250 psi. Ductile iron fittings larger than 48-inches shall conform to AWWA C153.

2.03 DESIGN OF PIPE

A. The pipe shall be designed, manufactured, tested, inspected, and marked according to AWWA C150 and C 151 except where modified by this Section.

B. Pipe Dimensions: The pipe shall be of the diameter and class indicated.

C. Fitting Dimensions: The fittings shall be of the diameter and class indicated.

D. Joint Design: Ductile iron pipe and fittings for buried pressure service shall be furnished with restrained joints, unless otherwise indicated. Ductile iron pipe and fittings for buried gravity service shall be furnished with mechanical joints or push-on joints as required, unless otherwise indicated. Above ground ductile iron pipe and fittings joints shall be as indicated. Flanged joints or grooved and shouldered joints shall be furnished where required.

1. Mechanical and push-on joints shall conform to AWWA C111.

2. Flanged joints shall conform to AWWA C115. Where threaded flanges are provided, the pipe wall thickness under the cut threads shall not be less than the calculated net thickness required for the pressure class of the pipe.

3. Restrained joints shall be **Flex-Ring or Lok-Ring** restrained joint by **American Ductile Iron Pipe**, **TR FLEX** restrained joint by **U.S. Pipe**, or equal.

4. Joint restraining devices that impart point loads and/or wedging action on the pipe wall as a means of joint restraint shall not be allowed unless there are no other options for joint restraint available. Under such circumstances, the CONTRACTOR may propose such devices provided the following conditions are met and the request is made as a substitution:

   a. A formal request for substitution is submitted stating the locations where the devices are intended to be used and a statement from the device manufacturer and the pipe manufacturer that the proposed device is appropriate for the intended installation and is rated at least for the class of the pipe being supplied.

   b. A statement from the pipe manufacturer is provided accepting the use of the retaining devices and indicating that the use of such devices will in no way affect the warranty of the pipe and/or the performance of the pipe.

   c. The manufacturer of the device and the pipe manufacturer jointly provide instruction on the proper installation of the device to the personnel installing the units and provide certification to the OWNER that the installers are

adequately trained in the installation of the units and that warranties are in full affect for the project.

d. The devices shall be **MegaLug Model 1100** as manufactured by **EBAA Iron** or equal.

5. Grooved and Shouldered Joints shall meet the requirements of mechanical-type couplings in accordance with Section 40 05 00 – Piping, General and conform to AWWA C606.

E. For bell-and-spigot ends with rubber gaskets, the clearance between the bells and spigots shall be such that when combined with the gasket groove configuration and the gasket itself, will provide watertight joints under all operating conditions when properly installed. The CONTRACTOR shall require the pipe manufacturer to submit details complete with significant dimensions and tolerances and also to submit performance data indicating that the proposed joint has performed satisfactorily under similar conditions. In the absence of a history of field performance, the results of a test program shall be submitted.

2.04 CEMENT-MORTAR LINING

A. Cement-Mortar Lining for Shop Application: Except as otherwise provided herein, interior surfaces of ductile iron pipe, fittings, and specials shall be cleaned and lined in the shop with cement-mortar lining applied centrifugally in conformity with AWWA C104. During the lining operation and thereafter, the pipe shall be maintained in a round condition by suitable bracing or strutting. The lining machines shall be of a type that has been used successfully for similar work. Every precaution shall be taken to prevent damage to the lining. If lining is damaged or found defective at the Site, the damaged or unsatisfactory portions shall be replaced with lining conforming to these Specifications.

1. Cement: Cement for mortar lining shall conform to the requirements of AWWA C104; provided, that cement for mortar lining shall be Type II or V. Cement shall not originate from kilns that burn metal-rich hazardous waste fuel, nor shall a fly ash or pozzolan be used as a cement replacement.

B. The minimum lining thickness shall be as follows:

Nominal Pipe Diameter, inches	Minimum Lining Thickness, inches
3 - 12	1/16
14 - 24	3/32
30 - 64	1/8

2.05 PROTECTION OF PIPE LINING

A. Protection of Pipe Lining/Interior**:** Shop-applied cement mortar lining shall be given a seal coat of asphaltic material in conformance with AWWA C104 and NSF 61.

2.06 EXTERIOR PROTECTION OF PIPE

A. Exterior Coating of Exposed Piping: The exterior surfaces of pipe which will be exposed to the atmosphere inside structures or above ground shall be thoroughly cleaned and then given a shop coat of rust-inhibitive primer conforming to the requirements of Section 09 96 00 - Protective Coating.

B. Exterior Coating of Buried Piping: The exterior coating shall be an asphaltic coating approximately 1-mil thick.

C. Polyethylene Sleeve: Sleeves shall conform to the requirements of AWWA C105, CONTRACTOR's choice between tubular 8-mil thick linear low-density film or 4-mil thick high-density cross-laminated film. Color shall be white.

PART 3 -- EXECUTION

3.01 INSTALLATION OF PIPE

A. The CONTRACTOR shall inspect each pipe and fitting prior to installation to insure that there are no damaged portions of the pipe. Pipe damaged prior to Substantial Completion shall be repaired or replaced by the CONTRACTOR.

B. Before placement of pipe in the trench, each pipe or fitting shall be thoroughly cleaned of any foreign substance which may have collected thereon and shall be kept clean at all times thereafter. For this purpose, the openings of pipes and fittings in the trench shall be closed during any interruption to the WORK.

C. Pipe Laying: The pipe shall be installed in accordance with AWWA C600.

D. Pipe shall be laid directly on the bedding material. No blocking will be permitted, and the bedding shall be such that it forms a continuous, solid bearing for the full length of the pipe. Excavations shall be made as needed to facilitate removal of handling devices after the pipe is laid. Bell holes shall be formed at the ends of the pipe to prevent point loading at the bells or couplings. Excavation shall be made as needed outside the normal trench section at field joints to permit adequate access to the joints for field connection operations and for application of coating on field joints.

E. Each section of pipe 24-inches diameter and larger shall be laid in the order and position shown on the laying schedule. Each section shall be laid to the line and grade, within approximately one-inch plus or minus.

F. Where necessary to raise or lower the pipe due to unforeseen obstructions or other causes, the CONSTRUCTION MANAGER may change the alignment and/or the grades. Such change shall be made by the deflection of joints, by the use of bevel adapters, or by the use of additional fittings. However, in no case shall the deflection in the joint

exceed 75 percent of the maximum deflection recommended by the pipe manufacturer. No joint shall be misfit any amount that will be detrimental to the strength and water tightness of the finished joint.

G. Except for short runs that may be permitted by the CONSTRUCTION MANAGER, pipes shall be laid uphill on grades exceeding 10 percent. Pipe that is laid on a downhill grade shall be blocked and held in place until sufficient support is furnished by the following pipe to prevent movement. Bends shall be properly installed as indicated.

H. Cold Weather Protection: No pipe shall be installed upon a foundation into which frost has penetrated or at any time that there is a danger of the formation of ice or penetration of frost at the bottom of the excavation before backfilling occurs.

I. Pipe and Specials Protection: The openings of pipe and specials shall be protected with suitable bulkheads to prevent unauthorized access by persons, animals, water, or any undesirable substance. At all times, means shall be provided to prevent the pipe from floating.

J. Pipe Cleanup: As pipe laying progresses, the CONTRACTOR shall keep the pipe interior free of debris. The CONTRACTOR shall completely clean the interior of the pipe of sand, dirt, mortar splatter, and any other debris following completion of pipe laying and shall perform any necessary interior repairs prior to testing and disinfecting the completed pipeline.

3.02 POLYETHYLENE SLEEVE UNBONDED PROTECTION

A. Buried ductile iron pipe shall be polyethylene encased in accordance with the requirements of AWWA C105, CONTRACTOR's choice between Method A or Method B.

B. Coating of Fittings and Specials: Coatings shall be the same as for the straight pipe.

3.03 INSTALLATION OF PIPE APPURTENANCES

A. Protection of Appurtenances: Where the joining pipe is dielectric-coated, buried appurtenances shall be coated in kind. Where pipe is encased in polyethylene sleeves, buried appurtenances shall be encased in polyethylene.

B. Installation of Valves: Valves shall be handled in a manner to prevent any injury or damage to any part of the valve. Joints shall be thoroughly cleaned and prepared prior to installation. The CONTRACTOR shall adjust stem packing and operate each valve prior to installation to insure proper operation.

C. Valves shall be installed so that the valve stems are plumb and in the location indicated.

3.04 CORROSION CONTROL

A. Joint Bonding/Electrolysis Test Stations: Except where otherwise indicated, joints shall be bonded. The pipe shall be cleaned to bare bright metal at the point where the bond is installed.

B. Electrolysis test stations shall be installed where indicated.

C. Cathodic Protection: Corrosion mitigation and testing materials, such as an impressed current cathodic protection system, magnesium anodes, reference electrodes, and test lead wires shall be provided where indicated.

END OF SECTION

SECTION 33 95 34

POLYETHYLENE PRESSURE PIPING

PART 1 -- GENERAL

1.01 THE SUMMARY

A. The CONTRACTOR shall provide high density polyethylene (HDPE) pressure pipe, complete and in place, in accordance with the Contract Documents.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

AWWA C906	Polyethylene (PE) Pressure Pipe and Fittings, 4 In Through 63 In, for Water Distribution and Transmission
AWWA C901	Polyethylene (PE) Pressure Pipe and Tubing, 3/4 In. (19 mm) Through 3 In. (76 mm), for Water Service
ASTM D 3350	Polyethylene Plastics Pipe and Fittings Materials

1.03 CONTRACTOR SUBMITTALS

A. Furnish Shop Drawings of pipe, fittings, and appurtenances in accordance Special Provisions Section 20

B. Certifications: Furnish a certified affidavit of compliance for pipe and other products or materials furnished under this Section:

1. Hydrostatic proof test reports.

2. Sustained pressure test reports.

3. Burst strength test reports.

C. Expenses incurred in making samples for certification of tests shall be borne by the CONTRACTOR as part of the WORK.

1.04 QUALITY ASSURANCE

A. Each manufacturer shall have an approved in-house QA/QC program for compliance to the testing specifications and requirements of AWWA C901 or AWWA C906 for both pipe and fittings.

B. Inspection: Pipe shall be subject to inspection at the place of manufacture in accordance with the provisions of the referenced standards as supplemented by the requirements herein. The CONTRACTOR shall notify the CONSTRUCTION MANAGER in writing of the manufacturing start date not less than 14 calendar days prior to the start of any phase of manufacture.

C. During manufacture of the pipe, the CONSTRUCTION MANAGER shall be given access to areas where manufacturing is in process confirm compliance with the Specifications. `

D. Tests: Except as modified herein, materials used in the manufacture of the pipe shall be tested in accordance with the requirements of this Section and in the referenced standards, as applicable.

E. The CONTRACTOR shall perform said material tests in accordance with the requirements of the Contract Documents. The CONSTRUCTION MANAGER shall have the right to witness testing conducted by the CONTRACTOR, provided that the CONTRACTOR's schedule will not be delayed for the convenience of the CONSTRUCTION MANAGER.

F. In addition to those tests specifically required, the CONSTRUCTION MANAGER may request additional samples of any material for testing by the OWNER. The additional samples shall be furnished as part of the WORK.

PART 2 -- PRODUCTS

2.01 GENERAL

A. Scope: The pipe shall be nominal size as shown on drawings and pipe schedule, meeting the specifications and requirements of AWWA C901 or AWWA C 906 as applicable. Pipe shall be in ductile iron pipe sizes (DIPS).

B. Materials: Pipe and fittings shall be made from prime virgin resins exhibiting a cell classification of PE 345444C as defined in ASTM D 3350, with an established hydrostatic-design basis of 1600 psi for water at 73 degrees F. The resin shall be listed by the PPI (Plastic Pipe Institute) in its pipe-grade registry Technical Report (TR) 4, "Listing of Plastic Pipe Compounds.

C. Pipe and Fittings: The pressure rating shall be 160 psi, DR 11.0. Laying lengths shall be 40-ft standard. Both pipe and fittings shall be listed as compliant with NSF Standard 61 and shall bear the "NSF-pw" logo or mark.

D. Joints: Pipe sections shall be joined by heat fusion.

E. Marking: Pipe and fittings shall be marked as prescribed by AWWA C901 or AWWA C906 and NSF. Pipe markings shall include nominal size, OD base (ie: 12-inch ductile iron pipe sizing, DIPS), dimension ratio, pressure class, AWWA C901 or AWWA C906, manufacturer's name, manufacturer's production code including day, month, and year extruded, manufacturer's plant and extrusion line, and NSF - pw logo. In addition, a green stripe, integral to the pipe material, shall be made at the time of fabrication in order to identify that this is a sewage pipeline.

2.02 POLYETHYLENE DOUBLE CONTAINMENT CHEMICAL PIPING SYSTEMS

A. Containment system constructed of polyethylene pipe and fittings meeting the requirements for PE material according to ASTM D 3035 with a minimum cell classification of PE445584C.

B. Pipe and Fittings:

1. Pipe shall be one-piece double-wall extruded simultaneously. Primary pipe shall be integral with the secondary pipe via connecting ribs continuous down the entire length of each section of pipe. No centralizing clips, spiders, disks or supports shall be allowed.

2. Carrier pipe shall be 150 psi rated at 68°F SDR11 dimensions. Containment pipe shall be 90 psi rated at 68°F SDR17. Pipe lengths shall be 16.4’ long.

3. Fittings shall be of unitary construction. Permanent alignment of inner and outer fittings shall be maintained via integral ribs.

4. Termination of double containment shall be conducted utilizing an end termination dogbone and flanged end termination.

5. PE double containment piping shall be **Poly-Flo by Asahi/America, Inc**., or equal.

C. Electronic Leak Detection System:

1. The leak detection system shall consist of leak detection stations that are installed inline that allow leakage from the interstitial space to accumulate. Each station shall have an external capacitive sensor affixed to the outside of the leak detection station pipe that will alarm when fluid is detected in the pipe. Provide leak detection stations where indicated on Drawings.

2. Capacitive proximity sensor:

   a. Switches: 3-wire, 24 VDC, normally closed solid state switches to ensure a failsafe system.

   b. Wire break/short or sensor malfunction shall trigger an alarm.

   c. Sensor power shall be sourced to the sensors from the control panel.

   d. Sensor shall switch open when fluid is detected in the outer containment pipe.

   e. A sensor LED light shall be provided to indicate that the sensor is operational.

   f. Built-in sensitivity control shall be provided to allow for adjustment of sensing point to minimize false alarms.

3. Control Panel:

   a. Provide control panel in NEMA 4X enclosure operating on 120 VAC and supplying 24 VDC to zone sensors.

   b. LCD display shall indicate the following:

   c. System operating conditions

d. HMI buttons to scroll through history, status, and test screens as well as alarm acknowledgement

e. Date, time, zone, and type of alarm (break/short, sensor malfunction or leak) and store data in non volatile memory

4. The following items shall be provided:

a. Power indicator light

b. Keyed on/off switch

c. Keyed alarm silence switch

d. Common audible and visual alarm

e. External output switch for accessory alarms and an RS-232 communication port.

f. Leak detection system shall be Centra-Guard by IPEX or approved equal.

2.03 PLASTIC MARKING TAPE

A. The pipeline shall be marked with a magnetically detectable yellow marking tape labeled “Caution Sanitary Sewer Below” **or “Caution** Chemical line below”. The tape shall be placed along the trench centerline between 18- and 24-inches above the pipe.

PART 3 -- EXECUTION

3.01 GENERAL

A. Laying, jointing, and testing for defects and for leakage shall be performed in the presence of the CONSTRUCTION MANAGER and shall be subject to approval before acceptance. All material found to be defective will be rejected and the CONTRACTOR shall promptly remove such materials from the Site.

B. Installation shall conform to AWWA M23, instructions furnished by the pipe manufacturer, and to the supplementary requirements or modifications herein. Wherever the provisions of this Section and the aforementioned requirements are in conflict, the more stringent provision shall apply.

3.02 HANDLING AND STORAGE

A. Handling: Pipe, fittings, and accessories shall be carefully inspected before and after installation and those found defective will be rejected. Pipe and fittings shall be free from fins and burrs. Before placing in position, clean pipe, fittings, and accessories, and maintain them in a clean condition. Proper methods shall be used for lowering sections of pipe into trenches. Under no circumstances shall pipe, fittings, or any other material be dropped or dumped into trenches.

B. Storage: Pipe shall be stored, if possible, at the Site in unit packages provided by the manufacturer. Caution should be exercised to avoid compression damage or

deformation to the pipe. Pipe shall be stored in such a way as to prevent sagging or bending, and it shall be protected from exposure to direct sunlight by covering with an opaque material that allows adequate air circulation above and around the pipe. Gaskets shall be stored in a cool, dark place out of the direct rays of the sun, preferably in original cartons.

3.03 TRENCHING AND BACKFILL

A. Trench excavation and backfill shall conform to Section 31 30 00 - Earthwork.

3.04 JOINING

A. Prior to installation of any pipe, the manufacturer shall provide training in the recommended butt fusion and saddle fusion procedures, testing procedures, and any other installation methods required by the WORK. Training shall include the CONTRACTOR's installation personnel, an OWNER's representative, the CONSTRUCTION MANAGER's representative, and any other personnel chosen by the OWNER. The CONTRACTOR shall record the names of trained personnel.

B. On every day that butt fusion joints are to be made, the first fusion of the day shall be a test. The test fusion shall be allowed to cool completely, then fusion test straps shall be cut out. Test strap length shall be 12-inches (min) or 30 times the wall thickness with the fused area in the center and width shall be 1-inch (min) or 1.5 times the wall thickness. The CONTRACTOR shall bend the test strap until the ends of the strap touch. If the test strap fails at the joint, the CONTRACTOR shall perform a new test to be cooled completely and bent as before. The CONTRACTOR shall not commence installation of pipe until a test fusion has passed the bent strap test.

C. The fusion machine used in the joining of the pipe shall incorporate a data logging device that records information related to each individual joint for the construction of the entire pipeline. The recorded information shall include at least the date and time of the fusion, the employee ID of the machine operator, the machine ID, the machine model, the piston area, pipe material, pipe size, the interfacial pressures (including heat, soak, fuse, cool), recommended gauge pressures (including heat, soak, fuse, cool), drag pressure, data logger probe temperature, and the external probe temperature.

3.05 INSTALLATION

A. Trench shall be graded in straight lines, taking care to avoid formation of any dips or low points. Pipe shall not be laid when the conditions of trench or weather are unsuitable. At the end of each day's work, open ends of pipe shall be closed temporarily with wood blocks or bulkheads.

B. Pipe shall be cut by means of saws, power driven abrasive wheels, pipe cutters, or other manufacturer recommended methods that will produce a clean, square cut.

C. Pipe shall be supported uniformly and firmly at its proper elevation. Wood support blocking will not be permitted. The full length of each section of pipe and fittings shall rest solidly on the soil, with recesses to accommodate joints and couplings. Anchors and supports shall be provided where necessary and where indicate for fastening WORK into place. Fittings shall be independently supported.

D. Short lengths of pipe shall be used in and out of each rigid joint or rigid structure. Piping that does not allow sufficient space for proper installation of jointing shall be replaced.

E. Joints shall be installed according to manufacturer's recommendations. Trenches shall be kept free of water until joints have been properly made. The maximum combined deflection at any coupling shall be in accordance with the manufacturer's recommendations.

3.06 FIELD TESTING AND DISINFECTION

A. Field testing and disinfection shall conform to the requirements of Section 01 74 30 - Pressure Pipe Testing and Disinfection.

END OF SECTION

SECTION 33 95 40

SMALL POLY VINYL CHLORIDE NON-PRESSURE PIPING, RUBBER JOINTS

PART 1 -- GENERAL

1.01 THE SUMMARY

A. The CONTRACTOR shall provide PVC solid wall nonpressure pipe and appurtenant WORK, complete and in place, in accordance with the Contract Documents.

B. This Section covers pipe from 4- to 15-inches diameter nominal size.

1.02 CONTRACTOR SUBMITTALS

A. Submittals shall be in accordance with Special Provisions Section 20.

B. Shop Drawings: The CONTRACTOR shall submit Shop Drawings and laying diagrams of pipe, joints, bends, special fittings, and piping appurtenances.

C. Samples: Submit samples of the pipe and flexible coupling proposed. The samples shall be clearly marked to show the manufacturer's name and product identification and shall be submitted with the manufacturer's technical data and application instructions.

D. Certificates: The CONTRACTOR shall submit manufacturer's certificate that pipe conforms to these specifications.

PART 2 -- PRODUCTS

2.01 GENERAL

A. Pipe shall be continuously and permanently marked with the manufacturer's name, pipe size, and minimum pipe stiffness in psi.

B. The CONTRACTOR shall also require the manufacturer to mark the date of extrusion on the pipe. This dating shall be done in conjunction with records to be held by the manufacturer for 2 years, covering quality control tests, raw material batch number, and other information deemed necessary by the manufacturer.

2.02 PIPE

A. Pipe shall conform to the requirements of ASTM D 3034 - Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings, SDR 26. Material for PVC pipe shall conform to the requirements of ASTM D 1784 - Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds, for cell classification 12454-B or 12454-C as defined therein. The manufacturer shall test a sample from each batch according to ASTM D 2444 - Test Method for Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight).

B. Joints shall conform to ASTM D 3212 - Joints for Drain and Sewer Plastic Pipe Using Flexible Elastomeric Seals. Elastomeric seals for compression type joints shall conform to the requirements of ASTM F 477 - Elastomeric Seals (Gaskets) for Joining Plastic Pipe or ASTM F 913 - Thermoplastic Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

2.03 FITTINGS

A. Fittings shall conform to the requirements of ASTM D 3034. The ring groove and gasket ring shall be compatible with PVC pipe ends. The flanged fittings shall be compatible with cast-iron or ductile iron pipe fittings.

B. The stiffness of the fittings shall be not less than the stiffness of adjoining pipe.

2.04 BEDDING MATERIAL

A. Unless otherwise indicated, material used for pipe bedding shall conform to Section 31 30 00 - Earthwork.

2.05 FLEXIBLE COUPLINGS

A. Flexible couplings shall be neoprene, full-circle, clamp-on type conforming to ASTM C 425 - Compression Joints for Vitrified Clay Pipe and Fittings and provided with 2 stainless steel band screw-clamps to secure the coupling tightly to entering and exiting pipes. Screw-clamp hardware shall be Type 304 or Type 316 stainless steel. Neoprene material shall be suitable for sewage service.

PART 3 -- EXECUTION

3.01 TRENCHING AND BACKFILL

A. Trench excavation and backfill shall conform to the requirements of Section 31 30 00 - Earthwork and the Drawings.

3.02 LAYING PIPE

A. Pipe shall be installed in accordance with the requirements of ASTM D 2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications and as indicated. Pipe sections shall be closely jointed to form a smooth flow line. Immediately before placing each section of pipe in final position for jointings, the bedding for the pipe shall be checked for firmness and uniformity of slope.

B. Handling

1. Handling of the PVC pipe shall be done with implements, tools, and facilities as recommended by the pipe manufacturer to insure that the pipe is not damaged in any manner during storage, transit, loading, unloading, and installation.

2. Pipe shall be inspected both prior to and after installation in the ditch and all defective lengths shall be rejected and immediately removed from the working area.

3. Fittings shall be lowered into trench by means of rope, cable, chain, or other means without damage. Cable, rope, or other devices used for lowering fitting into trench, shall be attached around exterior of fitting for handling. Under no circumstances shall the cable, rope, or other device be attached through the fitting interior for handling or shall pipe or fittings be dropped or dumped into the trench.

C. Cutting and machining of the pipe shall be accomplished in accordance with the pipe manufacturer's standard procedures. Pipe shall not be cut with a cold chisel, standard iron pipe cutter, or any other method that may fracture the pipe or will produce ragged, uneven edges.

D. Foreign matter or dirt shall be removed from the interior of the pipe before lowering into position in the trench. Pipe shall be kept clean during and after laying. Openings in the pipeline shall be closed with watertight expandable type sewer plugs or PVC test plugs at the end of each day's operation or whenever the pipe openings are left unattended. The use of burlap, wood, or other similar temporary plugs will not be permitted.

E. Adequate protection and maintenance of all underground and surface utility structures, drains, sewers, and other obstructions encountered in the progress of the WORK shall be the CONTRACTOR's responsibility.

F. Where the grade or alignment of the pipe is obstructed by existing utility structures such as conduits, ducts, pipes, branch connections to main sewers, or main drains, the obstruction shall be permanently supported, relocated, removed, or reconstructed by the CONTRACTOR in cooperation with owners of such utility structures. Unless otherwise indicated, protection of existing utility structures shall be the CONTRACTOR's responsibility.

3.03 FIELD JOINTING

A. Each pipe compression type joint shall be joined with a lock-in rubber ring and a ring groove that is designed to resist displacement during pipe insertion.

B. The ring and the ring seat inside the bell shall be wiped clean before the gasket is inserted. A thin film of lubricant shall be applied to the exposed surface of the ring and to the outside of the clean pipe end. Lubricant other than that furnished with the pipe shall not be used. The end of the pipe shall be then forced into the ring to complete the joint.

C. The pipe shall not be deflected either vertically or horizontally in excess of the printed recommendations of the manufacturer of the coupling.

D. Fittings shall be carefully connected to pipe, and joint shall be checked to insure a sound and proper joint.

E. When pipe laying is not in progress, the open ends of the pipe shall be closed to prevent trench water from entering pipe. Adequate backfill shall be deposited on pipe to prevent floating of pipe. Any pipe that has floated shall be removed from the trench, cleaned, and relaid in an acceptable manner. No pipe shall be laid when, in the opinion of the CONSTRUCTION MANAGER, the trench conditions or weather are unsuitable.

3.04 TESTING

A. Field testing of gravity sewer pipe shall conform to the requirements of Section 01 74 20 - Gravity Pipeline Testing.

END OF SECTION

SECTION 33 95 50 - PVC PRESSURE PIPE, RUBBER JOINTS

PART 1 -- GENERAL

1.01 THE SUMMARY

A. Provide polyvinyl chloride (PVC) pressure pipe, complete in place, as indicated in accordance with the Contract Documents.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards

AWWA C104/A21.5 Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water

AWWA C110/A21.10 Ductile-Iron and Gray-Iron Fittings 3-in Through 48-in for Water and Other Liquids

AWWA C111/A21.11 Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

AWWA C600 Installation of Ductile-Iron Water Mains and Appurtenances

AWWA C900 Polyvinyl Chloride (PVC) Pressure Pipe 4-in Through 12-in for Water Distribution

ASTM D 2584 Test Method for Ignition Loss of Cured Reinforced Resins

PPI Technical Report TR 3/4 Policies and Procedures for Developing Recommended Hydrostatic Design Stresses for Thermoplastic Pipe Materials

AWWA Manual M23 PVC Pipe - Design and Installation

1.03 RELATED SECTIONS

A. Section 01 75 06 Field Testing

B. Section 31 30 00 Earthwork

C. Section 40 05 00 Piping, General

1.04 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with the requirements of Special Provisions Section 20.

B. Shop Drawings

1. Submit drawings of pipe, fittings, and appurtenances.

2. Submit design calculations in order to demonstrate compliance of pipe and fittings with the requirements of this Section.

3. Furnish manufacturer's literature for metallic locating tape.

C. Certifications

1. Furnish a certified affidavit of compliance for pipe and other products or materials under this Section and the following supplemental requirements:

a. hydrostatic proof test reports;

b. sustained pressure test reports; and,

c. burst strength test reports.

D. Perform and pay for sampling and testing as necessary for the certifications.

1.05 QUALITY ASSURANCE

A. Inspection

1. Pipe shall be subject to inspection at the place of manufacture.

2. Notify the CONSTRUCTION MANAGER in writing of the manufacturing starting date, not less than 14 Days prior to the start of any phase of the pipe manufacture.

3. During the manufacture of the pipe, give the CONSTRUCTION MANAGER access to areas where manufacturing is in process, and permit the CONSTRUCTION MANAGER to make inspections as necessary to confirm compliance with the indicated requirements.

B. Testing

1. Test the materials used in the manufacture of the pipe in accordance with the requirements of this Section and the referenced standards, as applicable.

2. The CONSTRUCTION MANAGER shall have the right to witness testing, provided that the CONTRACTOR'S schedule is not delayed for the convenience of the CONSTRUCTION MANAGER.

3. Additional Samples

a. In addition to those tests specifically required, the CONSTRUCTION MANAGER may request additional samples of any material for testing by the OWNER.

b. Furnish the additional samples as a part of the WORK.

PART 2 -- PRODUCTS

2.01 GENERAL

A. Provide PVC pressure pipe (4-inch through 12-inch) conforming to the applicable requirements of AWWA C900, and the requirements indicated in this Section.

2.02 PIPE DESIGN CRITERIA

A. General

1. Design PVC pressure pipe wall thickness for internal pressure in accordance with the requirements of AWWA M23, as applicable, and the requirements indicated in this Section.

B. Determination of External Loads

1. Compute the dead (earth) loads using the following 2 equations for trench or embankment conditions, as applicable:

a. Trench Condition:

$$W_d = HwB_c$$

Where:	W_d	=	earth load in pounds per linear foot
	H	=	height of soil cover, feet
	w	=	130 lb/cu ft
	B_c	=	outside diameter of pipe, feet

b. Positive Projecting Embankment Condition:

$$W_c = C_c w B_c^2$$

Where:	W_c	=	Earth load in pounds per linear foot
	C_c	=	Calculation coefficient (based on $r_{sd}P$ of 0.75)
	Ku	=	0.19
	w	=	130 lb/ft^3
	B_c	=	Outside diameter of pipe, feet

C. Truck Live Loads

1. Determine the truck live loads using the method recommended by AASHTO in "Standard Specifications for Highway Bridges."

2. For depths of cover less than 10 feet, add HS-20 live loads to the earth loads in order to determine the total load.

3. For depths of cover 3 feet or less, include HS-20 live load plus impact.

D. Deflection Control

1. The deflection of the pipe after installation, as determined from the Modified Iowa Formula outlined in AWWA M23, shall not exceed 0.03 times the outside diameter.

2. If the calculated deflection exceeds 0.03 times the outside diameter, increase the pipe class or improve the quality of the pipe zone backfill in order to achieve a higher modulus of soil reaction, E'.

3. For purposes of calculation, values of E' shall be 900 psi, and the deflection lag factor shall be 1.5.

2.03 PIPE

A. Provide pipe of the indicated diameter and pressure class, complete with rubber gaskets.

B. Provide specials and fittings as indicated.

C. The dimensions and pressure classes for Dimension Ratios for large PVC pressure pipe with Cast-Iron Pipe Equivalent O.D.s shall conform to the requirements of AWWA C900.

D. Additives and Fillers

1. Unless otherwise allowed in alternate qualification procedures of PPI-TR3, compounds which have a Hydrostatic Design Basis (HDB) of 4000 psi at 73.4 degrees F and for water shall not contain additives and fillers that exceed the recommended values in Table 1, Part Y of PPI-TR3 (e.g., allowable content range for calcium carbonate is 0.0-5.0 parts per hundred of resin).

2. If requested by the ENGINEER OF RECORD, determine the additive and filler content using the pyrolysis method as specified in ASTM D 2584.

E. Joints

1. Joints for the buried PVC pipe shall be either an integral bell manufactured on the pipe or a separate coupling both employing a rubber ring joint.

2. Provide the bell and coupling of the same thickness as of the pipe barrel, or greater thickness.

3. Provide the sealing ring groove in the coupling of the same design as the groove in cast iron fittings and valves available from local water works supply distributors.

4. Where indicated, provide ductile iron restrained joint pipe.

5. No restrained joint PVC pipe will be accepted.

F. Joint Deflection

1. Deflection at the joint shall not exceed 1.5 degrees or the maximum deflection recommended by the manufacturer.

2. No deflection of the joint will be accepted for joints that are over-belled or not belled to the stop mark.

2.04 PIPE DESIGN SCHEDULE

Pipe Designation or Pipe Class	Nominal Diameter, inches	Maximum Sustained Pressure, P_w, psi	Cover Range, feet	Trench Condition Outside Diam+feet	Minimum Compaction, percent
125 - 10	4 to 12	125	10	OD+2	90

2.05 FITTINGS

A. Provide ductile iron fittings conforming to the requirements of AWWA C110, Class 250.

B. PVC pipe fittings shall be mechanical joint.

C. Line and coat fittings in accordance with the requirements of Division 9.

D. Clearly label each fitting in order to identify its size and pressure class.

PART 3 -- EXECUTION

3.01 GENERAL

A. Perform laying, jointing, and testing for defects and leakage in the presence of the CONSTRUCTION MANAGER and obtain the CONSTRUCTION MANAGER's approval before acceptance.

B. Material found to have defects will be rejected, and the CONTRACTOR shall promptly remove such defective materials from the Site.

C. Installation shall conform to the requirements of AWWA M23, instructions furnished by the pipe manufacturer, and to the supplementary requirements indicated herein.

D. Wherever the provisions of this Section and the aforementioned requirements are in conflict, the more stringent provision shall apply.

3.02 HANDLING AND STORAGE

A. Handling

1. Carefully inspect pipe, fittings, and accessories before and after installation, and reject those found to be defective.

2. Pipe and fittings shall be free from fins and burrs.

3. Before being placed in position, clean the pipe, fittings, and accessories and maintain them in a clean condition.

4. Provide proper facilities for lowering sections of pipe into trenches.

5. Under no circumstances drop or dump pipe, fittings, or any other material into trenches.

B. Storage

1. Store pipe, if possible, at the Site in unit packages provided by the manufacturer.

2. Exercise caution to avoid compression damage or deformation to bell ends of the pipe.

3. Store pipe in such a way as to prevent sagging or bending, and protect pipe from exposure to direct sunlight by covering with an opaque material while permitting adequate air circulation above and around the pipe.

4. Store gaskets in a cool, dark place out of the direct rays of the sun, preferably in original cartons.

3.03 TRENCHING AND BACKFILL

A. Trench excavation and backfill shall conform to the requirements of Section 31 30 00 – Earthwork.

3.04 INSTALLATION

A. Lay bell-and-spigot pipe with the bell end pointing in the direction of laying.

B. Grade the pipe in straight lines, taking care to avoid the formation of any dips or low points.

C. Do not lay pipe when the conditions of trench or weather are unsuitable.

D. At the end of each day's WORK, temporarily close the open ends of pipe with wood blocks or bulkheads.

E. Supports

1. Support pipe at its proper elevation and grade, taking care to provide firm and uniform support.

2. Wood support blocking will not be accepted.

3. The full length of each section of pipe and fittings shall rest solidly on the pipe bed, with a recessed excavation in order to accommodate bells, joints, and couplings.

4. Provide anchors and supports where indicated and where necessary for fastening WORK into place.

5. Independently support fittings.

F. Use short lengths of pipe in and out of each rigid joint or rigid structure.

G. Replace piping that does not allow sufficient space for proper installation of jointing material with piping of proper dimensions.

H. Blocking or wedging between bells and spigots will not be accepted.

I. Install joints in accordance with the manufacturer's recommendations.

J. Keep trenches free of water until joints have been properly made.

K. The maximum combined deflection at couplings shall be in accordance with the manufacturer's recommendations.

L. Cutting

1. Cut the pipe by means of saws, power-driven abrasive wheels, or pipe cutters, which will produce a square cut.

2. Cuts by wedge-type roller cutters will not be accepted.

3. After cutting, bevel the end of the pipe using a beveling tool, portable type sander, or abrasive disc.

3.05 INSTALLATION OF COPPER WIRE

A. Provide polyvinyl chloride pipelines with No. 10 AWG bare copper wire, laid along the top of the pipe and held in place with ties or hitches of the same kind of wire and spaced not more than 13 feet apart, or metallic locating tape laid along the centerline of the pipe trench at a depth of 18 inches below finish grade.

B. Furnish manufacturer's literature, completely describing the tape proposed to be furnished.

C. No tape shall be used prior to receipt of written approval of the CONSTRUCTION MANAGER.

3.06 SERVICE CONNECTIONS

A. Direct tapping will not be accepted.

B. Use double-strap bronze service clamps for service connections.

C. Provide service clamps with a bearing area of sufficient width along the axis of the pipe such that the pipe will not be distorted when the saddle is made tight.

D. Cutting

1. Use an internal shell cutter to drill through the corporation stop in order to minimize PVC shavings, retain the coupon, and reduce stress.

2. Cuts by single-fluted shell cutters or twist drills will not be accepted.

3. Lubricate the cutting and tapping edges of the tool with cutting lubricant.

4. Make the cuts slowly, use the follower very lightly, and do not force the cutter through pipe wall.

5. Provide the shell cutter with sufficient throat depth to handle the heavy-wall PVC pipe.

6. Maximum outlet size permitted with service clamps or saddle is 2-inches.

E. Tapping Sleeves

1. Use tapping sleeves and valves for outlet sizes greater than 2 inches in diameter.

2. Assemble and install tapping sleeves in accordance with the manufacturer's recommendations.

3.07 CONNECTIONS TO EXISTING WATERLINES

A. Locate underground improvements and install the pipelines to the indicated depths.

B. Where the new WORK is to be connected to existing pipelines, make arrangements with the serving utility well in advance of the connections in order to allow adequate time for dewatering of the existing line, if necessary, and expedite the WORK in order to minimize water outages to the users.

C. Where sections of existing distribution mains are taken permanently out of service and abandoned in place, plug the cut ends solid with concrete to a depth of not less than one pipe diameter.

3.08 FIELD TESTING AND DISINFECTION

A. Field testing and disinfection of water mains shall conform to the requirements of Section 01 74 30 – Pressure Pipe Testing and Disinfection and Section 01 75 06 Field Testing.

END OF SECTION

SECTION 40 05 00

PIPING, GENERAL

PART 1 -- GENERAL

1.01 THE SUMMARY

A. The CONTRACTOR shall provide piping systems indicated, complete and operable, in accordance with the Contract Documents.

B. The provisions of this Section shall apply to piping in Divisions 33 and 40, and on the Drawings and as indicated in the Piping Schedule.

C. The Drawings define the general layout, configuration, routing, method of support, pipe size, and pipe type. The Drawings are not pipe construction or fabrication drawings. The CONTRACTOR shall prepare pipe spooling and fabrication drawings and shall submit them to the ENGINEER OF RECORD for review.

D. Where pipe layout details are not indicated on the Drawings, it is the CONTRACTOR'S responsibility to develop the details necessary to design and construct piping systems to accommodate the specific equipment provided, and to provide spacers, adapters, and connectors for a complete and functional system.

1.02 DEFINITIONS

A. Pipe, piping, pipe work, pipe system, piping system, or similar words, singular or plural shall mean and include, any type of pipes, tubes, fittings, valves, piping specialties, appurtenances, supports, restraints, anchors, coatings and linings and items related to piping.

B. Submerged piping, underwater piping or similar words, shall include any piping located two feet above water surface in basins or tanks

C. Potable water or similar words, shall mean and include any type of potable water or process water that be deemed potable after treatment processes.

D. Corrosive service shall mean and include in locations listed below:

a. Buried locations

b. Submerged locations or submerged piping.

c. Inside buried vaults, manholes, and structures that do not drain through a gravity sewer or to a sump with a pump.

d. Chemical handling areas

e. Inside trenches, containment walls, and curbed areas

f. Locations indicated or designated in the contract documents.

1.03 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Special Provisions Section 20.

B. Shop Drawings: Shop Drawings shall contain the following information:

1. Drawings: Layout drawings including necessary dimensions, details, pipe joints, fittings, specials, bolts and nuts, gaskets, valves, appurtenances, anchors, guides, and material lists. Pipe spooling and fabrication drawings shall indicate spacers, adapters, connectors, fittings, and pipe supports to accommodate the equipment and valves in a complete and functional system.

2. Welding Qualifications and Procedures

3. Pipe Supports: Submit pipe support fabrication drawings including calculations in accordance with Section 40 05 07 - Pipe Supports.

4. Grooved joint couplings and fittings shall be shown on drawings and product submittals, and shall be specifically identified with the applicable style or series designation, and restraint system if applicable.

5. Thermoplastic Pipe Joints: Submit solvent cement manufacturer's catalog indicating that the recommended product is suitable for each fluid service application.

6. Gasket Material: Submit gasket manufacturer's catalog indicating that the recommended product is suitable for each fluid service application.

7. Seals and Seating Materials: Submit elastomer material and manufacturer's catalog indicating that the recommended product is suitable for each fluid service application.

8. Modular Seals for Pipe: Manufacturer's catalog sheet showing materials and installation procedures.

9. Expansion Joints: Submit detailed calculations and manufacturer's Shop Drawings of proposed expansion joints, piping layouts, and anchors and guides, including information on materials, temperature, and pressure ratings

10. Flexible Connectors: Submit pressure and thermal expansion calculations

C. Samples

1. Performing and paying for sampling and testing as necessary for certifications are the CONTRACTOR'S responsibility.

D. Certifications

1. Necessary certificates, test reports, and affidavits of compliance shall be obtained by the CONTRACTOR.

2. A certification from the pipe fabricator that each pipe will be manufactured subject to the fabricator's or a recognized Quality Control Program. An outline of the program shall be submitted to the ENGINEER for review prior to the manufacture of any pipe.

1.04 MATERIAL DELIVERY, STORAGE, AND PROTECTION

A. Piping materials, fittings, valves, and accessories shall be delivered in a clean and undamaged condition and stored off the ground for protection against oxidation caused by ground contact.

B. Defective or damaged materials shall be replaced with new materials.

PART 2 -- PRODUCTS

2.01 GENERAL

A. Extent of Work

1. Pipes, fittings, and appurtenances shall be provided in accordance with the requirements of the applicable Sections of Divisions 33 and 40 and as indicated.

2. Materials in contact with potable water or process water that be deemed potable after treatment processes shall be listed as compliant with NSF Standard 61. Potable water shall be considered to be plant water and all process water pipelines including sludge, thickened sludge, decant, and centrate pipelines as well as drain pipelines that return to the gravity thickeners, washwater recovery facility, or to the existing washwater recovery basins.

B. Piping Supports

1. Pipes shall be adequately supported, restrained, and anchored in accordance with Section 40 05 07 – Pipe Supports, and as indicated.

2. Piping support seismic and wind loads shall be sized in accordance with the design criteria as shown on GS-1 – General Structural Notes– Design Criteria– Seismic Loads.

C. Lining

1. Application, thickness, and curing of pipe lining shall be in accordance with the applicable Sections of Division 33, unless otherwise indicated.

D. Coating

1. Application, thickness, and curing of coating on buried pipe shall be in accordance with the applicable Sections of Division 33 and Section 09 96 00 - Protective Coating, unless otherwise indicated.

2. Pipes above ground or in structures shall be coated in accordance with Section 09 96 00 – Protective Coating.

E. Pressure Rating

1. Piping systems shall be designed for the pressure as defined in respective pipe sections, or as indicated on the Piping Schedule, whichever is greater.

F. Inspection

1. Pipe shall be subject to inspection at the place of manufacture.

2. During the manufacture, the CONSTRUCTION MANAGER shall be given access to areas where manufacturing is in progress and shall be permitted to make inspections necessary to confirm compliance with requirements.

G. Tests

1. Except where otherwise indicated, materials used in the manufacture of the pipe shall be tested in accordance with the applicable specifications and standards.

2. Welds shall be tested as indicated.

3. The CONTRACTOR shall be responsible for performing material tests.

H. Welding Requirements

1. Qualification of welding procedures used to fabricate pipe shall be in accordance with the provisions of AWS D1.1 - Structural Welding Code or the ASME Boiler and Pressure Vessel Code, Section 9, whichever is applicable.

I. Welder Qualifications

1. Welding shall be performed by skilled welders and welding operators who have adequate experience in the methods and materials to be used.

2. Welders shall be qualified under the provisions of AWS D1.1 or the ASME Boiler and Pressure Vessel Code, Section 9, whichever is applicable.

3. Machines and electrodes similar to those used in the WORK shall be used in qualification tests.

4. Qualification testing of welders and materials used during testing is part of the WORK.

2.02 PIPE FLANGES

A. General

1. Flanges shall be provided with flat faces and shall be attached with bolt holes straddling the vertical axis of the pipe unless otherwise indicated.

2. Flange faces shall be perpendicular to the axis of the adjoining pipe.

3. Flanges for miscellaneous small diameter pipes shall be in accordance with the standards indicated for those pipes.

B. Pressure Ratings

1. 150 psig or less: Flanges shall conform to either AWWA C207 - Steel Pipe Flanges for Waterworks Service--Sizes 4 In. Through 144 In., Class D, or ASME B16.5 - Pipe Flanges and Flanged Fittings, Class 150.

2. 150 psig to 275 psig: Flanges shall conform to either AWWA C207 Class E or Class F, or ASME B16.5, Class 150.

3. 275 psig to 700 psig: Flanges shall conform to ASME B16.5, Class 300.

4. Selection Based on Test Pressure

a. Do not expose AWWA flanges to test pressures greater than 125 percent of rated capacity.

b. For higher test pressures, the next higher rated AWWA flange or an ANSI-rated flange shall be selected.

C. Blind Flanges

1. Provide blind flanges in accordance with AWWA C207, or as indicated for miscellaneous small pipes.

2. Blind flanges for pipe diameters 12 inches and greater shall be provided with lifting eyes in the form of welded or threaded eye bolts.

D. Flange Coating

1. Machined faces of metal blind flanges and pipe flanges shall be coated with a temporary rust-inhibitive coating to protect the metal until the installation is completed.

E. Flange Fasteners

1. Unless otherwise shown on the drawings, or indicated in the applicable Sections of Divisions 33 and 40, Bolts and nuts shall conform to the following requirements;

a. Threads shall be in accordance with ANSI/ASME B1.1, Class 2, UNC for bolt diameters 1” and smaller and UN8 for bolt diameters greater than 1”.

b. Bolts shall have heavy hexagon heads and heavy hexagon nuts. Length of studs shall provide a projection of not less than 0.25 inch and no more than 0.5 inch through the nut when it is drawn tight.

c. Thread studs on flange connections are not permitted except where space restrictions preclude the use of standard bolts and where approved by the ENGINEER.

d. Through bolt holes shall be drilled in accordance with the applicable flange standard.

e. All bolts fastening metallic flanges shall be provided with plain washers installed under the nut. Washer materials shall be of the same material as the bolt. If the through bolt holes are drilled larger than the applicable standard by 1/8 inch in diameter or more, bolts shall be also installed with a plain washer under the bolt head as well.

f. All bolts fastening non-metallic flanges shall be provided with plain washers installed under both the bolt head and nut.

g. Washer materials shall be of the same material as the bolt.

h. Anti-seize compound shall be used on carbon steel fasteners, and shall be Husk-ITT, Husky 2000; or equal.

i. Anti-galling compound used for stainless steel fasteners in LOX, nitrogen injection, oxygen, ozone process/off-gas/vent and ozone contactor maintenance air service shall be DuPont “Krytox”; or equal.

j. Anti-galling compound used for stainless steel fasteners for other services shall be certified for potable water use and shall be Husk-ITT, Lube O’seal; Hercules, Real-Tuff; La Co, Slic-Tite; or equal.

2. Fastener Material Group Numbering System

a. Flange fasteners shall conform to the following material standards and shall be categorized within the Fastener Material Schedule Groups as indicated:

1) Material Group C1 (Carbon steel): ASTM A307 Grade B bolts, ASTM A563 Grade B nuts with ASTM F436 washers

2) Material Group C2 (Carbon steel): ASTM A193 Grade B7 bolts, ASTM A194 Grade 2H nuts with ASTM F436 washers

3) Material Group S1 (316 SS): ASTM A193, Grade B8M bolts, ASTM A194 Grade 8M nuts with Type 316 SS plain washers.

4) Material Group S2 (304 SS): ASTM A193, Grade B8 bolts, ASTM A194 Grade 8F nuts with Type 304 SS plain washers.

5) Material Group S3 (Hastelloy C-276): ASTM F468 N10276 bolts ASTM F467 N10276 nuts with type Hastelloy plain washers.

3. Fastener Material Group Numbers used in Non-Corrosive Service Applications

a. AWWA C115 ductile iron flanges - Material Group C1

b. AWWA C207 steel flanges - Material Group C2

c. ASME B31 group piping flanges – Material Group C2

d. Non-metallic pipe flanges - Material Group S1

e. Stainless steel pipe flanges and all others not listed above - Material Group S1

f. Where mating flanges are of different flange material standards and the specified Fastener Material Groups are in conflict, then fasteners of the higher grade shall be utilized unless otherwise indicated. For the purpose of this requirement, the Material Groups in order of decreasing grade shall be S1, C2, C1. Provide insulating flange sets for dissimilar metal flanged piping to electrically isolate the dissimilar piping.

g. Where gaskets of Teflon or Viton-A are required, fasteners of Material Group C2 shall be utilized for all C1 flange standards.

4. Fastener Material Group Numbers used in Corrosive Service Applications

a. All Flange fasteners shall be of Material Group S1 unless S2 and S3 are otherwise indicated on the drawings.

F. Insulating Flanges

1. Insulated flanges shall be provided with bolt holes 1/4-inch diameter greater than the bolt diameter.

G. Insulating Flange Sets

1. In order to prevent corrosion, insulating flange sets shall be furnished on all piping connections where two dissimilar metals are to be connected. Each insulating flange set shall consist of an insulating gasket, insulating sleeves and washers, and a steel washer.

2. For bolt diameters 1-1/2 inches or smaller, insulating sleeves and washers shall be one piece and shall be made of acetyl resin.

3. For bolt diameters larger than 1-1/2 inches, insulating sleeves and washers shall be 2-piece and shall be made of polyethylene or phenolic material.

4. Insulating flange sets materials used for fluids other than general water and wastewater shall be made of materials compatible with the fluid services.

5. Insulating gaskets shall be full-face.

H. Insulating Flange Manufacturer, or Equal

1. **JM Red Devil, Type E**

2. **Fluid Sealing Products, Inc.**

3. **Enpro Industries, Inc. (GPT)**

I. Flange Gaskets

1. Gaskets for flanged joints used in general water and wastewater service shall be full faced type in accordance with AWWA C207, suitable for temperatures to 700 degrees F, a pH of one to 11, and pressures to 1000 psig.

2. Blind flanges shall be provided with gaskets covering the entire inside face of the blind flange and shall be cemented to the blind flange.

3. Ring gaskets will not be accepted unless otherwise indicated.

4. Unless otherwise indicated, flange gaskets up to 150 psi shall be EPDM sheet material, NSF 61 approved, **Garlock, Style 98206-U (unbranded), or similar products from John Crane, or equal**.

5. Unless otherwise indicated, flange gaskets up to 500 psi shall be aramid fiber with rubber binder material, NSF 61 approved, **Garlock, Style 3760-U (unbranded), or similar products from John Crane, or equal**.

6. Gaskets for flanged joints used in water with chloramines shall be Teflon material, NSF 61 approved, **Garlock, Gylon Style 3505, or similar products from John Crane, or equal**.

7. Gaskets for flanged joints used in water with ozone shall be Teflon material, NSF 61 approved, **Garlock, Gylon, Style 3504, or similar products from John Crane, or equal**.

8. Gaskets for flanged joints used in cryogenic oxygen (LOX and GOX) service shall be Teflon material, **Garlock Gylon, Style 3502 and 3503 or similar products from John Crane, or equal**.

9. Gaskets for flanged joints in PVC and CPVC piping used in general water and wastewater service shall be NSF 61 approved, full-faced, 1/8-inch thick, and made of fluoroelastomer having a durometer hardness of 50 to 70. Gaskets for pipe sizes up to 24-inch and 150 psi shall be Garlock Style XP or similar products from John Crane, or equal.

10. When the mating flange has a raised face, provide stainless steel flat ring gasket filler between the PVC flange and gasket and the adjacent flange.

11. Gaskets for flanged joints used in chemicals, hot air, ozone gas, solvents, hydrocarbons, steam, chlorine and other fluids shall be made of materials compatible with the service, pressure, and temperature. Consult gasket Manufacturer for recommended gasket material.

2.03 PIPE THREADS

A. Pipe threads shall be in conformance with ASME B1.20.1 - Pipe Threads, General Purpose (inch), and be made up with Teflon tape unless otherwise indicated.

B. Unless otherwise indicated, use metal FNPT and plastic MNPT for threaded pipe connections between metal and plastic pipes.

2.04 THREADED INSULATING CONNECTIONS

A. General

1. Threaded insulating bushings, unions, or couplings, as appropriate, shall be furnished for joining threaded pipes of dissimilar metals and for piping systems where corrosion control and cathodic protection are involved.

B. Materials

1. Threaded insulating connections shall be constructed of nylon, Teflon, polycarbonate, polyethylene, or other non-conductive materials, and shall have ratings and properties to suit the service and loading conditions.

2.05 MODULAR MECHANICAL SEALS FOR PIPING PENETRATIONS

A. Where indicated and where required in order to prevent flow of water or air, the passages of piping through wall sleeves and cored openings shall be sealed with modular interlocking link mechanical closures.

B. Individual links shall be constructed of EPDM rubber, be suitable for temperatures between minus 40 and plus 250 degrees F, and be shaped to fill the annular space between the outside of the pipe and the inside of the wall sleeve or cored opening.

C. Assemble the links using Type 316 stainless steel bolts and nuts to form a continuous rubber belt around the pipe.

D. Pressure plates under each bolt and nut shall be fabricated of a corrosion-resistant composite material.

E. After the seal assembly is positioned in the sleeve, tighten the bolts against the pressure plates to expand the rubber links and form the watertight seal.

F. Sizing and installation of sleeves and assemblies shall be in accordance with the manufacturer's recommendations.

G. Modular Mechanical Seals Manufacturer, or Equal

1. **EnPro Industries Company (GPT), Link-Seal**

2. **Proco Products, Inc., Pen-Seal**

2.06 AIR AND GAS TRAPS

A. Air and gas pipes shall slope to low points and shall be provided with drip legs, shut-off valves, strainers, and traps.

B. Pipe the traps to the nearest drain.

C. Air and gas traps shall be not less than Class150 iron body float-type, with a copper or stainless steel float.

D. Bracket, lever, and pins shall be constructed of stainless steel.

E. Drain traps shall be provided with threaded connections.

F. Air and Gas Traps Manufacturer, or Equal

1. **Armstrong International, Inc.**

2. **Spirax Sarco, Inc.**

2.07 PIPE INSULATION

A. Hot and cold liquid piping, flues, and engine exhaust piping shall be insulated as indicated.

B. No unprotected hot piping shall be within reach of operating personnel or other persons.

2.08 HEAT TRACING

A. Pipes subject to freezing shall be protected by heat tracing in accordance with the requirements of Section 26 05 50 – Electric Heat Tracing.

B. Heat traced pipe shall be insulated as indicated and in accordance with the requirements of Section 23 07 00 – Pipe, Ductwork and Equipment Insulation.

2.09 CATHODIC PROTECTION

A. Metallic buried piping shall have bonded joints so that it may be cathodically protected in the future if necessary.

PART 3 -- EXECUTION

3.01 GENERAL

A. This section specifies the general installation requirements for piping, valves, and related items and shall be installed in accordance with the manufacturer's technical data and printed instructions. Specific piping materials, systems, appurtenances, and related installation and testing requirements are specified in related sections of Divisions 01, 33, and 40, and as noted on the Drawings, Pipe and Valve Schedules.

B. Piping shall be installed in a neat and workmanlike manner, properly aligned and cut from measurements taken at the Site to avoid interferences with structural members, architectural features, openings, and equipment. Exposed pipe shall afford maximum headroom and access to equipment, and where necessary piping shall be installed with sufficient slopes for venting or drainage of liquids and condensate to low points.

C. CONTRACTOR shall obtain the assistance of the pipe manufacturer to instruct the pipe fitters in the correct installation and support of the piping system. Valves and flanges attached to the pipe shall be provided with adequate supports.

D. Lined Piping Systems

1. The lining manufacturer shall take full responsibility for the complete, final product and its application.

2. Pipe ends and joints of lined pipes at threaded flanges shall be epoxy-coated in order to assure continuous protection.

E. Refer to the following table for reference pipe types and applicable specifications for fluid abbreviations indicated in the drawings:

Fluid Abbreviation	Description	Nominal Diameter	Material	Wall Thickness Schedule, Type, Reference	Specification Section
CEN	Centrate	Where material is	Ductile iron (DIP)	Per Specification	33 92 20
CPEN	Polymer, anionic,	All	PVC (PVCP)	SCH. 80,Containment SCH. 40	40 05 30
D	Drain	2” and smaller	PVC (PVCP)	SCH. 40	40 05 30
D	Drain	2.5” and larger (above ground)	PVC (PVCP)	SCH. 40	40 05 30
D	Drain	2.5” and larger (buried)	PVC (PVCP)	SDR 26	33 95 40
D	Drain	Where material is shown	Cast Iron Soil Pipe	Service	ASTM A74
D	Drain	Where material is shown	Copper (CUP)	Per Specification	40 05 17
D	Drain	Where material is shown	Ductile Iron (DIP)	Per Specification	33 92 20
OF	Overflow	Where material is shown	PVC (PVCP)	SCH. 80	40 05 30

OF	Overflow	Where material is shown	Steel (GSP)	SCH. 40	15232
OF	Overflow	Where material is shown	Ductile Iron (DIP)	Per Specification	33 92 20
PW	Plant water	Smaller than 4”	PVC, where shown (PVCP)	SCH. 40	40 05 30
PW	Plant water	4” and larger	AWWA C900 PVC, where shown (PVCP)	Per Specification	33 95 50
PW	Plant water	All sizes	Stainless steel, where shown (SSP)	Per Specification, Schedule 40 unless otherwise indicated	40 05 23
PW	Plant water	Smaller than 4”	Copper, where shown (CUP)	Type K	40 05 17
SAM	Sample	Where material is shown	PVC (PVCP)	SCH. 40	40 05 30
SAM	Sample	Where material is shown	Copper (CUP)	Type K	40 05 17
SAM	Sample	Where material is shown	Stainless steel, Type 316L (SSP)	Per Specification	40 05 23
SLG	Sludge	Where material is shown	Ductile iron (DIP)	Per Specification, Minimum Class 53	33 92 20
TPEN	Polymer, anionic,	All	PVC (PVCP)	SCH. 80, Containment SCH. 40	40 05 30
TSLG	Thickened Sludge	Where material is shown	Ductile iron (DIP)	Per Specification, Minimum Class 53	33 92 20

General Notes:

(1) Should discrepancies between this pipe schedule and specific Drawing callouts arise, the specific Drawing callouts shall take precedence with respect to pipe materials.
(2) See referenced Technical Specifications for description of requirements for piping, fittings, flanges, testing, etc.
(3) If individual Technical Specifications or applicable California or local codes require higher test pressures than listed herein, the higher test pressures shall be used.

3.02 INSTALLATION

A. Installation shall be free from defects. Prior to installation, each pipe length shall be carefully inspected, be flushed clean of any debris or dust, and be straightened if not true straight. Ends of threaded pipes shall be reamed and filed smooth. Groove ends shall be clean and free from indentations, projections, and roll marks in the area from the pipe end to the groove. Fittings shall be equally cleaned before assembly.

B. Building gravity flow plumbing pipes shall be installed in a neat and workmanlike manner, in accordance with the prevailing plumbing and building codes. Pipes shall have the required slopes for proper drainage. Pipe locations inside buildings shall be coordinated with the rest of the WORK to avoid interferences and to provide sufficient headroom. Installations shall be acceptable to the local plumbing inspector.

C. Supports and Anchors: Piping supports, thrust, and seismic restraints shall be provided where shown on the Drawing or where determined to be required in according to Section 40 05 07 - Pipe Supports. Where necessary to avoid stress on equipment or structural members, the pipe shall be anchored or harnessed. Expansion joints and guides shall compensate for pipe expansion due to temperature differences. Pipe shall be firmly supported with fabricated or commercial hangers or supports.

D. Piping Joints: Pipe joints requirements shall conform to the applicable piping sections of Division 33 and Division 40.

1. Threaded Joints: Pipe threads shall be full and cleanly cut with sharp dies. Not more than 3 threads shall remain exposed after installation.

2. Welded Joints: Welded joints shall conform to the specifications and recommendations of ASME B 31.1 - Power Piping. Welding shall be done by skilled and qualified welders. Pipe surface residues, oxides, and heat stains are to be removed from a field weld and the affected areas adjacent by the use of stainless steel wire brushes. For alloy and stainless steel pipe, the post welding surfaces shall be cleaned with a pickle agent such as nitric/hydrofluoric acid solutions or pickle paste or equal, then complete removal of the agent by wash the surface thoroughly with clean water.

3. Flange Joints: Flanged joints shall be made with gaskets with bolts and nuts as specified. Care shall be taken not to over-torque the bolts, in accordance with the manufacturer's written recommendations.

4. Fusion-Welded Joints: Fusion-welded joints shall be made with the manufacturer's recommended equipment on clean, dry pipe ends. The joints shall be made up at the recommended ambient temperatures, to the pipe manufacturer's written recommendations. The pipe supplier shall be consulted to obtain machinery and expertise for the joining by fusion welded of pipe and fittings. No pipe or fittings shall be joined by fusion by any of the Contractor's personnel unless they are adequately trained and qualified in the techniques involved. Butt fusion joining shall yield a joint strength equal to or greater than the tensile strength of the pipe. Socket fusion, extrusion welding and hot gas welding shall not be used for field connections.

5. Brazed and Soldered Joints: Brazed and soldered joints shall conform to the manufacturer’s recommendations and to the specifications and recommendations of ASME B 31.1 - Power Piping. Brazing shall be done by skilled and qualified welders. Prior to the application of flux, the ends of tubes shall be thoroughly dried and cleaned

6. Grooved Joints: Grooves for grooved couplings and fittings shall be made with specially designed grooving tools to the manufacturer's recommendations and conform to AWWA C 606 – Joints, Grooved and Shouldered Type. Grooves shall be clean and sharp without flaws, and the pipe ends shall be accurately cut at 90 degrees to the pipe axis.

7. Push On Joints: Push on joints and gasket installation shall be in accordance with the manufacturer's recommendations and lubricants. Pipe ends shall be beveled to facilitate assembly. Lubricants shall be suitable for potable water service and shall be kept clean in closed containers.

8. Solvent-Welded Joints: Solvent-welded joints shall be made with fresh primer and solvent cement on clean, dry pipe ends. The primer and cement cans shall be kept closed at all times and the joints shall be made up at the recommended ambient temperatures, to the pipe or cement manufacturer's written recommendations. PVC socket connections shall be joined with PVC cement conforming to ASTM D2564 Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC). CPVC socket connections shall be joined with CPVC solvent cement conforming to ASTM F493. For chemical service applications, solvent cement shall be formulated and labeled for use on that chemical.

9. Adhesive Joints: Adhesive joints shall be made with freshly-mixed 2-part epoxy on clean, dry pipe ends per pipe manufacturer recommendations. The joints shall be made up at the recommended ambient temperatures, to the pipe or adhesive manufacturer's written recommendations. Pipe ends shall be inserted to the full depth of the socket.

E. Valves and Unions: Unless otherwise indicated, connections to fixtures, groups of fixtures and equipment shall be provided with a shutoff valve and union, unless the valve has flanged ends. Unions shall be provided at threaded valves, equipment, and other devices requiring occasional removal or disconnection.

F. Branch Connections: Branch connections in horizontal runs of air and gas piping shall be made from the top of the pipe, to avoid drainage of condensate into the equipment. Unless otherwise indicated for threaded pipe connections between metal and plastic pipes, use metal FNPT and plastic MNPT.

1. Pipe ends and joints of lined pipes at threaded flanges shall be epoxy-coated in order to assure continuous protection.

G. Isolation Joints / Dielectric Protection: Provide electrically isolate connections between dissimilar metal piping connections. Electrical checks shall be made to assure no contact is made between dissimilar metal piping elements.

1. Use dielectric couplings specially designed for the prevention of galvanic reaction between dissimilar metals.

2. For flanged connections, use stainless steel bolts with isolation bushings, washers, and full-face flange gaskets.

H. Core Drilling: Where core drilling is required for pipes passing through existing concrete, core drilling locations shall be determined by radiograph of concrete construction in order to avoid damage to embedded raceways and reinforcing bars.

I. Coating: Exposed pipes shall be coated with a finish coat to the pipe manufacturer's standard protective coating, with the manufacturer's recommended prime coat and a finish coat in accordance with Section 09 96 00 - Protective Coating.

J. Low points in piping systems and driplegs in steam, gas, and air systems shall have drainage valves.

K. Care shall be taken to insure that piping flanges, mechanical-type couplings, sleeve-type couplings, flexible connectors, and expansion joints are properly installed as follows:

1. Gasket surfaces shall be carefully cleaned and inspected prior to making up the connection. Gasket shall be centered properly on the contact surfaces.

2. Connections shall be installed to prevent inducing stress to the piping system or the equipment to which the piping is connected.

3. Contact surfaces for flanges, couplings, and piping ends shall be aligned parallel, concentric, and square to each axis at the piping connections.

4. Flange Bolts

a. Flange bolts shall be initially hand-tightened with the piping connections properly aligned.

b. Bolts shall be tightened with a torque wrench in a staggered sequence to the recommended torque for the applicable piping material per AWWA or manufacturer's recommendation. Care shall be taken to avoid over-torquing the bolts especially on plastic flanged joints.

c. Harness, thrust restraint, and tie rod bolts used for sleeve couplings, flange coupling adapters, or flexible joints shall be tightened gradually and equally at diametrically opposite sides until snug, in order to prevent misalignment and to insure that all studs carry equal loads.

d. In order to prevent induced stress or misalignment, do not over-torque connections to adjoining pump or equipment. Flanges shall not be deformed nor cracked.

3.03 INSPECTION

A. After completion of the WORK, cuttings, joining and wrapping materials, and other scattered debris shall be removed from the Site. The entire piping system shall be in a clean and functional condition.

B. Inspection: Finished installations shall be carefully inspected for proper joints and supports, interferences, and damage to pipe, fittings, and coating. Temporary plugs and covers shall be removed from openings and floor drains. Defective WORK shall be repaired to the satisfaction of the field engineer or plumbing inspector.

3.04 FIELD TESTING FOR PRESSURE PIPING

A. Prior to enclosure or burying, piping systems shall be pressure tested as required in the Piping Schedule for a period of not less than two hours without exceeding the tolerances listed in the Piping Schedule or per testing requirements of Section 017430 - Pressure Pipe Testing and Disinfection. Where no pressures are indicated, the pipes shall be subject to 1-1/2 times the maximum working pressure. The CONTRACTOR shall furnish test equipment, labor, materials, and devices as part of the WORK. For additional testing requirements, refer to Section 01 74 30 - Pressure Pipe Testing and Disinfection.

B. Leakage may be determined by loss of pressure, soap solution, chemical indicator, or other positive and accurate method. Fixtures, devices, or other accessories which are to be connected to the lines and which would be damaged if subjected to the test pressure shall be disconnected and ends of the branch lines plugged or capped as required during the testing procedures.

C. Leaks shall be repaired, and the system shall be re-tested until no leaks are found.

3.05 FIELD TESTING FOR GRAVITY PLUMBING PIPING

A. Prior to enclosure or burying, drains and vents shall be tested in the presence of the local plumbing inspector and the CONSTRUCTION MANAGER for a period of not less than one hour, or as requested by the plumbing inspector if the request is more stringent. The CONTRACTOR shall furnish test equipment, labor, material, and devices as part of the WORK. Defective WORK shall be repaired to the satisfaction of the plumbing inspector, and the piping shall be re-tested until no leaks are found.

B. Leakage may be determined by loss of pressure, soap solution, chemical indicator, or other positive and accurate method. Fixtures, devices, or other accessories which are to be connected to the lines and which would be damaged if subjected to the test pressure shall be disconnected and ends of the branch lines plugged or capped as required during the testing procedures.

C. Testing and defective WORK shall be repaired to the satisfaction of the plumbing inspector.

END OF SECTION

SECTION 40 05 02

PIPING IDENTIFICATION

PART 1 -- GENERAL

1.01 THE SUMMARY

A. The CONTRACTOR shall provide identification for the piping and valves, complete and in place, in accordance with the Contract Documents.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards

ASME A13.1 Scheme for the Identification of Piping Systems

1.03 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Special Provisions Section 20.

B. Shop Drawings: Provide a list of the suggested wording for each pipe label and valve tag, prior to fabrication.

C. Samples

1. Sample of each type of identification device.

2. Sample of each proposed color required by the pipe color schedule.

PART 2 -- PRODUCTS

2.01 EXPOSED PIPING OR ABOVE GROUND PIPING IDENTIFICATION

A. Pipe markers, type as indicated below, suitable for outdoor application from -40 degrees to 180 degrees Fahrenheit; in accordance with ASME A13.1 requirements.

1. Marker Type (Select one of the following

a. Snap Around: Vinyl or polyester sheet with UV- resistant ink, preshaped and sized to tightly curl around the pipe and remain in position.

b. Adhesive: Vinyl or polyester sheet with UV- resistant ink, shaped similar to pipe curvature and coated with pressure sensitive adhesive.

c. Stencil: Lettering painted directly on surface of pipe inside color coded marker area.

2. Marker Area: Sized per pipe size according to ASME A13.1 and conforming to the color codes in the Identification Colors table below.

3. Lettering: Sized per pipe size according to ASME A13.1 and conforming to the color codes in the Identification Colors table below.

4. Arrows: At least one arrow at each marker area, showing direction of flow.

B. Pipe 1-inch diameter and smaller or pipe not suitable for the marker type(s) listed above shall be identified with aluminum or stainless steel pipe identification tags with stamped-in ¼" high identification lettering.

C. Manufacturer or Equal.

1. **Seton Identification Products**, Opti Code Pipe Markers (adhesive type)

2. **Grainger, Inc.** (adhesive, snap around)

3. **Marking Services, Inc.**(adhesive, snap around)

2.02 BURIED PIPELINE IDENTIFICATION

A. Underground Warning Tape

1. Material:

a. Polyethylene tape or polyolefin film. The material and ink shall be chemically inert and shall not degrade when exposed to acids, alkalis and other destructive substances commonly found in soil.

b. 6" wide tape with a minimum 4 mil thickness.

c. Message: "CAUTION, LINE BURIED BELOW" with the name of the fluid service in black lettering on a colored background.

1) Water: Blue

2) Sewer: Green

3) Gas and other services: Yellow

4) Other services: colors as approved by the OWNER.

2. Manufacturer, or Equal

a. **Reef Industries, Inc.**

b. **Seton Identification Products**

c. **T. Christy Enterprises, Inc.**

B. Tracer Wire

1. Material:

a. Solid copper conductor with 30 mil HMWPE.

b. 10 gauge or thicker wire.

2. Manufacturer, or Equal

a. **Kris-Tech Wire**

b. **Corrpro Companies, Inc.**

C. Witness Markers

1. Material:

a. UV resistant glass fiber and resin reinforced thermosetting composite material.

b. Constructed as a single pipe with pointer at the bottom end.

c. Message of the markers “CAUTION, LINE BURIED BELOW” with the name of the fluid service, and the following information:

1. Phone number for underground service alert.

2. Phone number for OWNER in case of emergency.

3. Application station number and offset information if marker is not directly over the pipe.

4. Name of buried appurtenance or fitting if applicable.

2. Manufacturers, or Equal

a. **Carsonite Composites, Utility Marker**

b. **Berntsen International, Inc.**

2.03 EXISTING IDENTIFICATION SYSTEMS

A. In installations where existing piping identification systems have been established, the CONTRACTOR shall follow the existing system. Where existing identification systems are incomplete, utilize the existing system as far as practical and supplement with the system indicated herein.

2.04 IDENTIFICATION OF VALVES AND SHORT PIPE LENGTHS

A. Valves and sections of pipe that are too short to be identified with markers and arrows shall be identified with metal or plastic tags.

B. Metal tags shall be stainless steel with embossed lettering. Plastic tags shall be solid black plastic laminate with white embossed letters. Tags shall be designed to be firmly attached to the valves or short pipes or to the structure immediately adjacent to the valves or short pipes.

C. Wording on valve tags shall describe the exact function of each valve (e.g., "HWR-BALANCING," "CLS THROTTLING", "RAS-PUMP SHUT-OFF," etc.) and include the valve number as indicated in the Contract Drawings. Wording on small pipes shall describe the contents of the pipe.

2.05 PIPE COATING:

A. Unless otherwise indicated, pipe coating shall be in conformance with Section 09 96 00 - Protective Coating.

PART 3 -- EXECUTION

3.01 GENERAL

A. Markers and identification tags shall be installed in accordance with the manufacturer's printed instructions, and shall be neat and uniform in appearance. Tags and markers shall be readily visible from all normal working locations.

3.02 VALVE TAGS

A. Valve tags shall be permanently attached to the valve or structure by means of 2 stainless steel bolts or screws.

3.03 MARKER LOCATIONS

A. Each pipe shall be marked at:

1. Intervals of 20-feet in straight runs.

2. At least once in every room.

3. Within 2 feet of turns, elbows, and valves.

4. On the upstream side of tees, branches, and other distribution points.

5. On both sides of walls and floors through which the piping passes.

3.04 IDENTIFICATION COLORS

1. Conform to the following color codes.

Pipe Contents		Marker Color	Letter Color	Pipe Color
Symbol	**Service**			
A	Air	blue	white	
AC	Activated carbon solution	orange	black	
AW	Filter air wash	blue	white	
BD	Bottom drain	green	white	
BBD	Boiler blow-down	orange	black	
BP	Plant bypass	green	white	
BW	Filter backwash	green	white	
C	Condensate	green	white	
CD	Chemical drain and vent	orange	black	
CL	Chlorine (gas or liquid state)	orange	black	
CLS	Chlorine solution	orange	black	
CLV	Chlorine gas under vacuum	orange	black	
CN	Centrate	green	white	
CS	Caustic soda	orange	black	
CSL	Circulated sludge	orange	black	
CV	Chlorine vent & detection line	orange	black	
CWR	Chilled water return	green	white	
CWS	Chilled water supply	green	white	
DCS	Defoaming chemical solution	orange	black	
DN	Decant	green	white	

DW	Demineralized water	green	white	
EE	Engine exhaust	orange	black	
EWR	Engine cooling water return	green	white	
EWS	Engine cooling water supply	green	white	
FC	Ferric chloride	orange	black	
FE	Final effluent	green	white	
FI	Filter influent	green	white	
FOR	Fuel oil return	brown	white	
FOS	Fuel oil supply	brown	white	
FS	Froth spray	green	white	
FSP	Fire protection sprinkler system	red	white	
HR	Heating water return	green	white	
HS	Heating water supply	green	white	
HWR	Domestic hot water return	green	white	
HWS	Domestic hot water supply	green	white	
IA	Instrument air	blue	white	
LA	Liquid alum	orange	black	
LE	Lagoon effluent	green	white	
LO	Lube oil	brown	white	
LS	Lime slurry	orange	black	
LSP	Landscape sprinkler system	green	white	
NG	Natural gas	yellow	black	
O	Ozone	orange	black	
OF	Overflow	green	white	
PA	Plant air	blue	white	

PD	Plant drain	orange	black	
PEA	Polymer-anionic	orange	black	
PEC	Polymer-cationic	orange	black	
PEN	Polymer-nonionic	orange	black	
PEF	Primary effluent	orange	black	
PI	Plant influent	orange	black	
PO	Plant overflow	orange	black	
PW	Potable water	green	white	
REW	Reclaimed water	Purple	white	
RW	Raw water	green	white	
RWL	Rain water leader	green	white	
SA	Sample lines	green	white	
SC	Spare chemical	orange	black	
SD	Sanitary drains and vents	orange	black	
SDR	Storm drain	orange	black	
SN	Supernatant	orange	black	
SOW	Softened water	green	white	
SPD	Sump pump discharge	orange	black	
SS	Sanitary sewer	orange	black	
SUC	Structure underdrain collector	green	white	
SW	Filter surface wash	green	white	
TSL	Thickened sludge	orange	black	
TSO	Thickener subnatant overflow	orange	black	
UW	Utility water (non-potable water)	green	white	
V	Vacuum	blue	white	

WLO	Waste lube oil	brown	white	
WW	Filter waste washwater	orange	black	

END OF SECTION

SECTION 40 05 06

PIPE COUPLINGS

PART 1 -- GENERAL

1.01 THE SUMMARY

A. The CONTRACTOR shall provide pipe couplings indicated, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 40 05 00 - Piping, General apply to the WORK of this Section

C. The provisions of this Section shall apply to piping in Divisions 33 and 40, and on the Drawings.

D. The couplings, adapters and joints shall be provided with restraining devices to restrict pipe axial movement. Where the restraining devices and/or details are not indicated on the Drawings, it is the CONTRACTOR'S responsibility to provide the devices/details necessary to restraint the piping system.

E. The Items specified in this section include the following:

1. Groove Couplings
2. Sleeve Couplings
3. Flanged Coupling Adapters
4. Dismantling Joints
5. Expansion Joints
6. Flexible Connectors
7. Transition Couplings.
8. Quick Disconnect Couplings
9. Tapping Sleeves
10. Miscellaneous Adapters

1.02 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Special Provisions Section 20.

B. Shop Drawings: Shop Drawings shall contain the following information:

1. Product submittals, and shall be specifically identified with the applicable style or series designation, pressure rating and restraint system if applicable.

2. Couplings schedule or layout indicating where the couplings will be installed.

3. Expansion Joints: Submit detailed calculations and manufacturer's Shop Drawings of proposed expansion joints, piping layouts, and guides, including information on materials, temperature, and pressure ratings

4. Flexible Connectors: Submit pressure and thermal expansion calculations

C. Certifications

1. Necessary certificates, test reports, and affidavits of compliance shall be obtained by the CONTRACTOR.

1.03 MATERIAL DELIVERY, STORAGE, AND PROTECTION

A. Piping couplings, adapters and joints accessories shall be delivered in a clean and undamaged condition and stored off the ground for protection against oxidation caused by ground contact.

B. Defective or damaged materials shall be replaced with new materials.

PART 2 -- PRODUCTS

2.01 GENERAL

A. Extent of Work

1. Piping couplings, adapters, joints and accessories shall be provided in accordance with the requirements of the applicable Sections of Divisions 33 and 40 and as indicated.

2. The CONTRACTOR shall not be allowed to substitute any other type of coupling in lieu of the couplings as specified herein unless approved by the ENGINEER OF RECORD.

3. The CONTRACTOR shall assign the responsibility to the coupling manufacturer to review the piping connection to the equipment and submit any modifications to the ENGINEER OF RECORD for review.

B. Pressure Rating

1. Couplings, adapters and joints shall be designed for the pressure as defined in respective pipe sections, or as indicated on the Piping Schedule, whichever is greater.

C. Seals

1. Seal elastomer materials shall be selected to be compatible with the fluid service, pressure and temperature. They shall be composed of elastomeric-compound material that will not deteriorate from age under normal storage or use conditions.

2. Where couplings are used in water containing dissolved ozone residual or chloramines, seal material shall be Viton-A.

D. Coating

1. Couplings shall be lined and coated at the factory, unless otherwise indicated.

2. Coating shall be in accordance with the Section 09 96 00 - Protective Coating, unless otherwise indicated.

2.02 GROOVED TYPE COUPLINGS

A. General

1. Provide cast grooved type couplings where indicated, conforming to the requirements of AWWA C606 - Grooved and Shouldered Joints.

2. Grooved or banded piping shall conform to the coupling manufacturer's recommendations to suit the highest expected pressure.

   a. If grooved connections are used, the remaining thickness of pipe material after grooving shall be adequate to carry the load imparted to the joint. Joints for thin wall pipes shall be banded or welded with a collared end to fit coupling.

   b. Rolled pipe ends are not acceptable as a means of connection for metallic piping.

3. Equipment connections with mechanical-type couplings shall be provided with rigid grooved couplings or flexible type coupling with harness in sizes where rigid type couplings are not available, unless thrust restraint is provided by other means.

4. Couplings shall be electrically bonded.

5. For uniformity and compatibility of the piping components; grooving tools, grooved fittings, couplings, and valves shall be furnished by the same manufacturer as the coupling.

B. Grooved Type Couplings Manufacturer, or Equal

1. Grooved couplings for ductile iron piping shall be provided with flush seal gaskets.

   a. **Victaulic Company,** Style 31 (flexible or rigid)

   b. **Gustin-Bacon** (banded or grooved)

2. Grooved couplings for steel piping

    a. **Victaulic Company**, Style 177 / 77 / W77 (grooved, flexible, or rigid)

    b. **Victaulic Company**, Style 107H / 07 / W07 or HP-70 (grooved, rigid)

    c. **Gustin-Bacon** (banded or grooved)

3. Grooved couplings for stainless steel piping

    a. **Victaulic Company**, Style 489 (rigid)

    b. **Victaulic Company**, Style 77S (flexible)

    c. **Gustin-Bacon** (banded or grooved)

2.03 SLEEVE COUPLINGS

A. General

1. Provide sleeve couplings specifically designed suitable for the fluid service and pressure rating.

B. Construction

1. Sleeve couplings shall be in accordance with AWWA C219 - Standard for Bolted Sleeve-Type Couplings for Plain-End Pipe.

2. Couplings shall be constructed without pipe stop.

3. The middle ring shall be at least the same wall thickness as the pipe to which the coupling is connected and not less than 1/4-inch thick.

4. If the strength of the middle ring material is less than the strength of the pipe material, the thickness of the middle ring shall be increased to have the same strength as the pipe.

5. For standard sleeve couplings, the coupling shall be either 5 or 7 inches long for pipe diameters up to and including 30-inch and 10 inches long for pipe diameters greater than 30-inch. For long sleeve couplings, the coupling shall be 16 inches long for all pipe diameters.

6. The followers shall be single-piece contoured mill sections welded and cold-expanded as required for the middle rings and of sufficient strength to accommodate the number of bolts necessary to obtain adequate gasket pressures without excessive rolling.

C. Insulating Sleeve Couplings

1. Where insulating couplings are required, both ends of the coupling shall be provided with a wedge-shaped gasket which assembles over a sleeve of an insulating compound material compatible with the fluid service in order to obtain insulation of coupling metal parts from the pipe.

D. Sleeve-Type Couplings Manufacturer, or Equal

1. **World Wide Metric, Inc.** (Dresser), Style 38

2. **Ford Meter Box Company, Inc.,** Style FC1 or FC3

3. **Smith-Blair, Inc.,** Style 411

2.04 FLANGED COUPLING ADAPTERS

A. Provide flanged coupling adapters specifically designed suitable for the fluid service and pressure rating.

B. Construction

1. Coupling bodies shall be fabricated from steel, ASTM A 512 - Cold-Drawn Butt-Weld Carbon Steel Mechanical Tubing or A 513 - Electric-Resistance Welded Carbon and Alloy Steel Mechanical Tubing.

2. Provide flanges in conformance with AWWA C207.

3. The body shall be at least the same wall thickness as the pipe to which the coupling is connected, but not less than 1/4 inch thick.

4. If the strength of the body material is less than the strength of the pipe material, the thickness of the middle ring shall be increased to have the same strength as the pipe.

5. The follower flange shall be fabricated from steel, ASTM A 576 - Steel Bars, Carbon, Hot Wrought, Special Quality or AISI C1012.

C. Flanged Couplings Adapter Manufacturer, or Equal

1. **Smith-Blair**, Model 913

2. **Dresser**, Model 128-W

3. **JCM**, Model 303

2.05 DISMANTLING JOINTS

A. Provide dismantling joints products specifically designed suitable for the fluid service and pressure rating.

B. Construction

1. Coupling bodies shall be fabricated from steel, ASTM A 512 - Cold-Drawn Butt-Weld Carbon Steel Mechanical Tubing or A 513 - Electric-Resistance Welded Carbon and Alloy Steel Mechanical Tubing.

2. Provide flanges in conformance with AWWA C207.

3. The body shall be at least the same wall thickness as the pipe to which the coupling is connected, but not less than 1/4 inch thick.

4. If the strength of the body material is less than the strength of the pipe material, the thickness of the middle ring shall be increased to have the same strength as the pipe.

5. The follower flange shall be fabricated from steel, ASTM A 576 - Steel Bars, Carbon, Hot Wrought, Special Quality or AISI C1012.

C. Dismantling Joints Manufacturer, or Equal

1. **Smith-Blair**, Model 975

2. **Dresser**, Model 131

3. **JCM**, Model 309

2.06 EXPANSION JOINTS

A. Piping subject to expansion and contraction shall be provided with sufficient means to compensate for such movement without exertion of undue forces to equipment or structures, accomplished with expansion loops, bellow-type expansion joints, or sliding-type expansion joints.

B. Expansion joints shall be provided with flanged ends and constructed of stainless steel, Monel, rubber, or other materials best suited for each individual service. Where expansion joints are used in water containing dissolved ozone residual or chloramines, provide Type 316 stainless steel expansion joints.

C. Where bellows-type expansion joints are mounted near the suction nozzle of the pump, a stainless steel internal liner shall be provided to minimize turbulence as the flow passes through the arches of the bellows.

D. Expansion joints for Plastic Tanks

1. Expansion joints for piping connections to polyethylene tanks nozzles shall be provided by the tank manufacturer, selected for the fluid service, and sized for up to 4% tank expansion or movement as required by the tank manufacturer. Fastener hardware shall be of Type 316 stainless steel construction.

2. Expansion joints for other plastic tanks shall be constructed of molded PTFE with at least two convolutions and flanged joints. Flanges shall be ductile iron with Type 316 stainless steel bolts and nuts. Flexible connectors shall be **Proco Series 442 molded expansion joint, or equal**.

2.07 FLEXIBLE CONNECTORS

A. Low-Temperature

1. Flexible connectors shall be installed in piping connections to engines, blowers, compressors, and other vibrating equipment, and where indicated.

2. Flexible connectors for service temperatures up to 180 degrees F shall be flanged-reinforced neoprene or butyl spools, rated for a working pressure of 40 to 150 psig, or reinforced flanged duck and rubber, as best suited for the application.

3. Flexible connectors for service temperatures above 180 degrees F shall be flanged, braided stainless steel spools with inner, annular, corrugated stainless steel hose, rated for a minimum 150-psig working pressure, unless otherwise recommended by the equipment manufacturer.

4. The connectors shall be a minimum of 9 inches long and provided with face-to-face flanges, unless otherwise indicated.

5. The final material selection shall be approved by the manufacturer.

B. High-Temperature (temperature exceeding 250°F (120°C))

1. Install flexible connectors in engine exhaust piping and where indicated.

2. Connectors shall be sufficient to compensate for thermal expansion and contraction and to isolate vibration between the engine and the exhaust piping system.

3. Connectors shall be stainless steel bellows-type, flanged, and rated for minimum 150 psig, 2000 degrees F.

2.08 TRANSITION COUPLINGS

A. Provide transition-coupling products specifically designed suitable for the fluid service and manufactured for the piping applications.

B. The transition couplings shall have function and design similar to the flexible couplings, joint and flanged coupling adapters for connecting piping having different outside diameters.

2.09 QUICK DISCONNECT COUPLINGS

A. Quick disconnect couplings shall be of the cam lock type (cam and groove type) consisting of a male adapter conforming to Specification MIL A-A-59326A. Male adapters shall be designed to receive a female coupler without requiring threading,

bolting, or tools. Connections shall remain tight and leak proof up to full system pressures.

B. Each adapter shall be furnished with a dust cap complete with an 18-in long security chain of corrosion resistant material.

C. Unless otherwise indicated, the quick disconnect couplings shall be flanged connection to piping and materials shall be Type 316 stainless steel.

D. Quick connect couplings shall be as manufactured by LMC-Couplings; Dover Corporation; Ever-tite; or equal.

2.10 TAPPING SLEEVES

A. Provide tapping sleeve products specifically designed suitable for the fluid service and manufactured for the piping applications

B. Unless otherwise indicated, the tapping sleeves shall be of full circumference band with flanged outlet connection sized to ANSI class 150. Material of construction for the body and fastener shall be stainless steel.

C. Gasket material: Nitrile (Buna-N) or EPDM.

D. Tapping sleeves shall be as manufactured by Smith-Blair; Romac Industries; Dresser or equal.

2.11 MISCELLANOUS ADAPTERS

A. A special pipe adapter may be required to provide proper connection between different type of pipes and/or fittings. The adapter may be indicated on the Drawing with the pipe type or equipment. However, it is the CONTRACTOR'S responsibility to ensure proper connection between various type of pipes and pipe appurtenances. Provide adapters as required whether specifically indicated or not.

B. Provide piping adapter products specifically designed suitable for the fluid service and manufactured for the piping applications.

PART 3 -- EXECUTION

3.01 GENERAL

A. Installation, inspection and field testing of the pipes shall in accordance with the requirements of Section 40 05 00 - Piping, General.

B. The CONTRACTOR shall have the coupling manufacturer's service representative verify the correct choice and application of couplings and gaskets, and the workmanship, to assure a correct installation.

C. The CONTRACTOR shall assign the responsibility to the couplings manufacturer to review the piping connection to the couplings and submit any modifications to the ENGINEER OF RECORD for review.

3.02 INSTALLATION

A. Where couplings are shown to connect piping to mechanical equipment such as pumps, compressors, and blowers, the piping shall be aligned with the equipment point of connection and shall be perpendicular to the axis of the flange or fitting for which the piping is to be connected.

B. The couplings or the piping shall not impose excessive stress to the equipment connection to cause misalignment of the equipment.

C. Restrained Joints on couplings, adapters and joints

1. Couplings, adapters and joints on pressure lines shall be harnessed unless thrust restraint is provided by other means.

2. Harnesses shall be designed by the pipe manufacturer in accordance with AWWA Manual M11, or as indicated.

3. Harness sets shall be designed for the maximum test pressure of the pipe in which they are installed.

4. Where harness sets are installed near the suction and discharge of the pump, harness bolts shall have zero elongation in order to prevent misalignment of the pump imparted by the thrust within the piping system.

5. Other means of restraining the coupling such as set screws on piping will not be accepted.

END OF SECTION

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SECTION 40 05 07

PIPE SUPPORTS

PART 1 -- GENERAL

1.01 THE SUMMARY

A. The CONTRACTOR shall provide pipe supports, hangers, guides, and anchors, complete and in place, as indicated in accordance with the Contract Documents.

B. Where pipe support systems are not indicated on the Drawings, the CONTRACTOR shall design and provide the supports in accordance with this Section. The absence of pipe supports and details on the contract drawings does not relieve the Contractor of responsibility for sizing and providing the pipe supports.

C. The provisions of this Section shall apply to piping in Divisions 33 and 40.

D. The CONTRACTOR shall provide supporting devices for supporting and restraining piping as indicated on the Drawings. Where pipe support devices and/or restraining details are not indicated on the Drawings, it is the CONTRACTOR'S responsibility to develop the details necessary to support and restraint the piping for a complete and functional pipe support system.

E. Seismic and Wind Forces

1. The CONTRACTOR shall arrange for the services of a registered professional engineer experienced in pipe support design to design such pipe supports to resist seismic and wind forces.

1.02 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with the requirements of the Standard Provisions Section 20.

B. Shop Drawings

1. Submit Shop Drawings which shall include the following information:

a. Drawings of pipe supports, hangers, anchors, and guides.

b. Pipe support schedule or layout indicating where the supports will be installed.

c. Calculations for supports and anchors, where indicated to be provided, stamped and signed by a registered professional engineer in the state where the project is located.

PART 2 -- PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Code Compliance

1. Piping systems and pipe connections to equipment shall be properly anchored and supported in order to prevent undue deflection, vibration, and dislocation due to seismic events, line pressures, pipe weight, fluid weight, liquid movement, thermal changes, vibration, and probable forces applied during construction as well as stresses on piping, equipment, and structures.

2. Supports and parts thereof shall conform to the requirements of ASME B31.1 - Power Piping – Chapter II, Part 5 -Expansion, Flexibility, and Pipe Supporting Element and design the pipe supporting elements in accordance with the rules of MSS SP-58 -Pipe Hangers and Supports – Materials, Design and Manufacture, except as supplemented or modified in this Section.

3. Supports for plumbing piping shall be in accordance with the latest edition of the applicable plumbing code or local administration requirements.

B. Structural Members

1. Wherever possible, pipes shall be supported from structural members.

2. Where it is necessary to frame structural members between existing members, such supplementary members shall be provided by the CONTRACTOR.

3. Supplementary members shall be in accordance with the requirements of the Building Code and the American Institute of Steel Construction, and shall be as acceptable to the ENGINEER OF RECORD.

C. Pipe Hangers

1. Pipe hangers shall be capable of supporting the pipe in operation, allowing free expansion and contraction of the piping and preventing excessive stress on equipment.

2. Hangers shall have a means of vertical adjustment after erection.

3. Hangers shall be designed to prevent becoming disengaged by any movement of the supported pipe.

4. Hangers subject to shock, seismic disturbances, or thrust imposed by the actuation of safety valves shall include hydraulic shock suppressors.

5. Hanger rods shall be subjected to vertical loading only.

D. Hangers Subject to Lateral or Axial Movement.

1. At hanger locations where lateral or axial movement is anticipated, suitable linkage shall be provided to permit such movement.

2. Where lateral or axial pipe movement is greater than 1/2 inch, or where the hanger rod deflection from the vertical is greater than 4 degrees from the cold-to-hot position of the pipe, the hanger rod and structural attachment shall be offset in such a manner that the rod is vertical in the hot position.

E. Spring-Type Hangers

1. Spring-type pipe hangers shall be provided for piping subject to vibration or vertical expansion and contraction, such as engine exhausts and similar piping.

2. Spring-type hangers shall be sized per the manufacturer's printed recommendations and for the loading conditions encountered.

3. Variable spring supports shall be provided with means to limit misalignment, buckling, eccentric loading, or to prevent overstressing of the spring, and with means to indicate the compression of the spring.

4. Supports shall be capable of accommodating at least 4 times the maximum travel due to thermal expansion.

F. Riser Supports

1. Where practical, risers shall be supported on each floor with riser clamps and lugs, independent of the connected horizontal piping.

G. Freestanding Piping

1. Freestanding pipe connections to equipment such as chemical feeders and pumps shall be firmly attached to support frames fabricated from angles, channels, or I-beams anchored to the structure.

2. Exterior, freestanding overhead piping shall be supported on fabricated pipe stands consisting of pipe columns anchored to concrete footings, or with horizontal, welded steel angles, and U-bolts or clamps securing the pipes.

H. Materials of Construction

1. Pipe support assemblies, including framing, hardware, and anchors, shall be of steel construction, galvanized after fabrication, unless otherwise indicated.

2. Submerged supports, as well as piping, conduits, and equipment in hydraulic structures located two feet above water level, shall be supported with support assemblies, including framing, hardware, and anchors constructed of Type 316 stainless steel, unless otherwise indicated.

3. Piping in chemical and corrosive service areas shall be supported with support assemblies, including framing, hardware, and anchors constructed of Type 316 stainless steel or FRP, unless otherwise indicated.

4. Corrosive service areas are indicated in section 40 05 00 -1.2 Definitions - Corrosive Service.

I. Point Loads

1. Meters, valves, heavy equipment, and other point loads on PVC, FRP, or other plastic pipes, shall be supported on both sides, according to manufacturer's recommendations, in order to avoid undue pipe stresses and failures.

2. In order to avoid point loads, the supports on PVC, FRP, or other plastic piping shall be equipped with extra wide pipe saddles or galvanized steel shields for general service and Type 316 stainless steel shields for chemical or corrosive areas.

J. Concrete Anchors

1. Unless otherwise indicated, concrete anchors for pipe supports shall be according to the following table; consult the ENGINEER OF RECORD for any anchor applications not appearing on the table.

2. Anchor embedment shall be in accordance with the requirements of Section 05 50 00 – Miscellaneous Metalwork.

Pipe Support Application	Type of Concrete Anchor
New Concrete	Use embedded concrete insert anchors on a grid pattern. Use **Grinnell (Anvil International), Tolco**, or equal.
Existing Concrete	Use non-shrink grouted anchors, expansion anchors, or epoxy anchors. Epoxy anchors are not permitted for vertical hanging applications or where sustained tension is exerted on the anchor. Exceptions: Expansion anchors and epoxy anchors are not permitted for pipe supports subject to vibrating loads. Epoxy anchors are not permitted where the concrete temperature is in excess of 100 degree F or higher than the limiting temperature recommended by the manufacturer.
Vibratory Loads and High-Temperature Conditions	Use non-shrink grouted anchors.

K. Noise Reduction

1. In order to reduce the transmission of noise in piping systems, copper tubes in buildings and structures shall be wrapped with a 2-inch wide strip of rubber fabric or similar suitable material at each pipe support, bracket, clip, or hanger.

2.02 SUPPORT SPACING

A. Supports for piping with the longitudinal axis in approximately a horizontal position shall be spaced to prevent excessive sag, bending, and shear stresses in the piping, with special consideration given where components such as flanges and valves impose concentrated loads.

B. Where pipe spacing are indicated on the Drawings and are referenced to a Standard Detail, that requirement shall take preference over the general requirements of this section.

C. Pipe support spacing shall not exceed the maximum indicated spans. Piping with grooved joint couplings, flexible joints, and bend fittings shall be balanced supported by a minimum of two pipe supports per pipe length, one at near each joint/fitting.

D. For temperatures other than ambient temperatures or those listed, and for other piping materials or wall thicknesses, the pipe support spacings shall be modified in accordance with the pipe manufacturer's recommendations.

E. Vertical supports shall be provided to prevent the pipe from being overstressed from the combination of loading effects.

F. Steel Pipe

1. Where support spacing is not indicated on the Drawings, the CONTRACTOR shall use the spacing below.

2. Support Spacing for standard wall or heavier welded steel, stainless steel or alloy steel pipe.

Nominal Pipe Diameter, Inches	Maximum Span, ft (Water Service)	Maximum Span, ft (Gas or Vacuum Service)
1/2	6	7
3/4 and 1	8	9
1-1/4 to 2	10	12
3	12	14
4	14	15

6	16	18
8 and 10	18	20
12 and 14	20	24
16 and 18	22	26
20 and greater	24	30

G. Ductile Iron Pipe

1. Install supports for ductile iron pipe in accordance with the recommendations of the Ductile Iron Pipe Research Association (DIPRA) Design of Ductile Iron Pipe on Supports.

2. As a minimum, where support spacing is not indicated on the Drawings, the CONTRACTOR shall use the spacing indicated in the following schedule:

Nominal Pipe Diameter, inches	Support Configuration
All diameters	two supports per pipe length, with one of the two supports located at a joint

H. Copper Tube

1. Where support spacing is not indicated on the Drawings, the CONTRACTOR shall use the spacing below:

Nominal Tube Size, inches	Support Spacing, feet	
	Water Service	Vapor Service
¾ and smaller	5	5
1	6	8
1-1/2 to 2-1/2	8	10
3	10	14
4	12	16
5	13	18

6	14	20
8	16	23

I. Schedule 80 PVC and CPVC Pipe

Nominal Pipe Size, inches	100 °F and below	101 to 120 °F	121 to 140 °F
1	5	3.5	3
1-1/2	5.5	3.5	3.5
2	6	4	3.5
3	7	4.5	4
4	7.5	5	4.5
6	9	6	5
8	9.5	6.5	5.5
10 and larger	10	7	6

J. Other Pipe Materials

1. Support spacing for pipe constructed of other materials shall be based on design temperature and in accordance with the pipe manufacturer's recommendations.

2.03 MANUFACTURED SUPPORTS

A. Stock Parts

1. Where not specifically indicated, designs that are generally accepted as exemplifying good engineering practice and using stock or production parts shall be utilized wherever possible.

2. Such parts shall be locally available, new, of best commercial quality, and designed and rated for the intended purpose.

B. Manufacturers, or Equal

1. **Basic PSA, Inc.**

2. **Bergen-Paterson Pipe Supports Group**

3. **Grinnell**

4. **Power Piping Company**

5. **TOLCO (Eaton B-Line)**

2.04 COATING

A. Unless otherwise indicated, fabricated pipe supports other than stainless steel or non-ferrous supports shall be blast-cleaned after fabrication and hot-dip galvanized in accordance with ASTM A 123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products and shall receive protective coatings in accordance with the requirements of Section 099600 – Protective Coating.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. General

1. Pipe supports, hangers, brackets, anchors, guides, and inserts shall be installed in accordance with the manufacturer's printed instructions and per ANSI/MSS SP-58 Pipe Hangers and Supports- Materials, Design, Manufacture, Selection, Application and Installation.

2. Embedded concrete inserts for pipe hangers and supports shall be coordinated with the formwork.

B. Appearance

1. Pipe supports and hangers shall be positioned in order to produce an orderly, neat piping system.

2. Hanger rods shall be vertical, without offsets.

3. Hangers shall be adjusted to line up groups of pipes at the proper slope for drainage and venting, as close to ceilings or roofs as possible, and without interference with other WORK.

3.02 FIELD FABRICATION

A. Quality Control

1. Field fabricated pipe hangers and supports shall be fabricated and installed by experienced welders and fitters, using the best welding procedures available.

2. Hangers and supports shall be neat in appearance without sharp corners, burrs, or edges.

END OF SECTION

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SECTION 40 05 17

COPPER WATER TUBE

PART 1 -- GENERAL

1.01 THE SUMMARY

A. The CONTRACTOR shall provide copper tube and appurtenances complete in place, in accordance with the Contract Documents

B. The requirements of Section 40 05 00 - Piping, General and Section 40 05 07 – Pipe Supports apply to the WORK of this Section.

C. Pipes, pipe fittings, and plumbing fixtures shall have no more than 0.25 percent lead in the wetted surface material.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

ASTM B 88	Seamless Copper Water Tube
ASME B 16.18	Cast Copper Alloy Solder Joint Pressure Fittings
ASME B 16.22	Wrought Copper and Copper Alloy Solder - Joint Pressure Fittings
ASME B 16.26	Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B 16.24C	Cast Copper Alloy Pipe Flanges and Flanged Fittings
ASTM B 62	Composition Bronze or Ounce Metal Castings, with Class 150. rating

1.03 RELATED SECTIONS

A.	Section 01 75 06	Field Testing
B.	Section 40 05 00	Piping, General
C.	Section 40 05 07	Pipe Supports

1.04 SUBMITTALS

A. The CONTRACTOR shall furnish Submittals in accordance with Special Provisions Section 20 and the following supplemental requirements:

B. Shop Drawings

1. Certified dimensional drawings of valves, fittings, and appurtenances.

C. Certifications: Indicate compliance for pipe and other products or materials furnished under this Section and as specified in the referenced standards and the following supplemental requirements:

1. Physical and chemical properties.

D. The CONTRACTOR shall be responsible for performing and paying for sampling and testing as necessary for field testing and acceptance.

PART 2 -- PRODUCTS

2.01 PIPE MATERIAL

A. Copper water tube shall conform to the requirements of ASTM B 88 - Seamless Copper Water Tube, and shall be soft temper tube in rolls for buried locations, or hard drawn lengths for other applications. Unless otherwise indicated, copper water tube shall be of Type K wall thickness.

2.02 JOINTS

A. Copper water tube shall have soldered joints, flared ends and fittings, or compression type joints. Soldered joints shall be made with 95 - 5 percent tin-antimony solder or with silver solder. Buried piping shall have flared or compression type joints. No soft-soldered joints will be allowed on buried piping. No solders containing more than 0.2 percent lead shall be used.

2.03 FITTINGS

A. Soldered Fittings: Soldered fittings shall conform to ASME B 16.18 - Cast Copper Alloy Solder Joint Pressure Fittings, or to ASME B 16.22 - Wrought Copper and Copper Alloy Solder - Joint Pressure Fittings. The soldering flux shall be the manufacturer's approved type for the fitting and solder used.

B. Flared Fittings: Flared fittings shall conform to ASME B 16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes.

C. Compression Fittings: Compression type fittings shall be brass fittings as manufactured by Crawford Company - SWAGELOK, Parker-Hannifin - CPI, or equal.

D. Flanged Fittings: Cast copper alloy flanges and flanged fittings shall be in accordance with ASME B 16.24 - Cast Copper Alloy Pipe Flanges and Flanged Fittings, and ASTM B 62 - Composition Bronze or Ounce Metal Castings, with Class 150. ratings, or as indicated.

PART 3 -- EXECUTION

3.01 GENERAL

A. Installation, inspection and field testing of the pipes shall in accordance with the requirements of Section 40 05 00 - Piping, General.

END OF SECTION

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SECTION 40 05 23

STAINLESS STEEL PIPE

PART 1 -- GENERAL

1.01 THE SUMMARY

A. The CONTRACTOR shall provide stainless steel pipe and appurtenances, complete and in place, in accordance with the Contract Documents.

B. The requirements of Section 40 05 00 - Piping, General and Section 40 05 07 – Pipe Supports apply to the WORK of this Section.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

ASTM A 312 Seamless and Welded Austenitic Stainless Steel Pipe, Type 316L seamless

ASTM A 409 Welded Large Diameter Austenitic Steel Pipe for Corrosive or High-Temperature Service

ASTM A 778 Welded, Unannealed Austenitic Stainless Steel Tubular Products, Type 316L

ASME B 16.5 Pipe Flanges and Flanged Fittings

ASME B 16.9 Factory-Made Wrought Steel Butt-Welding Fittings, Type 316.

ASME B 16.11Forged Fittings, Socket-Welding and Threaded, Type 316.

1.03 RELATED SECTIONS

A. Section 01 75 06 Field Testing

B. Section 40 05 00 Piping, General

1.03 CONTRACTOR SUBMITTALS

A. In addition to the submittals required by Special Provisions Section 20 and Section 40 05 00 – Piping, General, provide proposed post welding cleaning method (including precleaning, descaling, chemicals to be used) or mechanical descaling method and final cleaning/passivation.

B. Provide written certification that the pipe as supplied are in accordance with ASTM A 409 or ASTM 778, If the pipes are provided, Supplemental testing is not required.

PART 2 -- PRODUCTS

2.01 PIPE MATERIAL

A. Unless otherwise indicated, stainless steel pipe shall be in accordance with ASTM A 312 - Seamless and Welded Austenitic Stainless Steel Pipe, Type 316L seamless, of the schedules indicated. Stainless steel pipe 12 inches in diameter and larger shall be in accordance with ASTM A 409 - Welded Large Diameter Austenitic Steel Pipe for Corrosive or High-Temperature Service or ASTM A 778 - Welded, Unannealed Austenitic Stainless Steel Tubular Products, Type 316L, of the schedules indicated, with welded or flanged joints. Piping less than 3 inches in nominal diameter shall have a minimum wall thickness not less than the Schedule 40S.

2.02 PIPE JOINTS

A. Stainless steel pipe for sizes 2-1/2 inches and smaller shall have threaded ends with NPT threads made up with Teflon tape. Stainless steel pipe 3 inches and larger and where indicated shall have welded joints with socket-welding fittings, butt-welding fittings, or socket welding flanges. Stainless steel flanges shall have stainless steel bolts and nuts. Where indicated, stainless steel pipe shall have grooved ends for shouldered couplings, except that no pipe with less than Schedule 40 wall thickness shall be grooved. Where indicated, stainless steel pipe shall have plain ends for sleeve-type couplings.

B. Threaded joints (all sizes) are not allowed for the following fluid services: sodium hydroxide, sulfuric acid, oxygen and other fluid services indicated in pipe schedule.

2.03 FITTINGS

A. Threaded Fittings: Forged stainless steel fittings conforming to ASME B 16.11 - Forged Fittings, Socket-Welding and Threaded, Type 316.

B. Socket-Welding Fittings: Forged stainless steel fittings conforming to ASME B 16.11, Type 316.

C. Butt-Welding Fittings: Wrought stainless steel butt-welding fittings conforming to ASTM A 403 - Wrought Austenitic Stainless Steel Piping Fittings, and ASME B 16.9 - Factory-Made Wrought Steel Butt-Welding Fittings, Type 316.

D. Grooved Fittings: Wrought stainless steel grooved fittings conforming to ASTM A 403 and ASME B 16.9, with grooving conforming to AWWA C606 - Grooved and Shouldered Joints, Type 316.

E. Flanged Fittings: Type 316 stainless steel flanged fittings and flanges conforming to ASME B 16.5 - Pipe Flanges and Flanged Fittings.

F. Pressure Class: Unless otherwise indicated, fittings shall be in accordance with the pressure classes called for in the Piping Schedule. Where not indicated, the fittings shall have the same pressure rating as the pipe.

2.04 CLEANING

A. Stainless steel pipe and fittings shall be pickled at the point of manufacture, scrubbed and washed until all discoloration is removed in accordance with ASTM A 380 – Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems or A 967 - Standard Specification for Chemical Passivation Treatments for Stainless Steel Parts.

PART 3 -- EXECUTION

3.01 GENERAL

A. Installation, inspection and field testing of the pipes shall in accordance with the requirements of Section 40 05 00 - Piping, General.

END OF SECTION

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SECTION 40 05 24

STEEL PIPE

PART 1 -- GENERAL

1.01 THE SUMMARY

A. The CONTRACTOR shall provide steel pipe and appurtenances, complete and in place, in accordance with the Contract Documents.

B. The requirements of Section 40 05 00 - Piping, General and 40 05 07 – Pipe Supports apply to the WORK of this Section.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

ASTM A 53	Type E or S- Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 106	Seamless Carbon Steel Pipe for High Temperature Service, Grade B ASTM B 62 Composition Bronze or Ounce Metal Castings, with Class 150.
ASME B 16.3	Malleable-Iron Threaded Fittings, Classes 150 and 300.
ASME B 16.4	Cast Iron Threaded Fittings, Class 125 and 250
ASME B 16.5	Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and Other Special Alloys
ASME B 16.11	Forged Fittings, Socket - Welding and Threaded.
ASME B 16.9	Factory-Made Wrought Steel Butt Welding Fittings, Schedule 40 or 80, as indicated.
ASME B 16.11	Forged Fittings, Socket - Welding and Threaded.
ASME 16.12	Cast Iron Threaded Drainage Fittings.

1.03 RELATED SECTIONS

A.	Section 01 75 06	Field Testing
B.	Section 09 96 00	Protective Coatings
C.	Section 40 05 00	Piping, General
D.	Section 40 05 07	Pipe Supports

1.04 CONTRACTOR SUBMITTALS

A. Furnish Submittals in accordance with Special Provisions Section 20 and the following supplemental requirements:

B. Shop Drawings

1. Certified dimensional drawings of valves, fittings, and appurtenances.

C. Certifications: Indicate compliance for pipe and other products or materials furnished under this Section and as specified in the referenced standards and the following supplemental requirements:

1. Physical and chemical properties.

2. Hydrostatic test reports.

D. The CONTRACTOR shall be responsible for performing and paying for sampling and testing as necessary for the certifications and any field testing.

PART 2 -- PRODUCTS

2.01 PIPE MATERIAL

A. Water, Air, Fuel Gas, Oil, Steam, and Waste Service: Unless otherwise indicated, galvanized and black steel pipe shall conform to ASTM A 53 Type E or S- Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless or ASTM A 106 - Seamless Carbon Steel Pipe for High Temperature Service, Grade B, and shall be Schedule 40 or 80, as indicated in the Piping Schedule. Galvanized steel pipe shall not be cement mortar lined unless so indicated.

2.02 PIPE JOINTS

A. Black steel pipe for general service shall have threaded ends with NPT threads, welded joints, or flanged joints. Threaded joints shall be made up with Teflon tape and welded joints may have butt-weld fittings, socket-weld fittings, or flanges. Where indicated, black steel pipe shall have grooved ends for shouldered couplings or plain ends for sleeve-type couplings.

B. Galvanized steel pipe shall have threaded ends with NPT threads made up with Teflon tape. Where indicated, galvanized steel pipe shall have grooved ends for shouldered couplings or plain ends for sleeve-type couplings.

C. Where pressure conditions permit, black and galvanized steel pipe may have push-on joints for compression type fittings. For high pressure service these joints shall be harnessed.

2.03 FITTINGS

A. Common Use: The following fittings shall be provided for galvanized or black steel pipe, as indicated in the Piping Schedule:

1. Threaded malleable iron fittings conforming to ASME B 16.3 - Malleable-Iron Threaded Fittings, Classes 150 and 300.

2. Threaded cast iron fittings conforming to ASME B 16.4 - Cast Iron Threaded Fittings, Class 125 and 250.

3. Forged steel socket welded fittings conforming to ASME B 16.11 - Forged Fittings, Socket - Welding and Threaded.

4. Butt welding fittings conforming to ASME B 16.9 - Factory-Made Wrought Steel Butt Welding Fittings, Schedule 40 or 80, as indicated.

5. Threaded cast iron drainage fittings conforming to ASME 16.12 - Cast Iron Threaded Drainage Fittings.

6. Flanged steel fittings conforming to ASME B 16.5 - Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and Other Special Alloys.

7. Grooved ductile iron fittings with grooving dimensions conforming to AWWA C606 - Joints, Grooved and Shouldered Type.

8. Compression-type steel fittings with armored Buna S gaskets for plain end pipe.

B. Special Applications

1. Blind unions shall be provided as cleanouts where indicated, and straight unions shall be provided adjacent to each threaded valve or piece of equipment. Unions shall be as manufactured by **Henry Valve Company, Vogt Valve Co.,** or equal. High tensile alloy steel corrosion-resistant bolts and nuts shall be used with each set of flanged unions.

PART 3 -- EXECUTION

3.01 GENERAL

A. Installation, inspection and field testing of the pipes shall in accordance with the requirements of Section 40 05 00 - Piping, General.

END OF SECTION

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SECTION 40 05 30

PVC PRESSURE PIPE

PART 1 -- GENERAL

1.01 THE SUMMARY

A. The CONTRACTOR shall provide polyvinyl chloride (PVC) pressure pipe and appurtenances, complete and in place, in accordance with the Contract Documents.

B. The requirements of Section 40 05 00 - Piping, General and Section 40 05 07 – Pipe Supports apply to the WORK of this Section.

C. This Section includes PVC pressure pipe with solvent-welded, flanged, or threaded joints. PVC pipe with bell and spigot joints is included in Section 33 95 50 - PVC Pressure Pipe, Rubber Joints.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

ASTM D 1785	Poly (Vinyl Chloride) (PVC) Plastic Pipe
ASTM D 2467	Socket-Type Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2467	Socket-Type Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM F 1498	Taper Pipe Threads 60 Degrees for Thermoplastic Pipe and Fittings
ASME B 16.5	Pipe Flanges and Flanged Fittings, Class 150

1.03 RELATED SECTIONS

A.	Section 01 75 06	Field Testing
B.	Section 33 95 50	PVC Pressure Pipe, Rubber Joints
C.	Section 40 05 00	Piping, General
D.	Section 40 05 07	Pipe Supports

1.04 CONTRACTOR SUBMITTALS

A. Furnish Submittals in accordance with Special Provisions Section 20 and the following supplemental requirements:

B. Shop Drawings

1. Certified dimensional drawings of valves, fittings, and appurtenances.

C. Certifications: Indicate materials comply with requirements in this Section and as specified in the referenced standards and the following supplemental requirements:

1. Physical and chemical properties.

2. Hydrostatic test reports.

D. The CONTRACTOR shall be responsible for performing and paying for sampling and testing as necessary for the certifications and for any required field testing.

PART 2 -- PRODUCTS

2.01 PIPE MATERIAL

A. PVC pipe shall be made from new rigid unplasticized polyvinyl chloride and shall be normal impact Type 1, Grade 1, class 12454, Schedule 40 or 80, listed as compliant with NSF Standard 61, unless otherwise indicated, in accordance with ASTM D 1785 –Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.

2.02 PIPE JOINTS

A. Pipe joints shall be solvent-welded type with solvent cement and primer as recommended by the pipe manufacturer for the fluid in the pipe.

B. Threaded joints that are necessary to match up to threaded valves or fittings shall be made up with appropriate thread sealant, either paste or tape. Pipe threads shall conform to ASTM F 1498 - Taper Pipe Threads 60 Degrees for Thermoplastic Pipe and Fittings, and shall be full and cleanly cut with sharp dies or molded.

C. Flanged joints shall be made with solvent-welded PVC flanges, drilled to ASME B 16.5 - Pipe Flanges and Flanged Fittings, Class 150, unless otherwise indicated.

2.03 FITTINGS

A. Solvent Welded and Threaded Fittings: Solvent-welded and threaded fittings shall be Schedule 40 or 80 PVC fittings to match the pipe and in accordance with ASTM D 2466 or ASTM D 2467.

B. Flanged Fittings: Flanged fittings shall be Schedule 80 fabricated PVC fittings with Class 150 flanges in accordance with ASME B 16.5 - Pipe Flanges and Flanged Fittings, Class 150.

2.04 SOLVENT CEMENT

A. Solvent cement shall be in accordance with ASTM D 2564 and certified by the manufacturer for the service of the pipe.

B. Potable Water Applications: Solvent cement listed by NSF for potable water applications.

C. Manufacturer: IPS Corporation, or equal.

PART 3 -- EXECUTION

3.01 GENERAL

A. Installation, inspection and field testing of the pipes shall in accordance with the requirements of Section 40 05 00 - Piping, General.

END OF SECTION

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SECTION 40 05 31

CPVC PRESSURE PIPE

PART 1 -- GENERAL

1.01 THE SUMMARY

A. The CONTRACTOR shall provide chlorinated polyvinyl chloride (CPVC) pressure pipe and appurtenances, complete and in place, in accordance with the Contract Documents.

B. The requirements of Section 40 05 00 - Piping, General, and Section 40 05 07 - Pipe Supports apply to the WORK of this Section.

C. Submittals shall be in accordance with Section 20 of Special Provisions.

PART 2 -- PRODUCTS

2.01 PIPE MATERIAL

A. CPVC pipe shall be in accordance with ASTM F 441 - Chlorinated Poly (Vinyl Chloride) (CPVC), Plastic Pipe, Schedules 40, and 80, from all new compounds, meeting the requirements of Class 23447 per ASTM D 1784 - Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (PVC) Compounds. CPVC pipe shall be Schedule 80 pipe unless otherwise indicated. CPVC material shall be listed as compliant with NSF Standard 61.

2.02 PIPE JOINTS

A. Pipe joints shall be solvent-welded with solvent cement in accordance with ASTM F 493 - Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings, and with primer compatible with the solvent cement.

B. Threaded joints which are necessary to match up to threaded valves or fittings shall be made up with appropriate thread sealant, either paste or tape.

C. Flanged joints shall be made with solvent-welded CPVC flanges, drilled to ASME B 16.5 - Pipe Flanges and Flanged Fittings, Class 150, unless otherwise indicated.

2.03 FITTINGS

A. Solvent-Welded Fittings: Solvent-welded fittings shall be Schedule 80 CPVC fittings in accordance with ASTM F 439 - Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80. For chemical service applications, solvent cement shall be formulated and labeled for use on that chemical.

B. Threaded Fittings: Threaded fittings shall be Schedule 80 CPVC fittings in accordance with ASTM F 437 - Threaded Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.

C. Flanged Fittings: Flanged fittings shall be Schedule 80 fabricated CPVC fittings with Class 150 flanges to ASME B 16.5 – Pipe Flanges and Flanged Fittings, Class 150.

2.04 SOLVENT CEMENT

A. Solvent cement shall be in accordance with ASTM F 493.

B. Chemical service applications: Primer: IPS Type P-70 IPS, Cement: IPS Type 724 and certified by the manufacturer for the chemical services.

C. Manufacturer: IPS Corporation or equal.

PART 3 -- EXECUTION

3.01 GENERAL

A. Installation, inspection and field testing of the pipes shall in accordance with the requirements of Section 40 05 00 - Piping, General.

END OF SECTION

SECTION 40 90 10

CONTROL STRATEGIES

PART 1 -- GENERAL

1.01 SUMMARY

A. Section Includes:

1. Contractor-developed loop description submittal requirements.

2. General programming requirements.

3. Common control functions:

a. General control and monitoring functions to be provided throughout the PCIS system.

1) These requirements apply to all systems, and they supplement the specific loop descriptions in Section 40 90 10 and information indicated on the Drawings.

B. Related Sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.

3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.

a. Section 40 91 00 - Process Control and Instrumentation Systems.

1.02 REFERENCES

A. As specified in Section 40 91 00.

1.03 DEFINITIONS

A. As specified in Section 40 91 00.

B. Hardwired control: Control circuitry that does not utilize software to initiate functionality

C. Hardwired interlocks: A safety or protective feature that will interrupt operation of the equipment in all operating modes with no required operator intervention.

Software interlocks: A protective feature that will interrupt operation of the equipment when the PLC has control

D. Slew rate: Rate of change in respect to time.

E. Clamp: Imposed upper and lower limits on setpoints to eliminate entries outside the allowable control parameters.

1.04 SUBMITTALS

A. As specified in Section 40 91 00.

1.05 WARRANTY

A. As specified in Section 40 91 00.

PART 2 -- GENERAL REQUIREMENTS

2.01 GENERAL PROGRAMMING REQUIRMENTS

A. As specified in Section 40 91 00.

B. General programming requirements:

1. Use variable names or aliases derived from tag and loop identification on the P&IDs for all process values.

2. Store all adjustable parameters in the PLC and configure so that an operator with sufficient security access can change the parameters from the HMI or OIT. Update and display the current value at all locations, regardless of where the last change was made.

3. Digital bus networks shall not traverse the SCADA/PLC network. Digital bus network traffic shall be via the Maintenance Network.

4. Calculated values:

   a. Program calculations such that division-by-zero errors cannot occur.

   b. Prevent calculations from generating values that exceed the limits of the equipment or data type structures (integers) internal to the PLC.

   c. Configure counting functions (start counts and operation counts) to allow a minimum of 10,000 counts, and to roll-over to zero at an even decimal interval (1 followed by 4 or more zeros).

   d. Configure integrating functions to accumulate the maximum rate from the instrument for 1 year. Ensure that each incremental addition can be added while maintaining 2 significant digits of the incremental value at all times up to the reset value or 11 percent above the alarm value. Configure the integrated value to roll over to zero at an even decimal interval greater than 1 year’s accumulation

at full rate, or generate a reset alarm when the accumulated value reaches 90 percent of the maximum value that will allow accurate accumulation.

5. Timers:

   a. Provide programmable setting and proving timers in all control sequences for starting and stopping of equipment to allow the process to stabilize before proceeding with any additional control functions.

   b. Embed the timers in the PLC logic, tune in the field, and list separately as part of the software submittal and O&M manual.

6. PCM status:

   a. Furnish a minimum of 1 screen that depicts the status of all enclosures containing PLCs or I/O in the control system, including but not limited to the following:

      1) Intrusion status on all enclosures equipped with intrusion switches.

      2) AC power failure:

         a) Monitor ahead of UPS.

      3) DC power supply failure:

         a) For redundant power supplies, alarm when either power supply fails.

      4) UPS failure signal.

7. PLC system communication status:

   a. Furnish a minimum of 1 screen to display all communication errors and status within the PCIS:

      1) Communication between SCADA and PLCs, PLC to PLC, PLC to RIO.

      2) Display status of each node, and summary of failures over the past 60 minutes.

   b. Generate a communications alarm if any communication fault is detected or there is no response from a node for more than a user specified time.

   c. In the event of communications loss:

      1) Continue normal operation at each PLC.

      2) Where control parameters are received over a communications link:

         a) If a link fails where process elements use the remote value for closed-loop control, hold operating status, speed and position, of the process

elements at their last state before the communication alarm, unless other I/O local to that PLC indicates shutdown or over-ride conditions:

(1) Ensure that the operator can control the process using PCIS HAND mode at the local HMI.

b) If a link fails where process elements use the remote value to determine setpoints, settings or control levels, continue to operate using the last value received:

(1) Provide a manual over-ride entry at the local HMI to allow an operator to enter a different value for any such remote signal.

(2) Generate an alarm whenever an over-ride value is in use.

C. Common control functions:

1. Incorporate common control functions into all control loops and devices and into the control programming, whether or not specifically shown in the specific control descriptions or elsewhere in the Contract Documents.

2. Alarms:

a. Generate alarms within the PLC logic.

b. Indicate alarms at the HMI and OIT. Enable acknowledgement from either the OIT or the HMI.

c. Generate high, high-high, low, and low-low level alarms where indicated:

1) Provide an alarm reset deadband for each analog value to prevent excessive repeated alarms.

2) Provide logic and timers to inhibit analog alarms based on process events. For example, inhibit low flow alarms when a pump is stopped, or has not been running long enough to establish flow.

d. Flash all alarm and fail conditions and their respective indicators on the PCIS graphic screens and local indicating lights until the condition is acknowledged by the operator, even if the alarm condition is no longer present.

e. Once the alarm is acknowledged by an operator, display alarm conditions in a steady state (not flashing) while the alarm condition is still present:

1) Flash with a cycle rate of 1/2 second on and 1/2 second off.

f. Once the alarm has been cleared and the operator has acknowledged the alarm or fail condition, turn the graphic alarm indicator off.

g. For all alarms that do not have inherent timers, provide an operator- adjustable proving timer to limit nuisance alarms, continuously adjustable from zero seconds to 100 minutes. The initial setting of proving timers shall be zero seconds:

1) The PLC shall start the timer when it first detects an alarm condition and shall only activate the alarm after the timer has expired.

2) If the alarm condition clears while the timer is running, the timer shall reset, and the alarm shall not be activated.

h. Use interlocks and proving timers to prevent alarms from operating due to power loss, except for loss of power alarms.

i. Furnish an alarm silence pushbutton at each PCM, HMI, or LCP with an audible alarm to signal the PLC to turn off the audible alarm until the next alarm occurs.

j. Lamp test: Furnish lamp test pushbuttons at each control panel with more than 10 pilot lights, that illuminates all pilot lights on the panel:

1) The lamp test may sequence through blocks of lights.

2) Minimum on time for each lamp during lamp test 15 seconds.

k. All tags that are alarmed shall have associated Alarm Area field in the database populated. This Alarm Area field shall be used in conjunction with SCADA software navigation screen buttons to open a screen relevant to the alarm.

l. When a new alarm is activated the associate Navigation buttons will initially flash red on a new alarm. If the tag is still in alarm, then the button will remain red. Once a new alarm happens again, the Navigation buttons will flash red again.

m. On the Main Menu of the RMP Overview screen the associated boxes around the main sub group will flash red on a new alarm, and remain red if the tag is still in alarm. Once a new alarm comes in, the box will flash red again.

n. Configure new Critical Alarms to activate all critical beacons in the same manner as existing RIP critical alarms. Critical Alarms shall function the same way on the PLC and HMI as current RIP Critical Alarms.

o. Critical Alarms shall activate the Critical Pager System. INSTRUMENTATION SUPPLIER shall integrate all new Critical Alarm tags into the Critical Paging System.

3. Where a reset is shown for counts, totals and times maintained in the PLC:

a. Provide a reset selection on the OIT screen that displays the value.

b. Provide a preset function on the OIT to allow an operator-entered value to become the current accumulated total.

c. Limit access to the reset and preset functions to operators with suitable security level.

d. Log the value before reset, operator, time, and date of reset in the SCADA archive.

e. Log the value before preset, preset value, operator, time, and date of preset in the SCADA archive.

4. Where start counts are indicated on the Drawings, or required in this Section, count starts for each piece of equipment (off to on transitions of running status) in the PLC:

   a. Display total starts on PCIS screens, and provide a reset function.

   b. Where indicated, calculate number of starts for each day:

      1) Display current day and previous day starts on PCIS displays.

      2) Do not reset daily start count when overall count is reset.

      3) Archive starts for each day through SCADA.

5. Where run time accumulation is indicated on the Drawings, or required in this Section, integrate accumulated run time to the nearest 0.1 hour whenever the running status input indicates that the equipment is running:

   a. Display total run time in hours on PCIS screens.

   b. Where indicated, calculate total run time for each day:

      1) Display current day and previous day run time on the OIT to the nearest 0.1 hour.

      2) Do not reset daily run time when overall time is reset.

      3) Archive run time for each day through SCADA.

6. For all monitored analog values:

   a. Convert all values to engineering units within the PLC.

   b. Maintain trends in SCADA.

   c. Totalized forward and reverse flows shall be transmitted from the flow meter where indicated on the drawings or required in this section.

      1) Display totals on the OIT and HMI.

      2) Archive totals to the historical database through SCADA.

   d. Generate an alarm whenever an over-ride value is in use.

7. Analog data processing:

    a. Engineering units conversion:

        1) Use engineering units for all analog point values.

        2) Convert analog inputs to engineering units.

    b. Analog magnitude checking:

        1) Provide upper and lower limits to prevent operator-entered values (setpoints, etc.) from falling outside acceptable limits.

    c. Analog value quality:

        1) Monitor analog values received at each PLC from analog inputs or communications from another PLC or RIO, and generate alarms for the following conditions:

            a) Rate of change in excess of acceptable limit:

                (1) Provide a separate rate limit for each value.

            b) Stale value:

                (1) For analog signals that come from analog inputs or calculations using analog inputs, which are expected to have some variation each time the input is read, alarm when there is no change in the value for 10 times the normal expected scan or communication update.

8. Analog device Maintenance Mode (HMI and OIT):

    a. Provide the following functions from the OIT and the local HMI for each and every analog input:

        1) An over-ride value (Maintenance Mode) to be used in place of the analog input:

            a) Enter in engineering units:

                (1) Display the calibrated range in engineering units.

                (2) Only allow entries within the calibrated range of the instrument.

            b) When the Maintenance mode is enabled, the process analog input ignored and the over-ride value matches the process analog input value when the input is initially disabled.

            c) Maintain over-ride status and value in the PLC.

d) Only allow access to over-ride selections and settings to operators with sufficient security.

2) An enable/disable selection:

a) When Maintenance mode is enabled, the process analog value is over-ridden by a value entered by the Operator that is initially set to the last process analog value.

b) When Maintenance mode is disabled, the over-ride value is ignored and the process analog value is used.

c) Generate an alarm whenever an analog input is over-ridden.

3) Use the over-ride value for all display and control functions instead of the actual analog input value.

b. Provide the following functions in the PLC, with selections and value entry from the OIT and/or HMI:

1) An over-ride value to be used in place of the normal output value:

a) When the analog output is enabled, initially track the analog input so that the over-ride matches the analog output value when the output is initially disabled.

2) An enable/disable selection:

a) When enabled, the value sent to the output is the value determined by the PLC based on the control logic or operator- entered value in PCIS HAND.

b) When disabled, the calculated PCIS HAND values are ignored, and the over-ride value is sent to the output.

c) Generate an alarm whenever an analog output is disabled.

9. Tank and vessel levels:

a. Display all tank and vessel levels as both a level (typically in feet) and a volume (typically in gallons):

1) Some individual displays may be only level or volume, when agreed to by the OWNER and ENGINEER OF RECORD during screen meetings.

b. Monitor rate of change of volume on all tanks and vessels:

1) Establish the maximum withdraw rate at which the volume should decrease (all pumps or feeders operating at maximum output). Generate an alarm whenever the volume decreases faster than this rate.

2) Establish the minimum fill rate at which the volume should increase when filling. Generate an alarm whenever the volume increases faster than this rate. Verify tank and vessel level is fluctuating to verify the validity of the IO register. If it is determined the register is not active or failed in a manner that leaves a stagnant value generate an alarm.

10. I/O filtering and processing:

    a. Analog input filtering:

        1) For each analog input provide an adjustable first order filter, for the purpose of smoothing out spikes and other noise for analog transmitter input signals. By default, configure analog inputs with no filtering affect.

        2) Monitor analog input signal quality:

            a) Over range: The input value is above the normal range (typically over 21 mA).

            b) Under range: The input value is below the normal range (typically under 3 mA, indicating a probable broken connection).

            c) Generate alarms for over or under range inputs.

            d) Do not use over or under range values for control or calculation purposes:

                (1) Where a second instrument is provided to monitor the same condition (a redundant instrument, or additional instruments furnished for averaging or different operating modes), and has a valid signal, use that input for control.

                (2) Otherwise, hold all outputs affected by the signal at their last values before the signal went out of range.

        3) Digital input filtering (proving timer):

            a) Provide an adjustable time delay function (0-10 seconds) on discrete input for the purpose of de-bouncing.

            b) By default, discrete inputs shall be configured with de-bounce timers set to zero seconds.

11. Instrument scaling (OIT/HMI):

    a. Provide 1 or more maintenance screens to display ranges and trigger points for all field instruments:

        1) For analog instruments, use input scaling values in the PLC to determine minimum and maximum calibration points.

2) For discrete instruments, display calibrated pick-up and drop-out values.

12. Setpoint Entry and Recipe Files

    a. As part of setpoint entry, provide means to capture and store setpoints within appropriately named recipe files. Recipes shall be retrievable and downloadable as a means to capture current plant configurations in preparation for short term plant outages and plant operational reconfiguration (e.g., summer vs. winter operation, source water changes, etc.). Coordinate with the District operations and SCADA engineering personnel prior to programming to establish which setpoints are to be included in the setpoint recipe files.

13. PCIS LOCAL-REMOTE:

    a. Where indicated, provide AUTO-MANUAL and START-STOP selections in the PCIS, accessed from an HMI or OIT for operators with sufficient security, to provide the following operating modes:

        1) PCIS REMOTE AUTO: The normal, automatic control mode of the strategy which allows full PLC control in response to process conditions and programmed sequences.

        2) PCIS REMOTE MANUAL: Enables PCIS Manual control where control decisions are made by an operator through the PCIS START-STOP, OPEN/CLOSE, or other selections as indicated.

        3) Program the PLC so that switching a strategy between AUTO and MANUAL (either direction) occurs with a smooth transition. Keep running or position status unchanged when control is switched to MANUAL until a change is requested using the operator selections (START, STOP, OPEN, CLOSE). Keep running and position status unchanged when control is switched to AUTO until the control logic determines a change is required.

14. Display the current status of all operator selections (PCIS MANUAL/AUTO, PCIS START/STOP, etc.) on HMI and OIT.

15. Permissives:

    a. Implement software permissives where indicated to place equipment in a safe condition in response to impending hazardous process conditions. Apply software permissives when equipment is operating in PCIS AUTO or PCIS MANUAL:

        1) Where indicated, provide a selection to bypass software permissives for maintenance functions. This option shall only be selectable in PCIS Manual.

    b. Use hard-wired permissives for equipment protection where indicated.

16. Process control algorithms:

    a. Jog and hold: Unless otherwise indicated, use jog and hold control algorithms where possible:

        1) When the error between process variable and setpoint is beyond a setpoint deadband:

            a) Jog valve or ramp speed in the required direction for a preset “Jog Time” or until the process variable reaches or passes the setpoint.

            b) Then hold speed or position through a setpoint “Hold Time.”

            c) Continue alternating jog and hold until the error is less than the deadband.

        2) Provide operator access to Jog Time and Hold Time setpoints from the OIT.

    b. PID algorithms: Use where indicated, or where necessary to provide fast response:

        1) Provide a PID faceplate with the following displays and functions for each PID control algorithm:

            a) Display Output, CV.

            b) Display Setpoint, SP.

            c) Display Process Variable, PV.

            d) Allow for operator selection of Automatic or Manual control of the output.

            e) Under Manual control of output allow the operator to enter the desired output value.

            f) Allow for input of the three Proportional, Integral and Derivative tuning parameters.

            g) Configure PID loops to prevent reset windup when controlled equipment is operating in Manual (local or PCIS), or when the equipment has reached a physical limit.

            h) When controlled equipment is being operated in remote PCIS MANUAL, configure the PID function to track the process variable to provide a smooth transfer between Manual and Automatic modes.

            i) Provide selectable slew rates with adjustable setpoints to allow the PID algorithm to slowly ramp to its final value to minimize system disturbance.

17. Equipment alternating and sequencing:

    a. Distribute number of starts and run time equally between identical equipment.

18. Motor control:

    a. Monitor the device's LOCAL-OFF-REMOTE (LOR) switch (the hard-wired switch at the MCC, drive or equipment) to determine when the PLC has control of the associated equipment:

    b. Display current REMOTE status on the PCIS screens.

    c. Monitor the device's running status from the starter auxiliary or run status input:

    d. Display the current status (running or stopped) on the PCIS screens.

        1) Use status to calculate total run time and daily run time, and to count total starts and daily starts.

        2) Provide time stamp for each start.

        3) For motors 125 HP and greater, provide software to prevent exceeding the manufacturer's recommended maximum starts per hour.

    e. When equipment control has been given to the PLC as reported by the LOCAL-OFF-REMOTE switch, allow selection of PCIS AUTO or PCIS HAND control modes based upon operator selection using the PCIS screens.

    f. Starting, stopping and running when the device LOR is in LOCAL:

        1) With the LOR switch in the LOCAL position, the motor is controlled by the START and STOP pushbuttons.

        2) With the LOR switch in the OFF position, the motor is prohibited from running.

        3) With the LOR switch in the REMOTE position, the motor is controlled remotely.

    g. Starting, stopping and running when the device LOR is in REMOTE:

        1) When the motor is expected to be running (PLC has issued a START or RUN due to process conditions or operator selection), LOR is in REMOTE, and the device is not reported to be running, start an operator adjustable "Control Activation" timer:

            a) Provide "Control Activation" timers for each piece of controlled equipment:

(1) If the LOR and required running status do not change, and the PLC does not receive running status within the “Control Activation” time period:

(a) De-activate the output.

(b) Place the device in a “Failed” state.

(c) Generate a “Failed to Respond” alarm.

2) When the motor is not expected to be running (PLC has issued a STOP or removed the RUN output), LOR is in REMOTE, and the device is reported to be running, start the “Control Activation” timer:

a) If the LOR and required stopped status do not change, and the PLC does not lose the running status within the “Control Activation” time period:

(1) Keep the RUN output off or the STOP output on.

(2) Place the device in a “Failed” state.

(3) Generate a “Failed to Respond” alarm.

3) Re-establish PLC control of a device in a “Failed” state only after an operator turns the device’s LOR switch out of REMOTE, and back to REMOTE (i.e., REMOTE input to the PLC cycles off and back on).

4) When the motor is in remote, software controls shall be provided to prevent over starts of the motor.

h. Where motor winding high temperature switches or RTD temperature elements are shown, generate an alarm when high temperature is sensed (contact opens or temperature above the high alarm setpoint), the motor is stopped by the control system.

i. Control two-speed motors similar to other motors, except as listed below:

1) Motor states are RUN-FAST, RUN-SLOW, and STOP.

2) Start all two-speed motors in the RUN-SLOW state. If or when the high speed is required (RUN-FAST operator selection or process conditions), transition to RUN-FAST after a designated time.

3) When transitioning from RUN-FAST to RUN-SLOW, remove the RUN-FAST output or issue a STOP, then wait for a “Fast to Slow” time delay before energizing the RUN-SLOW or START-SLOW output.

j. Simultaneous starts:

1) Prevent more than one motor-driven load 25 HP or larger in the same facility from starting concurrently:

a) When starting one load, inhibit start logic for all other such equipment until the load being started is up to speed (RVSS or VFD), or after a setpoint time delay (full-voltage starters and miscellaneous equipment).

2) Use the same logic to prevent multiple large devices from starting concurrently on restoration of power after a power outage, whether operating on generator or utility power.

k. Speed control:

1) Modulate speed on VFD-driven motors using jog and hold, or PID control algorithms to maintain process conditions as described in the specific loop descriptions.

2) Operate speed control within a pre-defined range:

a) Minimum speed as determined by equipment manufacturer. The higher of:

(1) Minimum motor speed to maintain adequate cooling for the type of load driven (constant or variable torque).

(2) Minimum equipment speed, such as minimum speed to deliver flow or to deliver minimum flow for equipment cooling or lubrication.

b) Maximum speed 100 percent (60 Hz) or as identified by equipment manufacturer.

3) Where multiple equipment may operate together to maintain the same process condition:

a) Provide an operator selection for starting sequence.

b) Start the first equipment at a preset starting speed.

c) When one or more equipment is running and the speed control algorithm reaches a preset “Start Next” speed value (initially 95 percent of speed range) through a preset time delay:

(1) Start the next available equipment at the preset starting speed.

(2) Ramp speed of previously running equipment down to a preset value based on the number of items running. Determine preset values for each condition based on equipment and system characteristics to provide approximately the same total flow or process condition with the new load running at the starting speed.

(3) Once the previously-running equipment reaches the preset speed, resume the speed control algorithm for those equipment items.

(4) Ramp the speed of the equipment that had just started until it reaches the speed of the previously-running equipment.

(5) Operate all equipment at the same speed following the output of the speed control algorithm.

d) When two or more pieces of equipment are running, monitor for a “Stop Next” condition:

(1) Where flow rate is monitored, use a preset “Stop Next” flow rate for each possible number and combination of equipment:

(a) Determine initial “Stop Next” speed based on the flow that can be provided with one fewer piece of equipment running at a speed slightly below the “Start Next” speed.

(2) When the “Stop Next” condition exists through a preset time delay:

(a) Ramp speed of running equipment except for the equipment to be stopped up to a preset value based on the number of items running. Determine preset values for each condition based on equipment and system characteristics to provide approximately the same total flow or process condition with one fewer load running (typically slightly below the preset “Start Next” speed) while ramping speed of equipment to be stopped down to the preset minimum speed.

(b) Stop the load once it reaches minimum speed.

(c) Operate all remaining equipment at the same speed following the output of the speed control algorithm.

19. Gate and valve control:

a. Monitor the device’s LOCAL-OFF-REMOTE (LOR) switch(es) (the integral switch in the actuator or hard-wired switch at the local control station):

1) Display current REMOTE status on PCIS screens.

b. Start an “Open Activation” timer whenever the device is expected to be open (PLC has issued an OPEN command in PCIS AUTO, or OPEN was selected in PCIS HAND):

1) Initially set “Open Activation” time to twice the normal opening time.

2) If the LOR position and open command do not change, and the PLC does not receive fully open status feedback within the “Open Activation” time period:

a) De-activate the open output.

b) Place the device in a “Failed” state.

c) Generate a “Failed to Open” alarm.

c. Start a “Close Activation” timer whenever the device is expected to be closed (PLC has issued a CLOSE command in PCIS AUTO, or CLOSE was selected in PCIS HAND):

1) Initially set “Close Activation” time to twice the normal closing time.

2) If the LOR position and close command do not change, and the PLC does not receive fully closed status feedback within the “Close Activation” time period:

a) De-activate the close output.

b) Place the device in a “Failed” state.

c) Generate a “Failed to Close” alarm.

d. For modulating valves (valves controlled from either a 4-20 mA signal or digital communications command) with position feedback, start a “Position Error” timer whenever the position feedback differs from the required position command by more than a setpoint error when the LOR is in REMOTE:

1) For analog modulating devices, error is determined by position feedback differing from position command by more than the setpoint error.

2) For discrete modulating devices, error is determined by feedback not changing in the correct direction, or changing at less than a setpoint rate, when the OPEN or CLOSE PLC output is active.

3) Initially set the “Position Error” time to 60 seconds.

4) If the LOR position does not change, and position error stays outside of the setpoint error through the “Position Error” time period:

a) Hold position output.

b) Place the device in a “Failed” state.

c) Generate a “Position Fail” alarm.

e. Provide separate time delay settings for each function and for each device.

f. If the valve position inputs indicate an impossible state (i.e., valve open and closed at the same time), place the device in a “Failed” state and generate an “Illegal State” alarm.

g. Re-establish PLC control of a device in a “Failed” state only after an operator turns the device’s LOR switch out of REMOTE and back to REMOTE (i.e., REMOTE input to the PLC cycles off and back on).

h. For all alarm conditions, control other devices (as stopping pumps, etc.) as stated in the individual loop descriptions to make the system safe.

i. For discrete modulating valves (valves positioned to intermediate positions to control process values through discrete OPEN and CLOSE outputs), count the number of actuations (OPEN or CLOSE commands) in the PLC:

1) Display count on the OIT.

2) Provide a reset function for the count.

j. All valves shall display opened position, intermediate (mid travel), and closed valve position in HMI and OIT. If there are field lights for the opened and closed position for the valve then opened, intermediate (mid travel), and closed valve positions shall be displayed in the field.

k. All valve failed conditions and valve power off states shall be displayed in HMI and OIT. If there are field lights for fail out in the field, then valves' fail and valves' "power off" must be displayed out in the field.

20. Chemical systems (HMI/OIT):

a. Provide the following chemical system screens:

1) Where one HMI manages more than one chemical system, a main menu screen that will allow the operator to access the individual chemical system screens using software keys.

2) One or more screens for each individual chemical system controlled at that location, containing:

a) All status displays (running, failed, etc.).

b) Selections (lead/lag, which process flow to pace to, etc.).

c) Setpoint entry and display.

d) Calculated feed requirement (result of flow pacing calculation) in engineering units (typically milligrams of chemical per minute).

e) Output signal to feeder in percent of full span.

f) Actual chemical flow rate from flowmeter (where shown).

g) Process flow rate(s) used to pace each chemical on the individual chemical screens (PROC FLOW):

(1) Where different process flows can be selected for flow pacing, display and identify the selected source.

3) Chemical system calculations: Perform calculations as indicated on the Drawings and in the individual loop descriptions. Use the following assumptions, unless otherwise noted.

4) Where chemical flow feedback is not used, assume feeder output is linear in response to control signal.

5) Zero signal (typically 4 milliamperes) produces zero flow.

6) Perform flow-pacing calculations using as indicated on the Drawings or described in the individual loop descriptions.

b. Provide the setpoints and selections indicated on the Drawings and in the individual loop descriptions. Typical setpoints include:

1) QMAX: Maximum calibration value:

a) Chemical flow rate measured from calibration column at maximum feeder output (typically in gallons of solution per hour or milliliters of solution per minute).

2) CONC: Chemical concentration:

a) The concentration of the chemical in the solution to be fed, in engineering units (typically milligrams of chemical per liter of chemical solution).

3) DENSITY:

a) Density of the chemical solution to be fed in engineering units or as a specific gravity.

b) Used to calculate the concentration of the chemical in the solution.

4) DOSE: Desired dosage:

a) Desired chemical concentration in the process stream in engineering units (typically milligrams of chemical per liter of process fluid).

5) FLOW SEL: Selection of process stream(s) for flow pacing.

6) OPEN/CLOSED LOOP:

a) Selection of method of controlling chemical flow-paced feed rate.

b) OPEN LOOP: Signal to feeder is based on feeder calibration (QMAX) to deliver calculated chemical solution feed rate. Chemical solution flowmeter is not used for control.

c) CLOSED LOOP: Chemical feed rate is directly controlled using the calculated chemical solution feed rate as the setpoint, and the flow rate from the chemical solution flowmeter as the process variable.

21. Breaker status:

a. Display the following data to the extent it is available from the specified device:

1) Open.

2) Closed.

3) Tripped.

4) Ground fault.

5) Relay failure.

6) Communications error.

22. Power and starter information:

a. Retrieve data via power quality meters, motor protection relays, digital bus networks, or metering instruments, as indicated.

b. Display the following data to the extent it is available from the specified device:

1) Current: [A]:

a) A-Phase.

b) B-Phase.

c) C-Phase.

2) Volts: [V]:

a) A-B Phase to Phase.

b) B-C Phase to Phase.

c) C-A Phase to Phase.

3) Reactive power: [kVAR].

4) Real power: [kW].

5) Apparent power: [kVA].

6) Power factor: 0.8 percent.

c. For engine/generator system monitoring, also display percent of rated output.

d. Digital bus networks shall not traverse the SCADA/PLC network. Digital bus network traffic shall be via the Maintenance Network.

23. Starters, RVSS and VFDs equipped with digital bus communications:

a. Communicate and display all values listed in the equipment specifications, indicated on the Drawings, or listed below.

b. Monitor the following additional values, and display on the OIT:

1) Motor current.

2) Over current alarm.

3) Under current alarm.

4) Running status.

5) Phase loss.

6) Stall.

7) Not ready alarm.

8) Number of starts.

9) History of past 5 trips.

c. For Variable Frequency Drives:

1) Speed command.

2) Speed feedback.

d. For RVSS, Variable Frequency Drives, and where otherwise shown or available, monitor the following over the digital bus network:

1) Line voltage.

2) Power.

3) Power factor.

4) Over voltage alarm.

5) Under voltage alarm.

6) Over current alarm.

7) Under current alarm.

e. Digital bus networks shall not traverse the SCADA/PLC network. Digital bus network traffic shall be via the Maintenance Network.

24. Plant shutdown: Provide OOS for all equipment using a single bit for every device and a picture that displays status of all equipment for each area.

25. Power failure:

a. Retain all operating setpoints during power failure.

b. Restore plant operation to the state it was before the power loss:

1) Store the operating state of all major equipment and systems in the PLC, and retain the last state during a power loss.

2) When transferring to generator power, Provide a load sequence table on the workstation screen showing the major equipment and systems, and providing a “re-start” selection.

a) For each item, list the following:

(1) Equipment name and tag.

(2) Running kW and kVA.

(3) Starting kW and kVA.

(4) Identify whether it was running immediately before the power loss.

(5) Show current running and available status.

(6) Operator selection to re-start:

(a) Do not allow selection of loads that will cause the generator starting or running capacity to be exceeded.

(b) Insert a sequence number showing the order in which the load was selected. If a load is selected again, remove it from the queue, and update the sequence numbers for the remaining equipment.

b) When operating on generator power, also display the following, updating as selections are made, and as load:

(1) Generator(s) operating.

(2) Generator(s) available.

(3) Remaining running and starting kW and kVA:

(a) Calculate from measured generator output kW and kVA, and the maximum starting and running capacity required to start the selected loads.

c) Once the operator has selected loads, and selected “re-start”:

(1) Start the process loads in the order they were selected.

(2) Use the logic described above for preventing concurrent starts to provide necessary delays between each step.

d) After the initial loads have been sequenced on, allow automatic operation to continue to stop and start loads within generator capabilities.

c. Provide an operator selection to permit the plant to re-start. Once re-start is selected: Allow plant loads to re-start, and allow loads to sequence on and ramp up following normal control logic. Where loads were operating in PCIS HAND, restore their operation to the state before the power loss:

1) Use the logic described above for preventing concurrent starts to provide necessary delays between each start.

d. Operating on generator power:

1) Include running and starting kW and kVA requirements for each major equipment and system in registers in the PLC:

a) Where running load can vary due to speed, valve position, etc., use the normal starting value plus 25 percent of the difference between the maximum and minimum values.

2) Inhibit starting of loads from process control logic and from operator selection (in PCIS HAND) that will exceed generator capability.

3) Generate the following alarms:

a) Generator near capacity: When measured kW or kVA reaches 90 percent of the rating of running generators.

b) Generator at capacity: When measured kW or kVA reaches 95 percent of the rating of running generators.

c) Unable to start: When an operator selects a load that would exceed generator starting or running capacity.

d) Insufficient capacity: When the control system needs to start a load, but is inhibited due to generator capacity.

4) Whenever the Generator at Capacity alarm is active, inhibit starting of any loads, and inhibit increase in speed of all control loops, and other changes that would increase electrical load.

5) For multiple generator systems, coordinate capacity alarms and equipment starting with generator control system to ensure adequate generator capacity, and to prevent alarms.

6) Display the following power system data on the workstation screen in numerical and graphical formats:

a) Available power.

b) Current power demand.

c) Capacity of the generator.

d) Current power demand load as a percentage of capacity.

e) Generator frequency.

7) Provide transition time before restoring to normal. After a time delay (adjustable) when power is available provide a shut down that allows the equipment to transition back to utility power.

8) Communication and Signal Wiring

a) Communication, control and signal wiring for both hardwired configurations and network configurations shall be wired and terminated into the closed control cabinet..

(1) Only hardwired signals shall be allowed on the SCADA/PLC network. Please reference 40 90 10, part 2, B.3.

(2) Signals not used for controls and alarms shall go into maintenance mode.

RINCONADA RESIDUAL MANAGEMENT SYSTEM

SPECIFIC CONTROL STRATEGIES

PART 3 -- EXECUTION

3.01 GRAVITY THICKENERS

Reference Drawings: I-1

Overview:

Dilute sludge is delivered to the thickeners via a single pipe. The flow is split to the two gravity thickeners. Each thickener inlet contains a magnetic flow meter to measure the influent flow rate and a motor operated plug valve to isolate individual thickeners.

Each Gravity Thickener has a Thickener Sludge Collector Mechanism for collecting sludge from the bottom of the thickener and moving it towards the sludge hopper at the center of the thickener where it can be removed by the Sludge Transfer Pumps. Each Thickener Mechanism has a VCP. The VCP has an HOA switch to control the thickener sludge collector mechanism either Locally or Remotely.

A. LOOP GST_104 Gravity Thickener # 1 Sludge Collector (RGSTSLC01)

PLC: New Remedial PLC (Re-purposed existing I/O Drops 2 & 3)

Control:

When the LOCAL/OFF/REMOTE selector switch at the VCP is in the LOCAL position, the Operator may START and STOP the Gravity Thickener Sludge Collector Mechanism from the VCP.

When the LOCAL/OFF/REMOTE selector switch at the VCP is in the REMOTE position, the Operator may START and STOP the Gravity Thickener Sludge Collector Mechanism from SCADA. The thickener mechanism shall run continuously until it is stopped manually from SCADA.

Field (VCP):

LOCAL/OFF/REMOTE Selector switch (HS-104A)
START/STOP Pushbuttons (HS-104B)
RESET Pushbutton (HMS-104)

Local:

None

PLC/HMI

Collector Start/Stop Pushbutton (HS-104)

Hardware Interlocks:

Not impacted by design changes.

Software Interlocks:

Not impacted by design changes.

Alarms/Monitoring:

Field (VCP):

RUN indication (YL-104)
FAIL Alarm: (YA-104)
HIGH Torque Warning Alarm (WAH-104)
HIGH HIGH Torque Shutdown Alarm – Requires local reset (WAHH-104)
Gearbox Pressure Indication (PI-104)

Local :

None

PLC/HMI:

RUN indication (YL-104)
REMOTE Indication (ZL-105)
Total RUN HOURS (KQI-104)
FAIL Alarm (YA-104)
HIGH Torque Warning Alarm (WAH-104)
HIGH HIGH Torque Shutdown Alarm (WAHH-104)
Gearbox Pressure Indication (PI-104)

Fault Response:

Component Failure:

None

Communications Failure:

None

Power Failure:

On power failure the Collector will stop. When power is reinstated the Collector will start dependent on VCP switch positions.

Data Collection & Trending:

Historical Collection:

See general requirements in 2.01

Trending:

See general requirements in 2.01

B. LOOP GST_114 Gravity Thickener # 2 Sludge Collector (RGSTSLC02) is identical to that for Thickener # 1.

C. LOOP GST_100 Gravity Thickener Blanket Level (LE/LIT-100)

PLC: New Remedial PLC (Re-purposed existing I/O Drops 2 & 3)

Control:

The sludge blanket measurement is a continuous measurement used for both local and remote indication of sludge blanket and also control of the sludge transfer pumps when level mode 2 is selected. (See section 3.01 and associated loops for more details)

Field:

None.

Local:

None.

PLC/HMI:

LOW LOW Sludge Blanket Alarm setpoint (LKLL-100)
LOW Sludge Blanket Alarm setpoint (LKL-100)
HIGH Sludge Blanket Alarm setpoint (LKH-100)
HIGH HIGH Sludge Blanket Alarm setpoint (LKHH-100)

Hardware Interlocks:

None

Software Interlocks:

None

Alarms/Monitoring:

Field:

Sludge Blanket Level (LE/LIT-100)

Local:

None.

PLC/HMI:

Sludge Blanket Level (LI-100)

LOW LOW Sludge Blanket Alarm (LALL-100)
LOW Sludge Blanket Alarm (LAL-100)
HIGH Sludge Blanket Alarm (LAH-100)
HIGH HIGH Sludge Blanket Alarm (LAHH-100)

Fault Response:

Component Failure:

None.

Communications Failure:

None

Power Failure:

None.

Data Collection & Trending:

Historical Collection:

See general requirements in 2.01

Trending:

See general requirements in 2.01

D. LOOP GST_110 Gravity Thickener # 2 Sludge Blanket Level (LE/LIT 110) is identical to that for Thickener # 1.

E. LOOP GST_102 Gravity Thickener Level (LE/LIT-102)

PLC: New Remedial PLC (Re-purposed existing I/O Drops 2 & 3)

Control:

The gravity thickener level measurement is a continuous measurement used for both local and remote indication of thickener level and also control and interlocking of the sludge transfer pumps when in remote manual and automatic modes. (See section 3.01 and associated loops for more details)

Field:

None.

Local:

None.

PLC/HMI:

LOW LOW Gravity Thickener Level Alarm setpoint (LKLL-102)
LOW Gravity Thickener Level Alarm setpoint (LKL-102)
HIGH Gravity Thickener Level Alarm setpoint (LKH-102)
HIGH HIGH Gravity Thickener Level Alarm setpoint (LKHH-102)

Hardware Interlocks:

None

Software Interlocks:

None

Alarms/Monitoring:

Field:

Gravity Thickener Level (LE/LIT-102)

Local:

None.

PLC/HMI:

Gravity Thickener Level (LI-102)

LOW LOW Gravity Thickener Alarm (LALL-102)
LOW Gravity Thickener Alarm (LAL-102)
HIGH Gravity Thickener Alarm (LAH-102)
HIGH HIGH Gravity Thickener Alarm (LAHH-102)

Fault Response:

Component Failure:

None.

Communications Failure:

None

Power Failure:

None.

Data Collection & Trending:

Historical Collection:

See general requirements in 2.01

Trending:

See general requirements in 2.01

F. LOOP GST_112 Gravity Thickener # 2 Level (LE/LIT 112) is identical to that for Thickener # 1.

3.02 SLUDGE TRANSFER PUMPS

Reference Drawings: I-2 and I-3

Overview:

The existing Centrifuge 1 and two feed pumps are to be re-purposed as Sludge Transfer pumps for the new remediation system. The I/O for these pumps is landed on existing drops 2 and 3 that are to be made pat of the new Remediation PLC network.

Two variable speed positive displacement pumps shall transfer thickened sludge from the gravity thickeners to the sludge mixing tanks. Pump # 1 is assigned to Thickener # 1 and pump # 2 is assigned to Thickener # 2. Each pump has a manual inlet and outlet valves. Each pump also has a magnetic flow meter on the discharge side.

Under normal automated operation, both pumps will discharge to the same sludge storage tank. The operation of the storage tank inlet valves is controlled by the water surface levels in the thickener and storage mixing tanks and by the operation of the centrifuges (defined in section 3.03). Dependent on the operating mode, the Sludge Transfer Pumps will discharge to the designated sludge storage mixing tank until the mixing tank reaches its HIGH (full) level, the thickener tank reaches its LOW level or the timed operation stops. When the centrifuges draw from one tank, the Sludge Transfer Pumps will discharge to the other tank, unless the tank being filled reaches its HIGH level setpoint. In that event the valve positions will be changed so that the pumps discharge to the other tank.

There are three modes of operation for the sludge transfer pumps, one manual and two automatic:

MANUAL

In MANUAL mode the operator starts and stops the pumps manually from the SCADA in a remote manual mode to a manual speed setpoint.

FLOW Mode 1 (specific time slots to a target flow setpoint constrained by ultimate HIGH & LOW level setpoints)

In FLOW Mode 1, the pump shall be started and stopped periodically based on operator entered timer setpoints. The Operator shall be able to enter the time each pump will start as well as the duration for each start period on SCADA. The pump shall shut-off at the end of the time slot, a LOW sludge density in the pump feed line, the water falls below a LOW level setpoint in the Gravity Thickeners or a HIGH level in the receiving mixing tank, all adjustable by the Operator. The Operator shall also have the ability to override the low sludge density shut-off on SCADA. An interlock shall also be provided to shut down the pumps under a “NO AVAILABLE TANK” condition (see section 3.03). In FLOW Mode 1, the pump will modulate its speed to an operator entered FLOW setpoint via a Proportional/Integral (PI) flow controller in the PLC or at a manual speed set speed entered by the operator, if the flow controller is in automatic then the flow setpoint is targeted, if the flow controller is in manual then the manual speed setpoint is utilized.

LEVEL Mode 2

In LEVEL Mode 2, the pumps shall run on the same timed basis but the speed shall be stepped up or down periodically based on the sludge blanket level detected in the gravity thickener. A sludge blanket level controller shall be programmed into the PLC whereby the sludge blanket level (LIT-100/110) is periodically monitored and the pump speed stepped up or down dependent on the blanket level. The operator shall enter the period between each sludge blanket level assessment, this would be less than the timed duration. If the sludge blanket is within an expected sludge blanket level range then the initial pump speed will not be changed, if the sludge blanket is lower than expected, the speed shall be lowered by an operator entered speed percentage, and conversely if the sludge blanket is higher than expected then the speed shall be raised by the same operator entered speed percentage.

If a HIGH level in the sludge storage tank being filled is achieved, the pumps shall be stopped automatically. Likewise, if a LOW water surface level in the gravity thickeners is detected then the pumps shall also be stopped.

When the sludge storage tank inlet valve is detected as CLOSED, the pump shall be stopped via a software only interlock. Each pump is further protected from damage with a HIGH discharge pressure switch and a HIGH temperature switch on the pump housing, both of these devices are hardwired to the pump VFD and apply in both local and PLC control modes.

When a Sludge Transfer pump is STOPPED, the respective FLUSHING solenoid shall be OPENED for an Operator entered time period initially set at 10 mins. On the expiration of this timer, the flushing solenoid shall be CLOSED.

The mixing tanks are in a DUTY/STANDBY arrangement to enable valve alignment in conjunction with Centrifuge operation. The Centrifuges shall always empty from the selected DUTY tank. The sludge transfer pumps are able to fill both a DUTY or a STANDBY tank if the Centrifuges are not in operation but once Centrifuge operations are started then the DUTY mixing tank inlet valve shall be CLOSED thus preventing FILLING and EMPTYING of a tank simultaneously.

A. LOOP SLG_180 Sludge Transfer Pump # 1 (RSLGMXFP01)

PLC: New Remediation PLC

Control:

Each sludge transfer pump can be started and stopped by locally by placing the LOCAL/OFF/REMOTE in the LOCAL position at the VFD and using the START/STOP pushbuttons and speed control settings.

Remote manual control is achieved when the LOCAL/OFF/REMOTE selector switch at the VFD is in the REMOTE position and the AUTO/MANUAL selector switch on SCADA is in MANUAL, the Operator may START and STOP the Sludge Transfer Pump manually and control the pumps speed from the SCADA.

When the Sludge Transfer Pumps LOCAL/OFF/REMOTE selector switches are in REMOTE, and AUTO/MANUAL switch is in AUTO on SCADA, the pumps can then be selected to FLOW Mode 1 or LEVEL Mode 2.

Additional Software Control Interlocks

Field:

LOCAL/OFF/REMOTE Selector switch (HS-180)
SPEED Control (SK-180)
Fault Reset (HMS-180A)
Pump Start/Stop Pushbutton (HMS-180B/C)

Local:

None

PLC/HMI:

Pump Auto/Manual Selection (HS-180A)
Pump Start/Stop Pushbutton (HS-180B)
Speed Setpoint (SK-180)
Mode 1 Flow Setpoint (FK-180)
Pump # 1 Mode 1/2 Selection (HS-180C)
Pump # 1 Start times (KK-180A)
Pump # 1 Time Durations (KK-180B)
Mode 2 Step % Setpoint (YK-180)
Mode 2 Test Period (KK-180C)

Hardware Interlocks:

A HIGH Pump Discharge Pressure detected by PSH-180 shall stop the pump requiring a local reset.

A HIGH Pump Winding Temperature detected by TSH-180 shall stop the pump requiring a local reset.

An Overload Fault detected by YA-180 shall stop the pump requiring a local reset.

LOW Seal water flow as detected by FSL-180 shall stop the pump requiring a local reset.

Software Interlocks:

In the remote mode, when a pump is called to START or is already running and both mixing tank inlet valves are detected as CLOSED, the pump(s) shall be stopped.

In the remote mode, when a pump is called to START or is already running and the level in the gravity thickener is detected as low, the pump shall stop.

In the remote mode, when a pump is called to START or is already running and the level in the overflow wet well is detected as high, the pump shall stop.

Pumps shall not be allowed to start if the Sludge Storage Tanks are both at their FULL level setpoints or higher.

The pumps shall shut-off at the end of the time slot or at a low density set point unless the LOW density override has been selected.

An interlock shall also be provided to shut down the pumps under a “NO AVAILABLE TANK” condition.

Alarms/Monitoring:

Field:

RUN indication (YL-180)
FAIL ALARM: (YA-180)
HIGH Temperature Alarm (TAH-180)
HIGH Discharge Pressure Alarm (PAH-180)
LOW Seal Water Flow Alarm (FAL-180)

Local :

None

PLC/HMI:

Pump Auto/Manual Selection (HS-180A)
RUN indication (YL-180)
SPEED Indication (SI-180)
REMOTE Indication (ZL-180)
Total RUN HOURS (KQI-180)
FAIL Alarm (YA-180)
HIGH Temperature Alarm (TAH-180)
HIGH Discharge Pressure Alarm (PAH-180)
LOW Seal Water Flow Alarm (FAL-180)

Fault Response:

Component Failure:

None

Communications Failure:

None

Power Failure:

During Power Outage the Pumps will not operate due to loss of power. The Sludge Transfer Pumps COMMON FAIL alarms will be de-activated at SCADA during Power Outage. Upon power restoration, the pumps will operate as called for dependent on the selected mode of operation. Alarms will be re-activated at SCADA upon power restoration.

Data Collection & Trending:

Historical Collection:

See general requirements in 2.01

Trending:

See general requirements in 2.01

B. LOOP SLG_190 Sludge Transfer Pump # 2 (RSLGMXFP02) is identical to that for Sludge Transfer Pump # 1.

3.03 SLUDGE STORAGE MIXING TANKS

Reference Drawings: I-4 and I-5

Overview:

The Thickened Sludge Mixing Tanks shall receive thickened sludge from the sludge transfer pumps and provide storage and mixing for the sludge until it is ready to be processed by the Centrifuges. Each Thickened Sludge Mixing Tank will be provided with four Mixers.

The Mixing Tank can be in one of the following states,

1) OFFLINE
2) DUTY FILLING
3) DUTY FULL
4) DUTY EMPTYING
5) STANDBY
6) STANDBY FILLING
7) STANDBY FULL

If the operator selects the mixing tank as OFFLINE then the inlet and outlet valves shall be automatically CLOSED, the tank is designated OFFLINE and the STANDBY tank is designated as DUTY.

The mixing tanks are in a DUTY/STANDBY arrangement to enable valve alignment in conjunction with Centrifuge operation. The Centrifuges shall always empty from the selected DUTY tank. The sludge transfer pumps are able to fill both a DUTY or a STANDBY tank if the Centrifuges are not in operation but once Centrifuge operations are started then the DUTY mixing tank inlet valve shall be CLOSED thus preventing FILLING and EMPTYING of a tank simultaneously.

STANDBY, DUTY FILLING, STANDBY FILLING and DUTY EMPTYING states are automatically assigned based on process and equipment status. The mixing tanks are in a DUTY/STANDBY arrangement primarily to facilitate a common feed from both mixing tanks to the centrifuge feed pumps. The operator shall select the DUTY tank on SCADA.

To stop two tanks being filled simultaneously, the system will firstly attempt to fill the DUTY tank. A normal sequence of operations would be as follows.

If mixing tank 1 is selected as DUTY and is not FULL, the inlet valve to mixing tank 1 (PV510) is OPENED and mixing tank 2 inlet valve (PV520) is CLOSED. Manual valve PV182C is OPENED enabling either of the sludge transfer pumps to service mixing tank 1, mixing tank 1 is designated as DUTY FILLING, mixing tank 2 is designated as STANDBY.

Should mixing tank 1 become FULL then the inlet valve to mixing tank 1 (PV510) is CLOSED. The tank is designated as DUTY FULL.

When a Centrifuge is STARTED The discharge valve from the DUTY Mixing Tank (PV515 or PV525) is OPENED and the tank is designated as DUTY EMPTYING.

If Tank 1 is FULL, the sludge transfer pumps will then attempt to fill mixing tank 2. Mixing Tank 2 inlet valve (PV520) is OPENED, This configuration enables either sludge transfer pumps to service mixing tank 2, the tank is designated as STANDBY FILLING.

Should mixing tank 2 become FULL then the inlet valve to mixing tank 2 (PV520) is CLOSED. The tank is designated as STANDBY FULL.

The operators would then choose to either select tank 2 as DUTY so that it can be emptied or remain on tank 1.

If both mixing tanks are FULL then the respective inlet valves shall be CLOSED which in turn would inhibit all sludge transfer operations.

Likewise, if the DUTY or STANDBY tank is not FULL and the centrifuges are not in operation then it will automatically be placed into DUTY FILLING mode, the inlet valve shall be OPENED and the outlet valve shall be CLOSED. The tank will fill dependent on the mode of the sludge transfer pumps.

B. LOOP TSLG_500 Sludge Storage & Mixing Tank 1 and 2 Mode Selection and Status Display

PLC: New Remediation PLC

Control:

A mixing tank can be filled whilst designated as DUTY or STANDBY provided the centrifuges are not operating. If a tank does not have a “FULL TANK” status then it will automatically be placed in FILLING mode with the DUTY tank filled first, the tank outlet valve shall be CLOSED and the inlet valve shall be OPENED automatically allowing the thank to be filled dependent on the operating mode of the sludge transfer pumps .

When a tank reaches the “FULL TANK” status, the inlet valve shall be CLOSED (which in turn would automatically stop the sludge transfer pump).

If both mixing tanks have a “FULL TANK” status, a “NO AVAILABLE MIXING TANK” Alarm shall be annunciated on SCADA which shall in turn cause the Thickened Sludge Transfer Pumps to shutdown.

When a tank reaches the “EMPTY TANK” status, the respective outlet valve shall be CLOSED and the tank will be removed from the duty selection and designated as STANDBY. This should not interfere with Centrifuge operations as the STANDBY tank would be assigned as DUTY.

If the Level in the Thickened Sludge Mixing Tank reaches the Operator adjustable HIGH-HIGH Level setpoint, a “MIXING TANK OVERFILLED” alarm shall be generated on SCADA and the Sludge Transfer Pumps shall be shutdown and prevented from starting until the alarm is cleared.

Placing a valve in LOCAL at the actuator or if the AUTO/MANUAL selection on SCADA is set to MANUAL shall also remove the mixing from being selected as DUTY.

Field:

None.

Local:

None.

PLC/HMI:

Mixing Tank DUTY Selection (HS-500).
Mixing Tank # 1 ONLINE/OFFLINE Selection (HS-500-1).
Mixing Tank # 2 ONLINE/OFFLINE Selection (HS-500-2).

Hardware Interlocks:

None

Software Interlocks:

None

Alarms/Monitoring:

Field:

None.

Local :

None.

PLC/HMI:

Sludge Storage & Mixing Tank # 1 Status (UI-500-1)
- OFFLINE
- DUTY FILLING
- DUTY FULL
- DUTY EMPTYING
- STANDBY
- STANDBY FILLING
- STANDBY FULL

Sludge Storage & Mixing Tank # 2 Status (UI-500-2)

OFFLINE
DUTY FILLING
DUTY FULL
DUTY EMPTYING
STANDBY
STANDBY FILLING
STANDBY FULL

Sludge Storage & Mixing Tank # 1 Alarms (UI-500-1)
TANK FULL
EMPTY TANK
Sludge Storage & Mixing Tank # 2 Alarms (UI-500-2)
TANK FULL
EMPTY TANK
Sludge Storage & Mixing Tanks 'NO AVAILABLE TANK' Alarm
Sludge Storage & Mixing Tank # 1 'MIXING TANK OVERFILLED' Alarm.
Sludge Storage & Mixing Tank # 2 'MIXING TANK OVERFILLED' Alarm.

Fault Response:

Component Failure:

None

Communications Failure:

None

Power Failure:

Data Collection & Trending:

Historical Collection:

See general requirements in 2.01

Trending:

See general requirements in 2.01

C. LOOP TSLG_510 Sludge Storage & Mixing Tank # 1 Inlet Valve (PV510)

PLC: New Remediation PLC

Control:

The sludge storage & mixing tank # 1 inlet valve is normally operated in SCADA automatic mode. In SCADA automatic mode, the valve will open/close dependent on the mixing tank

availability which in turn is driven by centrifuge operations. (See section 3.03 Loop SLG_500 for more details).

When a mixing tank Inlet and outlet valve's LOCAL/OFF/REMOTE selector switches are placed in REMOTE and the MANUAL/AUTO switches set in AUTO mode on SCADA, that tank is available to be filled/emptied automatically. The mixing tanks are in a DUTY/STANDBY arrangement, the operator selects the DUTY tank on SCADA. The DUTY mixing tank is the tank that shall service the centrifuges should a centrifuge be started. The starting of any of the centrifuges is asynchronous to mixing tank operations. Once a particular centrifuge is called to run, the DUTY mixing tank is automatically set to DUTY EMPTYING mode. The tank outlet valve shall be OPENED and the inlet valve shall be CLOSED automatically.

A mixing tank can be filled whilst designated as DUTY or STANDBY provided the centrifuges are not operating. If a tank does not have a "FULL TANK" status then it will automatically be placed in FILLING mode with the DUTY tank filled first, the tank outlet valve shall be CLOSED and the inlet valve shall be OPENED automatically allowing the tank to be filled dependent on the operating mode of the sludge transfer pumps .

Field:

LOCAL/OFF/REMOTE Selector Switch (HS-510A)
OPEN/CLOSE/STOP Selector Switch (HS-510B)

Local:

None.

PLC/HMI:

Valve AUTO/MANUAL Command (HS-510)
Valve OPEN Command (HS-510C)
Valve CLOSE Command (HS-510D)

Hardware Interlocks:

Each Valve has an in-built over torque switch hardwired internally to the valve actuator.

Software Interlocks:

None

Alarms/Monitoring:

Field:

Valve FAULT (YA-510).
Valve OPENED Status (ZSO-510).
Valve CLOSED Status (ZSC-510).

Local:

None.

PLC/HMI:

Valve AUTO/MANUAL Status (HS-510)
Valve OPENED Status (ZLO-510)
Valve CLOSED Status (ZLC-510)
Valve REMOTE Status (ZL-510)
Valve FAULT (YA-510)
Valve Failed to Open (Derived)
Valve Failed To Close (Derived).

Fault Response:

Component Failure:

None.

Communications Failure:

None

Power Failure:

During Power Outage the valve will remain in its last position. Upon power restoration, the valve will operate as called for dependent on the selected mode of operation. Alarms will be re-activated at SCADA upon power restoration.

Data Collection & Trending:

Historical Collection:

See general requirements in 2.01

Trending:

See general requirements in 2.01

D. LOOP TSLG_520 Sludge storage & mixing tank # 2 inlet valve (SLGPV520) is identical to that for SLGPV510.

E. LOOP TSLG_515 Sludge storage & mixing tank # 1 discharge valve (SLGPV515) is identical to that for SLGPV510 albeit on the discharge of the tank.

F. LOOP TSLG_525 Sludge storage & mixing tank # 2 discharge valve (SLGPV525) is identical to that for SLGPV510 albeit on the discharge of the tank.

G. LOOP TSLG_511 Sludge Storage & Mixing Tank Mixer # 1 (RTSLGMXT1MX01)

PLC: New Remediation PLC

Control:

Each sludge mixing tank mixer can be started and stopped locally by placing the LOCAL/OFF/REMOTE in the LOCAL position at the VFD and using the START/STOP pushbuttons and speed controls.

Under normal operations, each sludge mixing tank mixer shall be started and stopped automatically by placing the LOCAL/OFF/REMOTE in the REMOTE position at the VFD and then selecting AUTO on the plant SCADA system screen. In this mode, the mixer will operate if the level in the tank is above the LOW level setpoint.

If the Level in either Sludge Mixing Tank reaches the LOW Level Setpoint then the Mixers shall be stopped.

Field:

LOCAL/OFF/REMOTE Selector switch (HS-511)
SPEED Control (SK-511)
Fault Reset (HMS-511A)
Pump Start/Stop Pushbutton (HMS-511B/C)

Local:

None

PLC/HMI:

Pump Auto/Manual Selection (HS-511B)
Pump Start/Stop Pushbutton (HS-511C)
Speed Setpoint (SK-511)

Hardware Interlocks:

A Mixer Overload FAIL shall stop the pump.

Software Interlocks:

If the Level in either Sludge Mixing Tank reaches the LOW Level Setpoint derived from (LI-510/LI-520) then the respective Mixers shall be stopped.

If the Level in either Sludge Mixing Tank reaches the LOW LOW Level float (LSLL-510/LSLL-520) then the respective Mixers shall be stopped.

Alarms/Monitoring:

Field:

RUN indication (YL-511)
FAIL ALARM: (YA-511)
HIGH Temperature Alarm (TAH-511)
HIGH Vibration Alarm (VAH-511)
Pump Failed to Start (Derived)
Pump Failed to Stop (Derived)
Pump Speed Deviation (Derived)

Local :

None

PLC/HMI:

RUN indication (YL-511)
SPEED Indication (SI-511)
REMOTE Indication (ZL-511)
Total RUN HOURS (KQI-511)
FAIL Alarm (YA-511)
HIGH Temperature Alarm (TAH-511)
HIGH Vibration Alarm (VAH-511)

Fault Response:

Component Failure:

None

Communications Failure:

None

Power Failure:

During Power Outage the Mixers will stop due to loss of power. Upon power restoration, the mixers will operate as called for dependent on the selected mode of operation. Alarms will be re-activated at SCADA upon power restoration.

Data Collection & Trending:

Historical Collection:

See general requirements in 2.01

Trending:

See general requirements in 2.01

H. LOOP TSLG_512 Sludge Storage & Mixing Tank 1 Mixer # 2 (RTSLGMXT1MX02) is identical in operation to RSLGMXT1MX01.

I. LOOP TSLG_513 Sludge Storage & Mixing Tank 1 Mixer # 3 (RTSLGMXT1MX03) is identical in operation to RSLGMXT1MX01.

J. LOOP TSLG_514 Sludge Storage & Mixing Tank 1 Mixer # 4 (RTSLGMXT1MX04) is identical in operation to RSLGMXT1MX01.

K. LOOP TSLG_521 Sludge Storage & Mixing Tank 2 Mixer # 1 (RTSLGMXT2MX01) is identical in operation to RSLGMXT1MX01.

L. LOOP TSLG_522 Sludge Storage & Mixing Tank 2 Mixer # 2 (RTSLGMXT2MX02) is identical in operation to RSLGMXT1MX01.

M. LOOP TSLG_523 Sludge Storage & Mixing Tank 2 Mixer # 3 (RTSLGMXT2MX03) is identical in operation to RSLGMXT1MX01.

N. LOOP TSLG_524 Sludge Storage & Mixing Tank 2 Mixer # 4 (RTSLGMXT2MX04) is identical in operation to RSLGMXT1MX01.

O. LOOP TSLG_510 Sludge Storage & Mixing Tank 1 Level (LE/LIT-510 & LSLL-516)

PLC: New Remediation PLC

Control:

The sludge storage and mixing tank level measurement is a continuous measurement used for both local and remote indication of tank level. The high and high high tank level alarms are used as interlocks to sludge transfer pump operation when in remote manual and automatic modes. Similarly, the low low level alarm shall interlock mixer operation as does the low low float switch.

Field:

None.

Local:

None.

PLC/HMI:

LOW LOW Sludge Storage & Mixing Tank Level Alarm setpoint (LKLL-510)
LOW Sludge Storage & Mixing Tank Level Alarm setpoint (LKL-510)
HIGH Sludge Storage & Mixing Tank Level Alarm setpoint (LKH-510)

HIGH HIGH Sludge Storage & Mixing Tank Level Alarm setpoint (LKHH-510)

Hardware Interlocks:

None

Software Interlocks:

None

Alarms/Monitoring:

Field:

Sludge Storage & Mixing Tank Level (LE/LIT-510)

Local:

None.

PLC/HMI:

Sludge Storage & Mixing Tank Level (LI-510)
LOW LOW Sludge Storage & Mixing Tank Level Alarm (LALL-510)
LOW Sludge Storage & Mixing Tank Level Alarm (LAL-510)
HIGH Sludge Storage & Mixing Tank Level Alarm (LAH-510)
HIGH HIGH Sludge Storage & Mixing Tank Level Alarm (LAHH-510)
LOW LOW Sludge Storage & Mixing Tank Level Switch Alarm (LALL-516)

Fault Response:

Component Failure:

None.

Communications Failure:

None

Power Failure:

None.

Data Collection & Trending:

Historical Collection:

See general requirements in 2.01

Trending:

See general requirements in 2.01

P. LOOP SLG_520 Sludge Storage & Mixing Tank 2 Level (LE/LIT-520 & LSLL-526)) is identical in operation to LE/LIT-510 & LSLL-510.

3.04 CENTRATE WET WELL B PUMP STATION

Reference Drawings: I-6

Overview:

The Centrate Wet Well B pump station and associated variable speed pumps shall pump thickened sludge from the sludge storage tank and centrate from centrifuges 3 and 4 back to either of the sludge storage tanks, to the gravity thickeners, or to the washwater recovery facility. The pumps shall be supplied with a Local Control Panel. The pumps shall operate in a LEAD/LAG configuration based on the level in the Centrate return sump.

Note that the controls setpoints defined below are in addition to and operate within the bounds of the LOW LOW, LOW, HIGH, and HIGH HIGH analog alarms derived from the level transmitter.

At a HIGH level control setpoint in the wet well, derived from the ultrasonic level transmitter analog signal, the LEAD pump will start and run at an INITIAL FLOW set point based on the flow meter.

As the water level in the sump rises, the pump speed shall ramp up proportionally until reaching a HIGH FLOW set point based on the flow meter. If the water level continues to rise, the pump speed will continue to ramp up proportionally until reaching 100% speed at the HIGH HIGH control level setpoint. If the water level rises above the HIGH HIGH setpoint, then the LAG pump will start. Both LEAD and LAG pumps shall both run at 100 % (60 Hz). LEAD and LAG pumps shall also start if the level rises above the FLOOD float switch (LSHH-302), this is a hardwired feature and adds additional protection should the analog instrument fails.

If the LEAD and LAG pumps are both operating and the water level in the wet well declines to the HIGH HIGH control level set point, the LAG pump shall be stopped. As the water level in the wet well continues declining below the HIGH HIGH control level set point, the pump speed shall ramp down proportionally until reaching minimum speed (not 0 Hz but the frequency at which the pump first moves water) at the lead pump START level. When the level falls below the lead pump START level, the pump shall run at minimum speed until reaching the LOW level control setpoint derived from the ultrasonic level transmitter analog signal. At this point the pumps called, LEAD only or LEAD and LAG shall be stopped.

The LEAD and LAG pumps shall also stop if the level falls below a LOW LOW float switch, this is also hardwired feature and adds additional protection should the analog instrument fail.

B. LOOP CEN_300 Centrate Sump B Level Controller (LC-300 & LE/LIT-300)

PLC: New Remediation PLC

Control:

A proportional level controller (LC-300) shall be programmed into the PLC whereby a proportional level band shall be established in the sump that equates to a 0-100% speed. The LEAD/LAG pumps shall be called to run/stop based off discrete level setpoints (LK-300) as described in the overview. The pumps shall start at 100% speed and ramp down to 0% speed when operating within the band, when the level is above the 100% level in the band they shall run at 100%. When the pump(s) have been running at 0% for a sustained period (KK-300) then the pump(s) shall stop.

The pump(s) shall also be stopped if the level falls below the float switch LSLL-303, this is an additional layer of hardwired protection.

Field:

None.

Local:

None.

PLC/HMI:

Lead/Lag Selection (HS-300)
Level Controller (LC-300)
Level Controller Timer Setpoints (KK-300)
Level Controller Level Control Setpoints (LK-300)
LOW LOW Centrate Sump B Level Alarm setpoint (LKLL-300)
LOW Centrate Sump B Alarm setpoint (LKL-300)
HIGH Centrate Sump B Alarm setpoint (LKH-300)
HIGH HIGH Centrate Sump B Alarm setpoint (LKHH-300)

Hardware Interlocks:

None

Software Interlocks:

None

Alarms/Monitoring:

Field:

None.

Local :

None.

PLC/HMI:

Centrate Sump B Level (LI-300)
Centrate Sump B Level Transmitter FAIL Alarm (YA-300)
LOW LOW Centrate Sump B Alarm (LALL-300 Derived)
LOW Centrate Sump B Alarm (LAL-300 Derived)
HIGH Centrate Sump B Alarm (LAH-300 Derived)
HIGH HIGH Centrate Sump B Alarm (LAHH-300 Derived)

Fault Response:

Component Failure:

If the level transmitter fails (YA-300) then the pumps shall be stopped and forced into manual mode awaiting operator intervention.

Communications Failure:

None

Power Failure:

Data Collection & Trending:

Historical Collection:

See general requirements in 2.01

Trending:

See general requirements in 2.01

C. LOOP CEN_300 Centrate Sump B Flow Indication (FIT-300)

PLC: New Remediation PLC

Control:

Field:

None.

Local:

None.

PLC/HMI:

HIGH Centrate Sump B Flow Alarm Setpoint (FKH-300)
HIGH HIGH Centrate Sump B Flow Alarm Setpoint (FKHH-300)

Hardware Interlocks:

None

Software Interlocks:

None

Alarms/Monitoring:

Field:

None.

Local :

None.

PLC/HMI:

Centrate Sump B Flow Indication (FI-300)
Centrate Sump B Totalized Flow (FQI-300)
HIGH Centrate Sump B Flow Alarm (FAH-300)
HIGH HIGH Centrate Sump B Flow Alarm (FAHH-300)

Fault Response:

Component Failure:

None.

Communications Failure:

None

Power Failure:

None.

Data Collection & Trending:

Historical Collection:

See general requirements in 2.01

Trending:

See general requirements in 2.01

D. LOOP CEN_301 Centrate Sump B Pump # 3 (RCENP03))

PLC: New Remediation PLC

Control:

Each Centrate sump pump can be started and stopped by placing the LOCAL/OFF/REMOTE switch into the LOCAL position and the using the START/STOP pushbuttons.

When the LOCAL/OFF/REMOTE switch is in the REMOTE position, the pump is available to the PLC. The pump can then be controlled in either remote manual or automatic modes (HS-301B and HS-301C). When the pumps are in automatic mode at SCADA, the first pump selected into AUTO shall become the LEAD pump, the second LAG. The two pumps are in a LEAD/LAG arrangement when both are switched into AUTO mode selectable from SCADA (HS-300). The LEAD pump shall start and run at 100% speed when the level as detected by the ultrasonic level transmitter rises above a HIGH level setpoint. If the level continues to rise above a HIGH HIGH level setpoint then the LAG pump shall be started, both pumps shall operate together at 100% speed until the level falls below the LEAD start setpoint. Below this setpoint, the pump speed shall ramp down proportionally based off the level indication until the level reaches the LEAD/LAG stop setpoint (0% speed) at which point the pump(s) shall be stopped.

The pumps are protected by hardwired interlocks on discharge pressure (PAH-301), LOW LOW sump level (LALL-303), High Motor Temperature (TAH-301) and High Moisture detected in the pump casing (MAH-301). These interlocks are active in both local and remote modes of operation.

Field:

LOCAL/OFF/REMOTE Selector switch (HS-301)
SPEED Control (SK-301)
Fault Reset (HMS-301A)
Pump Start/Stop Pushbutton (HMS-301B/C)

Local:

None

PLC/HMI:

Pump Auto/Manual Selection (HS-301B)
Pump Start/Stop Pushbutton (HS-301C)
Speed Setpoint (SK-301).

Hardware Interlocks:

A LOW LOW Tank Level detected by LSLL-302 shall stop the pump.

A HIGH Pump Discharge Pressure detected by PSH-301 shall stop the pump requiring a local reset.

A HIGH Pump Winding Temperature detected by TSH-301 shall stop the pump requiring a local reset.

An Overload Fault detected by YA-302A shall stop the pump requiring a local reset.

A HIGH Pump Moisture detected by MSH-301 shall not stop the pump but provide a warning alarm to SCADA.

Software Interlocks:

With the Pump in AUTOMATIC mode, a LOW LOW level derived from LI-300 shall stop the pump.

With the Pump in AUTOMATIC mode, a HIGH HIGH derived from LI-300 shall start the pump.

With the Pump in AUTOMATIC mode, if all discharge valves PV322, PV322, PV 323 and PV324 are detected as CLOSED, the pump shall be stopped.

Alarms/Monitoring:

Field:

RUN indication (YL-301)
FAIL ALARM: (YA-301)
HIGH Temperature Alarm (TAH-301)
HIGH Moisture Alarm (MAH-301)
High Discharge Pressure Alarm (PAH-301)

Local :

None

PLC/HMI:

Pump Auto/Manual Status (HS-301B)
RUN indication (YL-301)
SPEED Indication (SI-301)
REMOTE Indication (ZL-301)
Total RUN HOURS (KQI-301)
FAIL Alarm (YA-301)
HIGH Temperature Alarm (TAH-301)
HIGH Moisture Alarm (MAH-301)
High Discharge Pressure Alarm (PAH-301)
Pump Failed to Start (Derived)
Pump Failed to Stop (Derived)
Pump Speed Deviation (Derived)

Fault Response:

Component Failure:

None

Communications Failure:

None

Power Failure:

During Power Outage the Pumps will stop due to loss of power. Upon power restoration, the pumps will operate as called for dependent on the selected mode of operation. Alarms will be re-activated at SCADA upon power restoration.

Data Collection & Trending:

Historical Collection:

See general requirements in 2.01

Trending:

See general requirements in 2.01

E. LOOP CEN_302 Centrate Sump B Pump # 4 (RCENP04) is identical in operation to RCENP03.

F. LOOP CEN_303 Centrate Sump B LOW LOW and HIGH HIGH Level Switches (LSLL-303 and LSHH-303)

PLC: New Remediation PLC

Control:

The LOW LOW level alarm acts as an interlock to inhibit Centrate Sump B pumps when operating when activated, this is hardwired into the local control panel RCENPCP02. The HIGH HIGH level float acts as a backup to start the Centrate pumps should the analog level instrument fail.

Field:

None.

Local:

None.

PLC/HMI:

None.

Hardware Interlocks:

None

Software Interlocks:

None

Alarms/Monitoring:

Field:

None.

Local :

None.

PLC/HMI:

LOW LOW Centrate Sump B Level Switch Alarm (LALL-303)
HIGH HIGH Centrate Sump B Level Switch Alarm (LAHH-303)

Fault Response:

Component Failure:

None.

Communications Failure:

None

Power Failure:

None.

Data Collection & Trending:

Historical Collection:

See general requirements in 2.01

Trending:

See general requirements in 2.01

G. LOOP CEN_321 Centrate Sump to Thickeners Isolation Valve (CENPV321)

PLC: New Remediation PLC

Control:

The Centrate Sump B to Thickeners isolation valve is normally operated in SCADA manual mode, there is no SCADA automatic available.

When the valve's LOCAL/OFF/REMOTE selector switches are placed in REMOTE, the control is made available on SCADA.

Field:

LOCAL/OFF/REMOTE Selector Switch (HS-321A)
OPEN/CLOSE/STOP Selector Switch (HS-321B)

Local:

None.

PLC/HMI:

Valve OPEN Command (HS-321C)
Valve CLOSE Command (HS-321D)

Hardware Interlocks:

Each Valve has an in-built over torque switch hardwired internally to the valve actuator.

Software Interlocks:

None

Alarms/Monitoring:

Field:

Valve FAULT (YA-321)
Valve OPENED Status (ZSO-321)
Valve CLOSED Status (ZSC-321)

Local:

None.

PLC/HMI

Valve OPENED Status (ZLO-321)
Valve CLOSED Status (ZLC-321)
Valve REMOTE Status (ZL-321)
Valve FAULT (YA-321)
Valve Failed to Open (Derived)
Valve Failed To Close (Derived)

Fault Response:

Component Failure:

None.

Communications Failure:

None

Power Failure:

During Power Outage the valve will remain in its last position. Upon power restoration, the valve will operate as called for dependent on the selected mode of operation. Alarms will be re-activated at SCADA upon power restoration.

Data Collection & Trending:

Historical Collection:

See general requirements in 2.01

Trending:

See general requirements in 2.01

H. LOOP CEN_322 Centrate Sump B to Washwater Recovery Isolation Valve (PV322) is identical in operation to PV321.

I. LOOP CEN_323 Centrate Sump B to Sludge Thickeners Isolation Valve (PV323) is identical in operation to PV321.

J. LOOP CEN_324 Centrate Sump B to Sludge Storage Tank # 2 (PV324) is identical in operation to PV321.

3.05 CENTRIFUGE SLUDGE FEED SYSTEM

Reference Drawings: I-7 and I-8.

Overview:

Four new variable speed positive displacement centrifuge sludge feed pumps are provided for pumping thickened sludge from the mixing tanks to the four centrifuges.

The centrifuge feed pumps are fed via a common suction header.

Existing centrifuge feed pumps 1 & 2 are to be removed, replaced and repurposed as Transfer Pumps under this refurbishment. They shall be controlled by the new remediation PLC. Centrifuge Feed Pumps 1, 2, 3 & 4 are entirely new and shall also be controlled from the new remediation PLC. The I/O for all of the new pumps shall all be terminated in the new remediation PLC panel.

When Centrifuge 1, 2, 3 or 4 is called to run via its respective Centrifuge Operator Panel (COP), it also automatically calls for the associated feed pump to start. Normally, Centrifuge feed pump no 1 is assigned to Centrifuge no 1 and Centrifuge feed pump no 2 is assigned to Centrifuge no 2 etc.. This assignment is made manually from the respective COP Operator Interface in combination with the manual valve arrangement.

The Centrifuge Feed Pump Local control is from the VFD faceplate installed in the Local Control Panel adjacent to each pump.

A. LOOP TSLG_430 Centrifuge Feed Pump Flow Controller (FC-430 & FE/FIT-430)

PLC: New Remediation PLC

Control:

A proportional/Integral (PI) flow controller (FC-430) shall be programmed into the PLC whereby the centrifuge feed pump speed (SK-430) is modulated to a desired flow setpoint (FK-430).

Field:

None.

Local:

None.

PLC/HMI:

Flow Controller (FC-430)
Flow Controller Setpoints (FK-430)
LOW Centrifuge Feed Pump 1 Flow Alarm setpoint (FKL-430)
HIGH Centrifuge Feed Pump 1 Flow Alarm setpoint (FKH-430)

Hardware Interlocks:

None

Software Interlocks:

None

Alarms/Monitoring:

Field:

None.

Local :

None.

PLC/HMI:

Centrifuge Feed Pump 1 Flow (LI-430)
LOW Centrifuge Feed Pump 1 Flow Alarm (FAL-430)
HIGH Centrifuge Feed Pump 1 Flow Alarm (FAH-430)

Fault Response:

Component Failure:

If the flow transmitter signal is out of range then the feed pump shall be stopped and forced into manual mode awaiting operator intervention.

Communications Failure:

None

Power Failure:

None

Data Collection & Trending:

Historical Collection:

See general requirements in 2.01

Trending:

See general requirements in 2.01

LOOP TSLG_430 Centrifuge Feed Pump # 1 (RTSLGCTFP01)

PLC:

New Remediation PLC

Control:

Each centrifuge feed pump can be started locally by putting the LOCAL/OFF/REMOTE selector switch at the LCP in the LOCAL position. The pump can be started and stopped using the START/STOP pushbuttons. Pump speed can then be adjusted locally by changing the speed output from the controls at the VFD.

When the LOCAL/OFF/REMOTE selector switch is in the REMOTE position, the Operator may START and STOP the Centrifuge Feed Pump from SCADA. The pump can then be placed into remote MANUAL mode (HS-430D) and started and stopped using HS-430E.

When the LOCAL/OFF/REMOTE switch for the centrifuge feed pump is in the REMOTE position and the pump is placed into SCADA AUTO, the pump shall start and stop automatically and modulate to a discharge flow setpoint signal. The pump flow (sludge feed) setpoint can be adjusted at either the Centrifuge Operating Panel (COP) or in the plant SCADA Centrifuge Screen. The pump start and stop commands in automatic shall be based on the signal from the COP.

Seal water is supplied to the feed pump automatically on startup of the pump, a solenoid is hardwired into the starter and open/closes as the pump start and stops.

Similarly, a flush solenoid is also hardwired in the pump starter, this solenoid is opened after the pump is stopped and remains open for a preset time period initially set at 10 minutes. The timer and the solenoid controls are all hardwired within the starter.

The Centrifuge Feed Pump associated with a particular Centrifuge shall be determined by Operations. Normally Feed Pump # 1 shall be associated with Centrifuge # 1 and Feed Pump # 2 associated with Centrifuge # 2 etc…however, the Operators shall have the ability to assign Feed Pumps to specific Centrifuges so that the calls to run and associated feedback can be aligned.

That said, feed pump RUN status shall be transmitted to SCADA and to the COP for indication.

In both the local and remote modes, when a pump is called to start, OPEN the seal water solenoid valve prior to starting the pump.

If a FAULT is detected in the centrifuge that called the feed pump, the call to run signal shall be removed and the feed pump shall be stopped.

If both the DUTY and STANDBY Mixing tanks levels are at or below the low low level, then no Centrifuges can be started and will be stopped if already running.

Field (VCP):

LOCAL/OFF/REMOTE Selector switch (HS-430A)
START/STOP Pushbuttons (HS-430B)
SPEED Control (SK-430)
RESET Pushbutton (HMS-430)

Local:

None

PLC/HMI:

Pump Auto/Manual Selection (HS-430D)
Pump Start/Stop Pushbutton (HS-430E)

Hardware Interlocks:

A LOW Seal Water FLOW detected by FSL-430 shall stop the pump requiring a local reset.

A HIGH Pump Discharge Pressure detected by PSH-430 shall stop the pump requiring a local reset.

A HIGH Pump Winding Temperature detected by TSH-430 shall stop the pump requiring a local reset.

An Overload Fault detected by YA-430 shall stop the pump requiring a local reset.

Software Interlocks:

With the Pump in AUTOMATIC mode, a LOW LOW Flow alarm derived from FI-430 shall stop the pump.

With the Pump in AUTOMATIC mode, a LOW LOW level in both Sludge mixing tanks derived from LI-410 and LI-420 shall stop the pump.

With the Pump in AUTOMATIC mode, a LOW LOW level in both Sludge mixing tanks as detected by LSLL-410 and LSLL-420 shall stop the pump.

With the Pump in AUTOMATIC mode the pump is started/stopped by the Centrifuge it is feeding if the Centrifuge is stopped or is on fault, the feed pump shall stop.

Alarms/Monitoring:

Field (VCP):

RUN indication (YL-430)
FAIL Alarm: (YA-430)
HIGH Discharge Pressure Alarm (PAH-430)
HIGH Pump Stator Temperature Alarm (TAH-430)
LOW Seal water Flow Alarm (FAL-430)

Local :

None

PLC/HMI:

Pump Auto/Manual Status (HS-430D)
RUN indication (YL-430)
REMOTE Indication (ZL-430)
Total RUN HOURS (KQI-430)
SPEED Indication (SI-430)
HIGH Discharge Pressure Alarm (PAH-430)
HIGH Pump Stator Temperature Alarm (TAH-430)
LOW Seal water Flow Alarm (FAL-430)
Pump Failed to Start Alarm (Derived)
Pump Failed to Stop Alarm (Derived)
Pump Speed Deviation Alarm (Derived)

For each Centrifuge Feed Pump there shall be a “No Flow” alarm that alarms at SCADA when a Pump is called to run or is running and the flow meter indicates a “No Flow” condition (FAL-430). An adjustable time delay (initially set at 15 seconds) shall allow a “No Flow” condition during startup without a “No Flow” alarm.

There shall be a “Flow out of range” warning alarm that alarms at SCADA when the actual flow (measured by the flow meter) is outside the desired flow setpoint by more than a certain range (adjustable setpoint, Default = 10% higher and 10% lower). An adjustable time delay (initially set at 15 seconds) shall allow the flow to deviate from the setpoint flow during startup without causing a warning alarm.

Fault Response:

Component Failure:

None

Communications Failure:

None

Power Failure:

On power failure the feed pump will stop. When power is reinstated the feed pump will start dependent on the selected mode and Centrifuge status.

Data Collection & Trending:

Historical Collection:

See general requirements in 2.01

Trending:

See general requirements in 2.01

C. LOOP TSLG_440 Centrifuge Feed Pump # 2 (RTSLGCTFP02) is identical to that for Centrifuge Feed Pump # 1.

D. LOOPS TSLG_450 & 460 Centrifuge Feed Pumps # 3 and 4 (RTSLGCTFP03 & RTSLGCTFP04) is identical to that for Centrifuge Feed Pumps 1 & 2 with the exception that they have a differing discharge valve arrangement that should also be configured manually.

3.06 CENTRIFUGE SYSTEMS

Reference Drawings: I-9, I-10, I-11 and I-12

Overview:

Two new Centrifuges #'s 3 and 4 are to be added to the existing Centrifuges #'s 1 and 2. Each new Centrifuge shall have its own Operating Panel (COP). New Centrifuge Starter Panels shall supply power to the centrifuge drives and will include the VFDs for the Centrifuge Main Bowl Drives.

Both the new and existing Centrifuges shall convey dewatered sludge to the existing loading conveyors. The existing solids loadout conveyor panel (RDWTCNVCP03) shall be retained and used as a marshalling cabinet for a new loadout conveyor panel (RDWTCNVCP09) to be situated in a more accessible location when the trucks are present. The new panel shall control the replacement unloading conveyors, existing transfer conveyors for Centrifuges 1 and 2, horizontal transfer conveyors for Centrifuges 3 & 4 and also the addition of four gate valves (G240, G242, G260 and G262). A new Remediation PLC located in the Centrifuge Building B control panel (RREMCP01) shall be programmed to control the existing and new Remediation equipment and also allow for better coordination of vendor controlled Centrifuges 1-4. This entails I/O for existing remediation systems that is terminated in existing drop2 2 and 3 be integrated into the new PLC architecture and also the networked Centrifuge 1 & 2 PLC's located in panels

(RCENTP01 and RCENTP02) and their associated Remote I/O chassis located in the respective conveyor panels (RDWTCNVP01 and RDWTCNVCP02) to also be under the scope of the new PLC. Therefore, the coordination of controls for the existing and new Centrifuges shall be governed by the new Remediation PLC.

Each Centrifuge System will be supported by a new Centrifuge Polymer Feed System, Centrifuge Sludge Feed System and Conveyor System. Each COP shall have a dedicated PLC which shall control all aspects of Centrifuge System operation. These PLC's shall interface with the new PLC located in the Centrifuge Building B control panel to facilitate control of the centrifuge feed pumps and polymer dosing pumps.

During normal operation, all of the equipment for one particular system shall be set to Automatic and shall be controlled automatically by the Centrifuge Operating Panel (COP) I.e. RCENTCP01, RCENTCP02, RCENTCP03 and RCENTCP04.

Each Centrifuge shall be controlled locally through its Centrifuge Operating Panel or remotely through SCADA..

A. LOOP DWT_470 Centrifuge # 3 (RDWTCFG03)

PLC: Centrifuge Vendor PLC's

Control:

The Centrifuge System control screen in the PLC/OIS shall allow for control and adjustment of various ancillary equipment and process parameters necessary for control of the Centrifuges which in turn shall be communicated to the COP. These include the Sludge Mixing Tanks, Centrifuge Sludge Feed Pumps, Centrifuge Polymer Feed Pumps and shall be as follows:

Centrifuge Auto Shutdown Initiation Switch. This switch shall allow the operator to initiate an auto shut-down of the Centrifuge through SCADA.

After a start-up has been completed through the COP and the Centrifuge is in operation, the operator shall be capable of entering a shutdown time in SCADA to end a process run.

On startup, the Centrifuge conveyor system shall remain stopped for a pre-determined preset time period whilst the discharge conveyor (RDWTCNV08) runs in reverse allowing the Centrifuge discharge pressure to increase. On expiration of this timer, the discharge conveyor system (RDWTCNV08 and RDWTCNV09) shall be started in the forward direction. The Operator's shall have already started the horizontal transfer conveyor RDWTCNV10, the loadout conveyor and opened the required gate valve(s) manually to deliver the cake to the Truck. At the end of the run cycle, the COP control system will automatically begin a shutdown and cleaning cycle. The Operators shall have to stop the horizontal transfer and loadout conveyor and close the gate valve(s) manually via the local control panel or SCADA.

Centrifuge Pause mode – Pause refers to the temporary stopping and starting of the process pumps (polymer and sludge feed). This feature shall be available through the COP and SCADA allowing the sludge and polymer feed to temporarily stop. The operator

may also select a Bin change pause in which the sludge and polymer shall stop and the washwater valves will open for a variable time to push the majority of the material out the solids end of the machine. Once the wash water de-energizes, spillage will be at a minimum allowing a cleaner method of changing cake bins. In either case, depressing the Resume push button, the process pumps shall restart at the previous settings.

Additionally, all operator interface parameters from the COP PLC shall be made available through an Ethernet connection to the plant PLC. This shall allow each COP to be accessible through the main plant SCADA system.

Mixing Tank Selection to Feed to Centrifuge

The status and availability of each mixing tank shall be displayed on the Centrifuge COP screen.

Centrifuge Sludge Feed Pump Selection

Logic in the plant PLC shall determine which feed pump shall feed the centrifuge based off valve configuration (See section 3.05). The feed pumps running and fault status, sludge flow setpoints and flow indication shall be available on the COP.

Polymer Supply Pumps

The status, availability, flow setpoints and flow indication of each polymer supply pump shall be displayed on the Centrifuge COP screen.

Centrifuge # 3

Field: (RDWTCFGST03)

Centrifuge Bowl Drive Start (HS-410A)
Centrifuge Bowl Drive Speed Setpoint (SK-410)

Centrifuge Backdrive Drive Start (HS-411A)
Centrifuge Bowl Drive Speed Setpoint (SK-411)

Local: (RCENTCP03)

Centrifuge COP BFV-410 Open/Close (HS-410D)

Centrifuge Bowl Drive Hand/Off/Auto (HS-410C)
Centrifuge Bowl Drive Start/Stop (HS-410B)
Centrifuge Bowl Drive Speed Controller (SIC-410)
Centrifuge Bowl Flush Solenoid SOV-410A Open/Close/Auto (HS-410C)

Centrifuge Backdrive Speed Controller (SIC-411)
Centrifuge Backdrive Flush Solenoid SOV-410C Open/Close/Auto (HS-410E

Centrifuge Discharge Conveyor Flush Solenoid SOV-410B Open/Close/Auto (HS-410F)

Common to all Centrifuges

Centrifuge Feed Pump # 1 Flow Setpoint (FK-430)
Centrifuge Feed Pump # 2 Flow Setpoint (FK-440)
Centrifuge Feed Pump # 3 Flow Setpoint (FK-450)
Centrifuge Feed Pump # 4 Flow Setpoint (FK-460)
Polymer Feed Pump # 1 Flow Setpoint (SK-561)
Polymer Feed Pump # 2 Flow Setpoint (SK-562)
Polymer Feed Pump # 3 Flow Setpoint (SK-563)
Polymer Feed Pump # 4 Flow Setpoint (SK-564)

PLC/HMI:

Centrifuge COP Running (YL-410C)
Centrifuge BFV-410 Opened (ZLO-410)
Centrifuge BFV-410 Closed (ZLC-410)
Centrifuge Flush Flow Indication (FI-410)

Centrifuge Bowl Drive Hand-Off-Auto (ZL-410)
Centrifuge Bowl Drive Start/Stop (HS-410E)
Centrifuge Bowl Drive Speed Controller (SK-410)

Hardware Interlocks:

If the Bowl drive is detected as FAILED (YA-410A) the Centrifuge shall be stopped.

If the Backdrive is detected as FAILED (YA-411A) the Centrifuge shall be stopped.

If the Bowl Drive HIGH HIGH vibration alarm is detected (VAHH-410A) the Centrifuge shall be stopped.

If the Bowl Drive HIGH HIGH temperature alarm is detected (TAHH-410A) the Centrifuge shall be stopped.

If the Centrifuge Emergency Stop is Activated (HS-410B) the Centrifuge shall be stopped and require a manual reset.

Software Interlocks:

Should either of the centrifuge discharge or transfer conveyors fail, then the associated centrifuge shall be shutdown and the fault addressed before attempting a restart.

Should the assigned centrifuge feed pump fail then the associated centrifuge shall be shutdown and the fault addressed before attempting a restart.

Should the assigned polymer feed pump fail then the associated centrifuge shall be shutdown and the fault addressed before attempting a restart.

Should the Duty mixing tank become unavailable (I.e. empty) then the standby Mixing tank shall be assigned as duty.

Should both Duty and STANDBY mixing tank become unavailable (I.e. empty) then the Centrifuge shall be stopped.

Should a single unloading conveyor fail, then an alarm condition shall be raised locally and on SCADA but Centrifuge operations shall not shutdown as the conveyors are common to all Centrifuges.

Should both unloading conveyor fail, then Centrifuge operations shall shutdown as the conveyors are common to all Centrifuges.

Alarms/Monitoring:

Field: (RDWTCFGST03)

Centrifuge Bowl Drive Fault Alarm (YA-410A)
Centrifuge Bowl Drive Running (YL-410A)
Centrifuge Backdrive Fault Alarm (YA-411A)
Centrifuge Backdrive Drive Running (YL-411A)
Centrifuge Backdrive Drive Current (II-411)

Local (RCENTCP03) :

Centrifuge COP Power On/Off (JL-410)
Centrifuge COP E-Stop (HS-410B)
Centrifuge COP Silence (HMS-410A)
Centrifuge COP Reset (HMS-410B)
Centrifuge COP Running (YL-410B)
Centrifuge COP Fault Alarm (YA-410D)
Centrifuge COP Trouble Alarm (YA-410C)
Centrifuge COP BFV-410 Opened (ZLO-410)
Centrifuge COP BFV-410 Closed (ZLC-410)

Centrifuge Bowl Drive Vibration (VI-410)
Centrifuge Bowl Drive Temperature (TI-410)
Centrifuge Bowl Drive Fault Alarm (YA-410B)
Centrifuge Bowl Drive High Vibration Alarm (VAH-411A)
Centrifuge Bowl Drive High High Vibration Alarm (VAHH-411A)
Centrifuge Bowl Drive High Temperature Alarm (TAH-411A)
Centrifuge Bowl Drive High High Temperature Alarm (TAHH-411A)

Centrifuge Backdrive Running (YL-411B)
Centrifuge Backdrive Fault Alarm (YL-411B)
Centrifuge Backdrive Pressure (PI-411)
Centrifuge Backdrive Temperature (TI-411)

Centrifuge Backdrive High Temperature Alarm (TAH-411A)
Centrifuge Backdrive Low Pressure Alarm (PAL-411A)
Centrifuge Backdrive Sump Low Level Alarm (LAL-411A)
Centrifuge Backdrive Filter Alarm (YA-411C)

Common to all Centrifuges

Storage & Mixing Tank # 1 Status (UI-400-1)
Storage & Mixing Tank # 2 Status (UI-400-2)
Centrifuge Feed Pump # 1 Run Status (YL-430)
Centrifuge Feed Pump # 1 Fault Alarm (YA-430)
Centrifuge Feed Pump # 1 Flow (FI-430)
Centrifuge Feed Pump # 2 Run Status (YL-440)
Centrifuge Feed Pump # 2 Fault Alarm (YA-440)
Centrifuge Feed Pump # 2 Flow (FI-440)
Centrifuge Feed Pump # 3 Run Status (YL-450)
Centrifuge Feed Pump # 3 Fault Alarm (YA-450)
Centrifuge Feed Pump # 3 Flow (FI-450)
Centrifuge Feed Pump # 4 Run Status (YL-460)
Centrifuge Feed Pump # 4 Fault Alarm (YA-460)
Centrifuge Feed Pump # 4 Flow (FI-460)
Polymer Feed Pump # 1 Run Status (YL-561)
Polymer Feed Pump # 1 Fault Alarm (YA-561)
Polymer Feed Pump # 1 Flow (FI-571)
Polymer Feed Pump # 2 Run Status (YL-562)
Polymer Feed Pump # 2 Fault Alarm (YA-562)
Polymer Feed Pump # 2 Flow (FI-572)
Polymer Feed Pump # 3 Run Status (YL-563)
Polymer Feed Pump # 3 Fault Alarm (YA-563)
Polymer Feed Pump # 3 Flow (FI-573)
Polymer Feed Pump # 4 Run Status (YL-564)
Polymer Feed Pump # 4 Fault Alarm (YA-564)
Polymer Feed Pump # 4 Flow (FI-574)

PLC/HMI:

Centrifuge COP Run Status (YL-410C)
Centrifuge COP Fault Alarm (YA-410E)
Centrifuge COP Trouble Alarm (YA-410F)

Centrifuge Bowl Drive Speed Indication (SI-410)
Centrifuge Bowl Drive Auto Indication (ZL-410)
Centrifuge Bowl Drive Vibration Indication (VI-410B)
Centrifuge Bowl Drive High Vibration Alarm (VAH-410B)
Centrifuge Bowl Drive High High Vibration Alarm (VAHH-410B)
Centrifuge Bowl Drive Temperature Indication (TI-410B)
Centrifuge Bowl Drive High Temperature Alarm (TAH-410B)
Centrifuge Bowl Drive High High Temperature Alarm (TAHH-410B)

Centrifuge Backdrive Run Indication (YL-411C
Centrifuge Backdrive Pressure Indication (PI-411B)
Centrifuge Backdrive Fault Alarm (YA-411C)
Centrifuge Backdrive Temperature Indication (TI-411B)
Centrifuge Backdrive High Temperature Alarm (TAH-411B)
Centrifuge Backdrive Low Pressure Alarm (PAL-411B)
Centrifuge Backdrive Sump Low Level Alarm (LAL-411B)
Centrifuge Backdrive Filter Alarm (YA-411C)

Fault Response:

Component Failure:

None

Communications Failure:

None

Power Failure:

Power Outage and Restore Operation: During Power Outage the Centrifuge System will de-energize and stop due to loss of power. During Power Outage the alarms associated with the Centrifuge Systems will be de-activated at SCADA. Upon Power Restore the Centrifuge Systems will remain Stopped and await Operator local Reset and manual initiate to restart system. Also when Power Restored the Centrifuge Systems alarms will be re-activated at SCADA.

Data Collection & Trending:

Historical Collection:

See general requirements in 2.01

Trending:

See general requirements in 2.01

B. LOOP DWT_420 Centrifuge # 4 (RDWTCFG04) is identical to that for Centrifuge # 3 (RDWTCFG03).

C. LOOP DWT_ 422 Inclined Discharge Conveyor (RDWTCNV08)

PLC: Centrifuge Vendor PLC's

Control:

On startup, the Centrifuge discharge conveyor shall run in reverse for a pre-determined preset time period allowing the Centrifuge discharge pressure to increase. On expiration of this timer, the discharge conveyor system (RDWTCNV08 and RDWTCNV09) will be started and run in a forward's direction to deliver the cake to the horizontal transfer and loading conveyors.

To operate the conveyor automatically in this mode, the conveyor shall be switched into remote mode at panel RDWTCNVCP07 (HS-422D).

The conveyor can be operated in local manual mode when switched into local mode at panel RDWTCNV11 (HS-422D) and then via start/stop switch (HS-422E) and forward/reverse switch (HS-422F).

If a low speed is detected by SSL-422 then the conveyor shall be stopped requiring a local reset via (HS-422A).

Field:

Solids Horizontal Discharge Conveyor # 3 Shutdown Reset (HS-422A)
Solids Horizontal Discharge Conveyor # 3 Emergency Stop (HS-422B)
Solids Horizontal Discharge Conveyor # 3 Reset Pushbutton (HS-422C)
Solids Horizontal Discharge Conveyor # 3 Local/Remote Switch (HS-422D)
Solids Horizontal Discharge Conveyor # 3 Start/Stop Pushbuttons (HS-422E)
Solids Horizontal Discharge Conveyor # 3 Fwd/Rev Switch (HS-422F)

Local (COP):

Solids Horizontal Discharge Conveyor # 3 Run Fwd Command (HS-422F)
Solids Horizontal Discharge Conveyor # 3 Run Rev Command (HS-422G)

PLC/HMI:

Solids Horizontal Discharge Conveyor # 3 Run Fwd Command (HS-422F)
Solids Horizontal Discharge Conveyor # 3 Run Rev Command (HS-422G)

Hardware Interlocks:

If the Conveyor is detected as SHUTDOWN (YA-422A) the Conveyor shall be stopped and require a manual reset..

If the Conveyor Emergency Stop is Activated (HS-422) the Conveyor shall be stopped and require a manual reset.

If the Conveyor is detected to have a LOW SPEED alarm (SAL-422A) and is potentially clogged, the Conveyor shall be stopped and require a manual reset.

Software Interlocks:

None

Alarms/Monitoring:

Field:

Solids Horizontal Discharge Conveyor # 3 Shutdown Alarm (YA-422)
Solids Horizontal Discharge Conveyor # 3 Low Speed Alarm (SAL-422A)
Solids Horizontal Discharge Conveyor # 3 Ready Status (YL-422A)
Solids Horizontal Discharge Conveyor # 3 Run Forward Status (YL-422B)
Solids Horizontal Discharge Conveyor # 3 Run Reverse Status (YL-422C)
Solids Horizontal Discharge Conveyor # 3 Loadout Status (YL-422D)

Local (COP):

Solids Horizontal Discharge Conveyor # 3 Shutdown Alarm (YA-422A)
Solids Horizontal Discharge Conveyor # 3 Low Speed Alarm (SAL-422B)
Solids Horizontal Discharge Conveyor # 3 Remote Status (YL-422E)
Solids Horizontal Discharge Conveyor # 3 Run Forward Status (YL-422E)
Solids Horizontal Discharge Conveyor # 3 Run Reverse Status (YL-422F)

PLC/HMI:

Solids Horizontal Discharge Conveyor # 3 Shutdown Alarm (YA-422A)
Solids Horizontal Discharge Conveyor # 3 Low Speed Alarm (SAL-422B)
Solids Horizontal Discharge Conveyor # 3 Remote Status (YL-422E)
Solids Horizontal Discharge Conveyor # 3 Run Forward Status (YL-422E)
Solids Horizontal Discharge Conveyor # 3 Run Reverse Status (YL-422F)

Fault Response:

Component Failure:

None

Communications Failure:

None

Power Failure:

Power Outage and Restore Operation: During Power Outage the Centrifuge Conveyor system will de-energize and stop due to loss of power. During Power Outage the alarms associated with the Centrifuge Systems will be de-activated at SCADA. Upon Power Restore, the Centrifuge conveying systems will remain Stopped

and await Operator local Reset and manual initiate to restart system. Also, when Power Restored the Centrifuge Systems alarms will be re-activated at SCADA.

Data Collection & Trending:

Historical Collection:

See general requirements in 2.01

Trending:

See general requirements in 2.01

D. LOOP DWT_423 Vertical Discharge Conveyor (RDWTCNV09) is identical to that for the Horizontal Discharge Conveyor (RDWTCNV10) with the exception that it does not run in reverse on startup and that it is controlled from RDWTCNVCP08.

E. LOOP DWT_426 Horizontal Transfer Conveyor (RDWTCNV10) is identical to that for the Horizontal Discharge Conveyor (RDWTCNV09) with the exception that it is started manually and that it is controlled from RDWTCNVCP09.

F. LOOP DWT_ 424 Horizontal Transfer Conveyor Gate (G424)

PLC: Centrifuge Vendor PLC's

Control:

The Centrifuge conveyor when called to run by the COP shall also send an open command to the gate valves G424 and G425. On completion of the run sequence the close command shall be issued by the COP.

The horizontal transfer conveyor can deliver to either unloading conveyor, should operations wish to leave a particular gate valve closed during centrifuge operation then the valve should be switched into local mode at panel RDWTCNVCP09 or switched into Manual mode at the COP.

To operate the valve in automatic mode by commands from the COP then the valve should be switched into remote mode at panel RDWTCNVCP09 (HS-424C) and automatic mode at the COP.

To operate the gate valve in remote manual mode from SCADA or the COP, the valve should be switched into remote at panel RDWTCNVCP09 (HS-424C) and manual mode at the COP.

The above controls assume that the valve is in remote mode at the valve actuator itself.

Field:

Sliding Gate 424 Local/Remote Switch (HS-424A)
Sliding Gate 424 Open/Close Switch (HS-424B)

Local (RDWTCNVCP08):

Sliding Gate 424 Local/Remote Switch (HS-424C)
Sliding Gate 424 Open/Close Switch (HS-424D)

PLC/HMI:

Sliding Gate 424 Open Command (HS-424E)
Sliding Gate 424 Close Command (HS-424F)

Local (COP):

Sliding Gate 424 Open Command (HS-424E)
Sliding Gate 424 Close Command (HS-424F)

Alarms/Monitoring:

Field:

Sliding Gate 424 Fault Status (YA-424)

Local (RDWTCNVCP08):

Sliding Gate 424 Opened Status (ZLO-424B)
Sliding Gate 424 Closed Status (ZLC-424B)

PLC/HMI:

Sliding Gate 424 Remote Status (ZL-424)
Sliding Gate 424 Opened Status (ZLO-424C)
Sliding Gate 424 Closed Status (ZLC-424C)

Fault Response:

Component Failure:

None

Communications Failure:

None

Power Failure:

Power Outage and Restore Operation: During Power Outage gate valve will remain in its last position due to loss of power. During Power Outage the alarms associated with the Centrifuge Systems will be de-activated at SCADA. Upon Power Restore the Centrifuge Systems will remain Stopped and await Operator local Reset and manual

initiate to restart system. Also when Power Restored the Centrifuge Systems alarms will be re-activated at SCADA.

Data Collection & Trending:

Historical Collection:

See general requirements in 2.01

Trending:

See general requirements in 2.01

G. LOOP DWT_425 Horizontal Transfer Conveyor Gate (G425) is identical to that for the Horizontal Transfer Conveyor Gate (G424).

H. LOOP DWT_236 Unloading Conveyor # 1 Gate (G236) is identical to that for the Horizontal Transfer Conveyor Gate (G424) but the local panel is RDWTCNVCP09.

I. LOOP DWT_238 Unloading Conveyor # 1 Gate (G238) is identical to that for the Horizontal Transfer Conveyor Gate (G424) but the local panel is RDWTCNVCP09.

J. LOOP DWT_240 Unloading Conveyor # 1 Gate (G240) is identical to that for the Horizontal Transfer Conveyor Gate (G424) but the local panel is RDWTCNVCP09.

K. LOOP DWT_242 Unloading Conveyor # 1 Gate (G242) is identical to that for the Horizontal Transfer Conveyor Gate (G424) but the local panel is RDWTCNVCP09.

L. LOOP DWT_256 Unloading Conveyor # 2 Gate (G256) is identical to that for the Horizontal Transfer Conveyor Gate (G424) but the local panel is RDWTCNVCP09.

M. LOOP DWT_258 Unloading Conveyor # 2 Gate (G258) is identical to that for the Horizontal Transfer Conveyor Gate (G424) but the local panel is RDWTCNVCP09.

N. LOOP DWT_260 Unloading Conveyor # 2 Gate (G260) is identical to that for the Horizontal Transfer Conveyor Gate (G424) but the local panel is RDWTCNVCP09.

O. LOOP DWT_262 Unloading Conveyor # 2 Gate (G262) is identical to that for the Horizontal Transfer Conveyor Gate (G424) but the local panel is RDWTCNVCP09.

P. LOOP DWT_ 232 Unloading Conveyor (RDWTCNV05)

PLC: Centrifuge Vendor PLC's

Control:

The unloading conveyor system (RDWTCNV05 and RDWTCNV06) will be predominantly operated in a manual mode from the panel RDWTCNVCP09. The Operators shall determine which conveyor to operate and which direction the conveyor should move in.

It shall also be possible to control the conveyors from the COP or SCADA.

The conveyor can be operated in local manual mode when switched into local mode at panel RDWTCNVCP09 (HS-232D) and then via start/stop switch (HS-232E) and forward/reverse switch (HS-232F).

If a low speed is detected by SSL-232 then the conveyor shall be stopped requiring a local reset via switch (HS-232C).

Field (RDWTCNVCP09):

Solids Loadout Conveyor # 1 Emergency Stop (HS-232B)
Solids Loadout Conveyor # 1 Reset Pushbutton (HS-232C)
Solids Loadout Conveyor # 1 Shutdown Reset Pushbutton (HS-232A)
Solids Loadout Conveyor # 1 Local/Remote Switch (HS-232D)
Solids Loadout Conveyor # 1 Start/Stop Pushbuttons (HS-232E)
Solids Loadout Conveyor # 1 Fwd/Rev Switch (HS-232F)

Local (COP):

Solids Loadout Conveyor # 1 Start/Stop Pushbuttons (HS-232G/H)
Solids Loadout Conveyor # 1 Fwd/Rev Switch (HS-232I)

PLC/HMI:

Solids Loadout Conveyor # 1 Start/Stop Pushbuttons (HS-232G/H)
Solids Loadout Conveyor # 1 Fwd/Rev Switch (HS-232I)

Alarms/Monitoring:

Field (RDWTCNVCP09):

Solids Loadout Conveyor # 1 Shutdown Alarm (YA-232A)
Solids Loadout Conveyor # 1 Low Speed Alarm (SAL-232A)
Solids Loadout Conveyor # 1 Ready Status (YL-232A)
Solids Loadout Conveyor # 1 Loadout Status (YL-232D)
Solids Loadout Conveyor # 1 Run Forward Status (YL-232B)
Solids Loadout Conveyor # 1 Run Reverse Status (YL-232C)

Local (COP):

Solids Loadout Conveyor # 1 Shutdown Alarm (YA-232B)
Solids Loadout Conveyor # 1 Low Speed Alarm (SAL-232B)
Solids Loadout Conveyor # 1 Remote Status (YL-232E)
Solids Loadout Conveyor # 1 Run Forward Status (YL-232F)
Solids Loadout Conveyor # 1 Run Reverse Status (YL-232G)

PLC/HMI:

Solids Loadout Conveyor # 1 Shutdown Alarm (YA-232B)
Solids Loadout Conveyor # 1 Low Speed Alarm (SAL-232B)
Solids Loadout Conveyor # 1 Remote Status (YL-232E)
Solids Loadout Conveyor # 1 Run Forward Status (YL-232F)
Solids Loadout Conveyor # 1 Run Reverse Status (YL-232G

Fault Response:

Component Failure:

None

Communications Failure:

None

Power Failure:

Power Outage and Restore Operation: During Power Outage the Centrifuge Conveyor system will de-energize and stop due to loss of power. During Power Outage the alarms associated with the Centrifuge Systems will be de-activated at SCADA. Upon Power Restore, the Centrifuge conveying systems will remain Stopped and await Operator local Reset and manual initiate to restart system. Also when Power Restored the Centrifuge Systems alarms will be re-activated at SCADA.

Data Collection & Trending:

Historical Collection:

See general requirements in 2.01

Trending:

See general requirements in 2.01

Q. LOOP DWT_252 Unloading Conveyor # 2 (RDWTCNV06) is identical to that for the Unloading Conveyor # 1 (RDWTCNV05).

3.07 DEWATERING POLYMER BATCHING SYSTEM

Reference Drawings: I-14, I-15, I-16, I-17, I-18

Overview:

The Dewatering Polymer Batching System is provided to prepare cationic Polymer (supplied in a Tote) into a dilute solution to serve as a dewatering aid to the Centrifuges.

The raw Polymer is stored in a bulk storage tank where it feeds two Polymer Blending Units. Each Blending Unit is a vendor supplied package incorporating a transfer pump, Polymer mixing chamber and microcontroller. Each Blending Unit supplies a Polymer solution to a batch tank. The On/Off operation of the Blending Unit is based on the level in that tank. The Blending Unit (and associated transfer pump) is called to run when the level in the associated tank falls below a low level setpoint. Once called to run, the Blending Unit shall produce a Polymer solution based off parameters entered at the local microcontroller operator interface. The unit shall stop once the level in the associated batch tank rises above a high level setpoint. The discharge of each transfer pump has a mixing chamber where the raw Polymer is mixed with utility water to make a 1% solution of Polymer whilst transferring to the batch tanks. The resultant Polymer solution is aged in the batch tanks where it is constantly homogenized.

The Operator enters the required concentration of the Polymer solution at the local microcontroller operator interface. The microcontroller monitors the flow of neat Polymer and dilution water into the unit which in combination with the speed of the pump and the dilution water supply solenoid enables the microcontroller to produce a batch of the required solution strength.

The batch tanks in turn feed a common supply line the Polymer feed pumps.

Four Polymer feed pumps are provided for feeding Polymer to the four Centrifuges, a fifth pump feeds the Gravity Thickeners. Feed Pumps 1 & 2 were originally controlled by existing plant PLC 3 but shall now be under the control of the new residuals PLC. Under normal operations, Feed pump 1 is assigned to Centrifuge 1, Feed pump 2 to Centrifuge 2, Feed pump 3 to Centrifuge 3 and Feed pump 4 to Centrifuge 4. However, it is possible to manually configure the discharge valve arrangement of the feed pumps to supply any Centrifuge with any pump.

Important Note: The Centrifuge system COP[s] shall be configured manually via the COP Operator interface so that it provides the calculated dosing speed setpoint to the correct Feed pump.

Under normal automatic operation, the Polymer feed pumps receive their start/stop commands and speed setpoint from the Centrifuge COP that they are feeding, the respective COP calculates the speed based off the required Polymer dosage.

A. LOOP PLM_511 Polymer Transfer Pump #1 (RPLMTP01)

PLC: New Remediation PLC

Control:

Each Polymer Transfer Pump and integral Blending Unit is located on an independent vendor skid, there are two in total. Each skid contains a microcontroller that deals with mixing of neat polymer and utility water to reach the desired concentration.

The controller can be placed in Local mode by setting its HAND/OFF/REMOTE switch to the HAND position. When in HAND, the vendor provided embedded controller is used to start/stop the unit. The integral mixer, Transfer pump and inlet solenoid are controlled solely by the vendor skid and cannot be directly controlled by the plant PLC.

When the HAND/OFF/REMOTE switch is in the REMOTE position, the Blending Unit receives its commands to run from the plant PLC. There is an additional INTERNAL/EXTERNAL software mode selection made at the Blending Unit operator interface that determines the speed of the Transfer pump. When placed into INTERNAL mode, the Blending Unit shall receive On/Off commands from the plant PLC based off batch tank level and calculate the Transfer pump speed based of required solution strength in combination with now neat polymer and utility water flow. When placed into EXTERNAL mode, the Blending Unit shall receive On/Off commands and CONCENTRATION from the plant PLC. In EXTERNAL mode, the Blending Unit is still responsible for calculating the Transfer Pump speed and coordinating the utility wtare solenoid controls.

The plant PLC also monitors the status of the batch tanks. The Blending Unit skids are in a duty/standby arrangement, the DUTY select switch on SCADA (HS-500) shall enable selection of either unit if selected to remote (ZL-512/ZL-522).

The plant PLC shall firstly attempt to fill batch tank # 1. If the tank inlet solenoid SV513 is in automatic mode and the batch tank HIGH level (LAH-531) has not been reached (indicating it has been filled) then SV513 shall be OPENED, SV523 shall be CLOSED and the DUTY Blending Unit shall be called to run, the Unit shall operate until the HIGH level in batch tank # 1 is reached.

If either SV513 is in manual mode or batch tank # 1 is in a filled state, then the system shall attempt to fill batch tank # 2, SV513 shall be commanded to CLOSE, SV523 is OPENED and the DUTY Blending Unit is started and runs until the tank HIGH level (LAH-541) is reached. The tanks ‘filled’ status shall not be reset until the tanks LOW level (LAL-531) has been reached.

If a Blending Unit fails during a transfer (YA-512/YA/522), then the STANDBY Blending Unit shall become DUTY and the transfer shall continue.

The Concentration of the Blending Unit (AK-512/AK-522) is manually set by operations prior to the transfer at either the local Blending Unit Operator Interface of the plant SCADA system. Additionally, the Blending Unit has an INTERNAL/EXTERNAL mode selection that configures the Unit to accept the local or remote CONCENTRATION setpoint.

Field:

None

Local: (VCP)

Blending Unit Controller Hand/Off/Remote Switch
Blending Unit Controller Internal/External Software Switch(HS-512B)
Blending Unit Controller Concentration Setpoint (AK-512A)

PLC/HMI:

Blending Unit Controller Concentration Setpoint (AK-512B)
Blending Unit Controller On/Off Command (HS-512)

Hardware Interlocks:

A HIGH Pump Discharge Pressure detected by PSH-512 shall stop the blending unit and pump.

A HIGH Pump Winding Temperature detected by TSH-511 shall stop the blending unit and pump.

A LOW Discharge flow detected by FAL-512 shall stop the blending unit and pump.

An Overload Fault detected by YA-511 shall stop the blending unit and pump.

Software Interlocks:

With the Blending Unit in REMOTE mode, a HIGH HIGH level alarm detected in both batch tanks LAHH-531 and LAHH-541 derived respectively from level transmitters LIT-531 and LIT-541 shall stop the blending unit and pump.

Alarms/Monitoring:

Field:

None

Local: (VCP)

Blending Unit Controller Low Flow Alarm (FAL-512)
Blending Unit Controller Neat Polymer Flow (FI-512A)
Blending Unit Controller Primary Dilution Flow (FI-512B)
Blending Unit Controller Secondary Dilution Flow (FI-512B)
Blending Unit Controller Discharge Solution Concentration (AI-512B)

PLC/HMI:

Blending Unit Remote Status (ZL-512)
Blending Unit Run Status (YL-512)
Blending Unit Controller Low Flow Alarm (FAL-512B)

Fault Response:

Component Failure:

None

Communications Failure:

None

Power Failure:

Power Outage and Restore Operation: During Power Outage the Polymer Transfer pump System will de-energize and stop due to loss of power. During Power Outage the alarms associated with the Polymer Transfer will be de-activated at SCADA. Upon Power Restore the Polymer Transfer will automatically re-initiate a transfer if previously active. When Power Restored the Polymer Transfer Systems alarms will be re-activated at SCADA.

Data Collection & Trending:

Historical Collection:

See general requirements in 2.01

Trending:

See general requirements in 2.01

B. LOOP PLM_522 Polymer Blending Unit skid # 2 (RPLMTP02) is identical to that for Polymer Blending Unit skid # 1 (RPLMTP01)

C. LOOP PLM_531 Batch Tank #1 Mixer (RPLMTMX01)

PLC: New Remediation PLC

Control:

Each Tank Mixer can be started locally by putting the LOCAL/OFF/REMOTE selector switch (HS-531) at the LCP in the LOCAL position. The Mixer can then be started and stopped using the START/STOP pushbuttons (HMS-531A/B). Mixer speed can then be adjusted locally by changing the speed control (SK-531A).

When the LOCAL/OFF/REMOTE selector switch is in the REMOTE position and selected to MANUAL (HS-531C), the Operator can start/stop the Mixer from SCADA. The Mixer is then started and stopped using the start/stop commands (HS-531B).

When the LOCAL/OFF/REMOTE switch for the Mixer is in the REMOTE position and the Mixer is placed into SCADA AUTO, the Mixer shall START if the low level alarm is not activated. The Mixer shall STOP if the low level alarm is activated and remain stopped until the alarm condition can be reset.

The Duty blending unit shall also determine which Batch Tank is drawn from. If the batch tank # 1 isolation solenoid SV531 is in automatic mode and Blending Unit # 1 is the DUTY system then then SV531 shall be OPENED and SV541 shall be CLOSED.

Field:

None.

Local: (VCP)

Mixer Local/Off/Remote Switch (HS-531A)
Mixer Start/Stop Pushbuttons (HMS-531A/B)
Mixer Speed Control (SK-531A)

PLC/HMI:

Mixer Start/Stop Commands (HS-531B)
Mixer Auto/Manual Commands (HS-531C)
Mixer Speed Command (SK-531B)
LOW LOW Batch Tank # 1 Level Alarm setpoint (LKLL-531)
LOW Batch Tank # 1 Level Alarm setpoint (LKL-531)
HIGH Batch Tank # 1 Level Alarm setpoint (LKH-531)
HIGH HIGH Batch Tank # 1 Level Alarm setpoint (LKHH-531)

Hardware Interlocks:

A LOW LOW Level alarm detected by LALL-531 and derived from LIT-531 shall stop the mixer.

An VFD Fault detected by YA-531A shall stop the mixer.

Software Interlocks:

None.

Alarms/Monitoring:

Field:

None

Local: (VCP)

Mixer Run Status (YL-531)
Mixer Fault Status (YA-531)
Mixer Speed Indication (SI-531)
Batch Tank # 1 Level (LE/LIT-531)
Batch Tank # 1 Low Level Alarm (LAL-531)
Batch Tank # 1 High Level Alarm (LAH-531)

PLC/HMI:

Mixer Auto/Manual Status (HS-531A)
Mixer Run Status (YL-531)
Mixer Runtime Status (KQI-531)
Mixer Remote Status (ZL-531)
Mixer Fault Status (YA-531)
Mixer Speed Indication (SI-531)
Mixer Failed to Start Alarm (Derived)
Mixer Failed to Stop Alarm (Derived)
Batch Tank # 1 Level (LI-531)
Batch Tank # 1 Level TX Failed (YA-531)
Batch Tank # 1 Low Low Level Alarm (LALL-531)
Batch Tank # 1 Low Level Alarm (LAL-531)
Batch Tank # 1 High Level Alarm (LAH-531)
Batch Tank # 1 High High Level Alarm (LAHH-531)
Batch Tank # 1 Isolation Solenoid Auto/Manual (HS-531B)
Batch Tank # 1 Isolation Solenoid Open/Close (HS-531A)

Fault Response:

Component Failure:

None

Communications Failure:

None

Power Failure:

Power Outage and Restore Operation: During Power Outage the Mixer will de-energize and stop due to loss of power. During Power Outage the alarms associated with the Mixer will be de-activated at SCADA. Upon Power Restore, the Mixer will re-start if the level in the tank is above the low level. When Power Restored the Mixer alarms will be re-activated at SCADA.

Data Collection & Trending:

Historical Collection:

See general requirements in 2.01

Trending:

See general requirements in 2.01

D. LOOP PLM_541 Batch Tank #2 Mixer (RPLMTMX02) is identical to that for Batch Tank #2 Mixer (RPLMTMX01)

E. LOOP PLM_561 Polymer Feed Pump # 1 (RPLMPF01)

PLC:

New Remediation PLC (Feed Pumps 1,2,3,4 & 5)

Control:

Each Polymer feed pump can be started and stopped by locally by placing the LOCAL/OFF/REMOTE in the LOCAL position at the VFD and using the START/STOP pushbuttons and speed control settings.

Remote manual control is achieved when the LOCAL/OFF/REMOTE selector switch at the VFD is in the REMOTE position and the AUTO/MANUAL selector switch on SCADA is in MANUAL, the Operator may START and STOP the Polymer feed pump manually and control the pumps speed from the SCADA.

When the Polymer feed pump LOCAL/OFF/REMOTE selector switch is in REMOTE, and AUTO/MANUAL switch is in AUTO on SCADA, the pump shall be started and stopped based off Centrifuge operations. Feed pump 1 shall be started/stopped based off the Centrifuge 1 startup sequence. The Centrifuge 1 COP is constantly passing the start/stop command and desired speed setpoint command to the new remediation PLC, when the feed pump is in automatic mode the feed pump responds to these commands.

Field:

None

Local:

LOCAL/OFF/REMOTE Selector switch (HS-561A)
SPEED Control (SK-561A)
Fault Reset (HMS-561C)
Pump Start/Stop Pushbutton (HMS-561A/B)

PLC/HMI:

Pump Auto/Manual Selection (HS-561B)
Pump Start/Stop Pushbutton (HS-561C)
Speed Setpoint (SK-561B)

Hardware Interlocks:

A HIGH Pump Discharge Pressure detected by PSH-561 shall stop the pump.

A LEAK in the pump housing as detected by XS-561A shall stop the pump.

An VFD Fault detected by YA-561A shall stop the pump.

Software Interlocks:

With the pump in the remote mode, when a feed pump is called to START or is already running and a controlling Centrifuge FAULT condition is detected, the feed pump shall be STOPPED.

Alarms/Monitoring:

Field:

None

Local :

RUN indication (YL-561A)
FAIL Alarm: (YA-561A)
HIGH Discharge Pressure Alarm (PAH-561A).
Diaphragm LEAK Alarm (XA-561A)

PLC/HMI:

Pump Auto/Manual Status (HS-561B)
RUN indication (YL-561B)
SPEED Indication (SI-561B)
REMOTE Indication (ZL-561)
Total RUN HOURS (KQI-561)
FAIL Alarm (YA-561B)
Pump Failed to Start Alarm (Derived)
Pump Failed to Stop Alarm (Derived)
HIGH Discharge Pressure Alarm (PAH-561B).
Diaphragm LEAK Alarm (XA-561B)

Fault Response:

Component Failure:

None

Communications Failure:

None

Power Failure:

During Power Outage the Pumps will not operate due to loss of power. The feed pump alarms will be de-activated at SCADA during Power Outage. Upon power restoration, pumps 1 to 4 that are driven by Centrifuge operations will not restart until centrifuge operations are resumed manually. Pump 5 shall start in the mode of operation prior to the power failure. Alarms will be re-activated at SCADA upon power restoration.

Data Collection & Trending:

Historical Collection:

See general requirements in 2.01

Trending:

See general requirements in 2.01

F. LOOP PLM_562 Polymer Feed Pump # 2 (RPLMFP02) is identical to that for Feed Pump # 1 (RPLMFP01)

G. LOOP PLM_563 Polymer Feed Pump # 3 (RPLMFP03) is identical to that for Feed Pump # 1 (RPLMFP01)

H. LOOP PLM_564 Polymer Feed Pump # 4 (RPLMFP04) is identical to that for Feed Pump # 1 (RPLMFP01)

I. LOOP PLM_565 Polymer Feed Pump # 5 (RPLMFP05) is identical to that for Feed Pump # 1 (RPLMFP01) with the exception that there is no automatic mode the speed command is derived from a flow pace calculation based on thickener inlet flow.

J. LOOP PLM_571 Polymer Feed Pump # 1 Flow Indication & Carrier Water Solenoid (FE/FIT-571 & SV571)

PLC: New Remediation PLC

Control:

When the Polymer feed pump is in AUTO on SCADA, the pump shall be started and stopped based off Centrifuge operations. When the feed pump started whilst operating in this mode and the solenoid is also switched to AUTO, the carrier water solenoid will be OPENED and stay open whilst the pump is called to run, when the pump is stopped the carrier water solenoid is CLOSED.

When the solenoid is in SCADA manual mode (HS-571A), the solenoid can be controlled manually using open/close commands (HS-571B).

The mode of the solenoid valve does not affect operation of the associated feed pumps.

Field:

None

Local:

SV571 Carrier Water Solenoid Open/Close Switch (HS-571B)

PLC/HMI:

SV562 Carrier Water Solenoid Open/Close Commands (HS-571C)

LOW Polymer Feed Flow Alarm Setpoint (FKL-571)

Hardware Interlocks:

None

Software Interlocks:

None

Alarms/Monitoring:

Field:

Polymer Feed Flow Indication (FI-571)

Local :

None.

PLC/HMI:

SV562 Carrier Water Solenoid Auto/Manual Status (ZL-571)
Polymer Feed Flow Indication (FI-571)
Polymer Feed Totalized Flow (FQI-571)
LOW Polymer Feed Flow Alarm (FAL-571)

Fault Response:

Component Failure:

None.

Communications Failure:

None

Power Failure:

None.

Data Collection & Trending:

Historical Collection:

See general requirements in 2.01

Trending:

See general requirements in 2.01

K. LOOP PLM_572 Polymer Feed Pump # 2 Flow (FE/FIT 572) is identical to that for Feed Pump # 1 (FE/FIT 571)

L. LOOP PLM_573 Polymer Feed Pump # 3 Flow (FE/FIT 573) is identical to that for Feed Pump # 1 (FE/FIT 571)

M. LOOP PLM_574 Polymer Feed Pump # 4 Flow (FE/FIT 574) is identical to that for Feed Pump # 1 (FE/FIT 571)

N. LOOP PLM_575 Polymer Feed Pump # 5 Flow (FE/FIT 575) is identical to that for Feed Pump # 1 (FE/FIT 571)

END OF SECTION

SECTION 40 91 00

PROCESS CONTROL AND INSTRUMENTATION

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The CONTRACTOR shall provide Process Control and Instrumentation Systems (PCIS) complete and operable, in accordance with the Contract Documents.

B. The requirements of this Section apply to every component of the PCIS unless indicated otherwise.

C. The requirements of Section 40 95 13 – Control Panels apply to all panel modifications as specified.

D. Responsibilities

a. The CONTRACTOR, through the use of an 'Instrumentation Supplier' and qualified electrical and mechanical installers, shall be responsible to the OWNER for the implementation of the PCIS and the integration of the PCIS with other required instrumentation and control devices.

b. The Instrumentation Supplier shall be a single firm, corporation, or other entity assuming full responsibility through the CONTRACTOR to perform all engineering and to select, furnish, configure, integrate, supervise the installation and connections, test, calibrate, and place into operation all instrumentation, controls, communication hardware and software. The System Supplier shall specialize and have experienced engineering and technical staff in the design, integration, and supply of systems similar to the one in these Contract Documents.

c. The Instrumentation Supplier shall be a "systems house" regularly engaged in the design and the installation of instrumentation systems and their associated subsystems as they are applied to the municipal water and wastewater industry.

i. For the purposes of this Specification Section, a "systems house" shall be interpreted to mean an organization that complies with all of the following criteria:

1. Employs a professional Control Systems Engineer or Electrical Engineer registered in the State of California to supervise or perform the work required by this Specification Section.

2. Employs personnel on this project who have successfully completed ISA or manufacturers' training courses on general process instrumentation and configuration and implementation of the specific process controllers, computers, and software proposed for this project.

3. Has performed work of similar or greater complexity on at least five previous projects.

4. Has been actively engaged in the type of work specified in this Specification Section for a minimum of five years.

5. Has been actively engaged in industrial process control programming and system integration for a minimum of ten years.

6. Has been actively engaged in HMI configuration and system integration for a minimum of five years.

ii. The Instrumentation Supplier shall maintain a permanent, fully staffed and equipped service facility within 4 hours travel time of the project site with full time employees capable of designing, fabricating, installing, calibrating, and testing the systems specified herein. At a minimum, the Instrumentation Supplier shall be capable of responding to on-site problems within 12 hours of notice. Additionally, all employee has to comply to all CDC, and Santa Clara County safety mandates/requirements.

iii. The Instrumentation Supplier shall furnish equipment that is the product of one manufacturer to the maximum practical extent. Where this is not practical, all equipment of a given type shall be the product of one manufacturer.

iv. The Instrumentation Supplier shall maintain a permanent, fully staffed and equipped service facility within 150 miles of the project site with adequate personnel and equipment to maintain and repair the system.

d. The term "Instrumentation Supplier" shall mean the same as "PCIS Supplier."

i. The Instrumentation Supplier shall have Experience on five (5) projects of similar size, scope and complexity to Rinconada Remediation Project. Specifically, the Instrumentation Supplier shall demonstrate such project experience by being able to show an expertise in at least three (2) of the following four (4) criteria within the same project.

1. Same PLC Hardware as the proposed system

2. More than 5 RTUs/ or PLCs

3. Multiple Control and Monitoring Centers

4. Upgrade & Replace Equipment and RTU/PLCs.

ii. The Instrumentation Supplier shall provide Reference Information for each of the qualifying projects.

iii. As a minimum, the ENGINEER OF RECORD will ask each reference to provide information relative to the applicant’s, applicant's project

manager's and lead technical member's performance (e.g. quality of work, documentation, technical capability, understanding, and meeting the needs of the client within the framework of the specifications, cooperation, responsiveness, etc.), and timely execution of the project milestones and completion of the project.

iv. The Instrumentation Supplier shall be an expert with Schneider Electric programming language, iFix Intellection programing language, and all tools associated with the successful integration of this project. The Instrumentation Supplier shall demonstrate that they have experience with the following:

1. Several projects using Schneider Electric programming language Concept, Unity XL Pro, and EcoStruxure Control Expert.

2. Several projects using Schneider Electric communication protocol related to Concept, Unity XL Pro, and EcoStruxure such as Modicon XMIT Function, MBP_MSTR, Read_Var, Write_Var, Modbus IO Scanner, Modbus peer cop, L9 MSTR, and etc for hot standby Unity Quantum CPUs and for hot standby Unity M580 level 6 CPUs.

3. Several projects using ProSoft ProTalk Q PTQ-PDPMV1 Profibus for hot standby Unity Quantum and Unity CPUs.

4. Several projects using Schneider Electric UMAC conversion tool to convert Unity Quantum application to Modicon M580 application.

5. Merging stand alone iFix program into an existing iFix Hot Standby system.

e. Due to the complexities associated with the interfacing of numerous control system devices, it is the intent of these specifications that the Instrumentation Supplier be responsible to the CONTRACTOR for the integration of the PCIS with existing devices and devices provided under other sections with the objective of providing a completely integrated control system free of signal incompatibilities.

f. As a minimum, the Instrumentation Supplier shall perform the following WORK:

i. Implementation of the PCIS:

1. Prepare hardware submittals using the contract documents in Division 40 and the Field Instrument List provided as Appendix A of this specification.

2. Design, develop, and electronically produce draft loop drawings and control panel designs using the wiring drawing templates provided in the general instrumentation sheets of the contract drawings, the wiring drawings will then be reviewed by the ENGINEER OF RECORD and OWNER for compliance with standards, then the CONTRACTOR shall produce a final set of

loop drawings. Loop drawings shall also be included for existing circuits that are modified as part of this Work.

3. Prepare a training plan.

4. Procure hardware.

5. Coordinate with the Systems Integrator for Loop Validation, Test Plans and testing activities.

6. Fabricate the New Remediation PLC Panel (REMCP01) shown on GI12 and the associated power panel on GI-12A. This PLC control panel serves as the controller for old and New Remediation process areas.

7. Fabricate the New Loadout PLC Panel (RDWTCNVCP09) shown on GI20 and the associated power panel on GI-12A. This PLC control panel serves as the controller for the Loadout Conveyors and gate valves and final Centrifuge Transfer Conveyors and associated gate valves.

8. Integrate the PLC code for the New Remediation PLC to meet the definitions within specification 40 90 10 Control Strategies and adhere to the client provided standards. Please refer to specification 40 95 10 PLC Control Systems Hardware.

9. Integrate the New Remediation PLC into the existing plant SCADA system (iFix) to meet the definitions within specification 40 90 10 Control Strategies whilst conforming to the client provided standards. Please refer to specification 40 95 20 PLC/SCADA Control Systems Software.

10. Modify the existing Solids area PLC in panel RSDSCP3A. The PLC within RSDSCP3A shall be modified such that RIO drops 2 and 3 are removed from the scope of Solids PLC 710 and now fall under the control of the New Remediation PLC via a revised network architecture shown on GI-11 and GI-19.

11. Install fiber connection between RSDSCP3A and New Remediation PLC (see GI-19).

12. Install, terminate, and test all Ethernet/ Modbus TCP Networks for the control system network as illustrated on the control system architecture shown on sheets GI-11, and GI-19.

13. Programming and configuring all new and existing PCIS components required to provide a working system, as referenced in these Contract Documents and in the Contract Drawings including the following:

a. The Instrumentation Supplier shall provide all programmable logic controller (PLC) programming, Human Machine Interface (HMI) configuration including development of control programs, database configuration, graphic screens, communication links, historical archiving, Win 911 paging, trends, ODMS, Reports, and other programming tasks as specified in these Specifications. Coordinate all programs with the ENGINEER OF RECORD to ensure that the HMI development, PLC programs, communications links, databases and other SCADA elements match the existing SCADA system. Provide all modified code and HMI configuration necessary to transition from existing PLCs and existing HMI servers to new PLCs and HMI servers.

b. The INSTRUMENTATION SUPPLIER shall remove all PLC code related to Solid Handling System (Conveyor, Centrifuge, Polymer Code, Loadout, and etc.) in PLC 710 and integrate that Solid Handling PLC code to the new M580 PLC system. Provide all associated equipment, supplies, and programming for HMI's, ODMS, Trends, Reports, Win 911 pager communication code, networking equipment configuration, and related equipment programming and configuration necessary to successful transfer PLC 710 code to the new PLC system.

c. The INSTRUMENTATION SUPPLIER shall modify and update all existing drawings related to the transfer of existing PLC 710 code to the new PLC 170 to fully document the new system. Work shall also include, but not be limited to, extracting the existing code from existing PLC 715 and developing new code compatible with the new M580 PLC that shall replace the existing PLC 710 to comply with software and programming requirements of these Division 40 specifications, including Section 40 95 10 and Section 40 95 20. This Work shall include accessing data and interfacing with existing control functions with existing PLC 710A/B (redundant processors and RIO drops 2, 3, 4, and 5), existing PLC 711, existing PLC 712, existing PLC 713, existing PLC 714, and the existing RIO rack in panel RDWTCNVCP03. See Architecture on Sheet GI-19 of the Contract Drawings. Existing code shall be analyzed to identify portions that are no longer in use and those parts shall be excluded from new code. New code for PLC 710 shall also be developed to integrate new equipment provided under this Work and shall fully execute the functionality called out in these Contract Documents (including, but not limited to Control Descriptions in Section 40 90 10) and as depicted in the Contract Drawings.

d. The INSTRUMENTATION SUPPLIER shall transfer all existing PLC 710 I/O drops related to Solid Handing System's trunk cables system from PLC 710 to the new PLC system Fiber/Ethernet RIO system.

e. The INSTRUMENTATION SUPPLIER shall supply all equipment necessary for the successful transfer and upgrade of PLC 710 to the new M580 PLC system, such as the transfer of the I/O trunk system cables to the M580 Fiber/Ethernet RIO system.

f. The INSTRUMENTATION SUPPLIER shall provide a Redundant Temporary pair of HMI Servers to service all PLCs provided as part of this WORK. The Redundant HMI Servers shall comply with the requirements of Section 40 95 10 - PLC Control Systems Hardware and Software. The Redundant HMI Servers shall be developed in conjunction with the PLC Control Logic Simulator to allow testing of all newly developed PLC Logic and new HMI elements for this WORK. The Redundant Temporary HMI Servers shall then be deployed to provide HMI functionality for Work under this contract. At a later date, outside the scope of this Work, the HMI functionality on these Redundant Temporary Servers will be combined with HMI functionality for the balance of the facility and transferred to a permanent HMI Server System.

g. The INSTRUMENTATION SUPPLIER shall provide a Test Bed HMI Server. The Test HMI Server shall comply with the requirements of Section 40 95 10 - PLC Control Systems Hardware and Software. The Test HMI Servers shall be developed in conjunction with the PLC Control Logic Simulator to allow testing of all newly developed PLC Logic and new HMI elements for this WORK. The Test Server shall then be turned over to the OWNER at the conclusion of testing PLC Control Logic.

h. Provide all modified code necessary for PLCs, HMI units, and view node computers to transition to the appropriate SCADA server computer system during the transition from the Existing HMI Redundant SCADA system to the emergency SCADA server computer and back.

i. Perform all necessary interim PLC programming and configuration to support the sequencing of construction improvements as determined by the Contractor. This works includes all modifications to the District's existing PLC, HMI, ODMS, Win 911 Pager, Reporting, scripts, configuration, and related system programs during construction to maintain operation of the existing systems.

As existing systems are transitioned to the new Program Control System, the INSTRUMENTATION SUPPLIER shall remove unused logic and documentation from existing PLC programs, modify graphic displays to show systems as they transition to the new system, move associated tags in the existing version 5.1 databases to the new 5.8 databases, and move associated historical data from the existing version 5.1 Historian to the new version 5.8 Historian. All work on existing PLC and HMI systems including removal of existing logic or graphics, shall be performed under direct supervision of the District's programming staff and shall be coordinated with plant operations staff to maintain plant operation. iFix 5.8 might be a higher version depending on the time period of the integration work and Instrumentation Supplier shall coordinate with the OWNER to provide version currently in use with the existing system.

j. The INSTRUMENTATION SUPPLIER shall modify and updated all drawings related to the transfer of PLC 710 code to the new PLC. All drawing be fully cross-reference to each other.

k. Provide a contingency plan to return to the existing logic and Plant system should there be an issue with the new logic. This may include having both the existing and new logic reside in the processor, but with only one set active. The INSTRUMENTATION SUPPLIER may develop a means to rapidly switch between existing and new program logic throughout the testing and transition process. Once the process systems associated with the existing logic have been removed from service, the INSTRUMENTATION SUPPLIER shall remove the logic that no longer applies to the final running system.

l. The INSTRUMENTATION SUPPLIER shall work with Operations to provide new critical beacon alarms and pager alarms.

m. The INSTRUMENTATION SUPPLIER shall relocate all existing Solid Handling System HMI alarms to PLC-based alarms. All are alarms shall be made functional, and the alarm shall be coded in such a way that it is meaningful and related to the process.

n. The INSTRUMENTATION SUPPLIER shall provide complete HMI programming and configuration for PLC-based control systems that are provided for packaged equipment by other system suppliers and equipment manufacturers, including the new centrifuge equipment.

Graphic displays developed by the INSTRUMENTATION SUPPLIER for the packaged systems shall match the layout and format of the GUIs provided by the packaged system suppliers. It is the responsibility of the INSTRUMENTATION SUPPLIER to coordinate with the packaged system suppliers' programmers to provide project programming standards, graphic display standards, and data transfer organization so that the final system is a fully integrated and operational system.

o. The INSTRUMENTATION SUPPLIER shall provide program and configure equipment to provides users with access to diagnostic and process data via network communications links as shown on the Drawings.

p. The INSTRUMENTATION SUPPLIER shall provide program and configure equipment to provides diagnostic and statistical data to SCADA system equipment data: All RIO I/O cards status, PLC processor status, PLC sync cable availability, RIO network status (such as Trunk Cables, Fiber optic cable, and Ethernet cable), PLC headend cards status, PLC CPU battery status, HMI SCADA server availability, HMI SCADA synchronization cable availability, View Node Computer availability, SCADA maintenance mode, and related equipment alarm and diagnostic states.

q. All Input and Output (I/O) signals used for command and control functions and for alarming in the SCADA system (PLC and HMI) shall be hardwire, no exceptions. The use of bus protocols (such as Profibus, Foundation Fieldbus, etc.) on the new system shall not be acceptable.

r. All SCADA analog signals shall be 4 to 20 mA. All SCADA discrete signals shall be 24 VDC.

s. All screens used on third party Centrifuge touch screen computers shall be replicated on the District HMI system. All HMI screens shall be functional and screens shall look identical to third party screens, unless otherwise approved by the OWNER.

t. The INSTRUMENTATION SUPPLIER shall provide HMI screens that show integrated permissive status of all field permissives and SCADA permissive signals.

u. The Instrumentation supplier shall provide the following communication status screens for existing PLC 710, PLC in RDWTCNVCP01, PLC in RDWTCNVCP02, PLC in RCENTCP01, PLC in RCENTCP07, PLC in RCENTCP08,

PLC in RCENTCP09, PLC in RCENTCP02, PLC in RCENTCP03, PLC in RDWTCNVCP03, and new Redundant PLCs (in RREMCP01). Refer to the existing equivalent communication status screens for dialogistic data to be included in the new communication status screens.

i. HMI Servers and iFix – PLC Network Status

ii. PLC Peer to Peer network status

iii. PLC Network

iv. PLC CPUs Status

v. PLC 700 Trunk Cables

vi. Individual RIO cards status

v. Instrumentation Supplier shall perform all work necessary to ensure the successful integration of all existing and new system in this project. This shall include all work necessary to integrate equipment by the manufacturers of Vendor Control Panels.

w. Instrumentation Supplier shall perform all testing on the remaining existing PLC equipment, including, but not limited to, PLC710 hardware, PLC711, PLC712, PLC713, and to ensure that all existing code still function properly on remaining existing equipment (PAC, Lower Ponds, etc).

x. Instrumentation Supplier shall ensure that all PLC-to-PLC communication code is written with I/O scanning on both PLC network 0 and PLC network 1 for all new and existing PLCs in this project. Read var and Write var on both PLC network 0 and PLC network 1 are allowed but shall only be used for PLC-to-PLC communication code only. Instrumentation Supplier shall make all modifications to PLC-to-PLC communication code as necessary to ensure the above.

y. Instrumentation Supplier shall perform all simulation programming, testing, and all other work necessary on simuation system as required under this contact.

z. Instrumentation Supplier shall perform all Communication, PLC, HMI, OIT, and Touch Screens training as required under this contact.

14. The Instrumentation Supplier shall coordinate with all vendors, equipment manufacturers, panel manufacturers, sub-contractors,

and etc. to ensure that the following type of drawings are cross-referenced with each other.

a. Loop

b. Electrical Schematic

c. P&ID

d. Single Lines

e. Point to Point

f. Panel Layout

g. Network/communication drawings

h. IO cards drawings

i. With regard to the Centrifuge Manufacturer, Hiller, the Instrumentation Supplier shall coordinate with the manufacture to provide all modifications on existing centrifuge 1 and 2 system to ensure that the integration of centrifuges 1 and 2 will work as a system. This shall include all programming of the centrifuge 1 and 2 VFDs, Quantum Unity PLCs, Allen Bradley touch screens, and Hiller proprietary PLC, Hiller proprietary touch screen system, and all other related vendor-furnished centrifuge-related control system components.

15. INSTRUMENTATION SUPPLIER shall not be responsible for PLC panels furnished as part of manufacturer-furnished equipment packages, as specified in these Contract Documents or in the Contract Drawings. However, INSTRUMENTATION SUPPLIER shall be responsible for integrating these manufacturer-furnished PLC panels into the PCIS to provide a seamless and functioning system as noted above.

16. Provide a PLC Control Logic Simulation Panel. WORK shall include configuring and programming all components in this panel and all components that will interface with this panel to while simulating and testing logic.

17. Prepare analog hardware submittals

18. Design, develop, and electronically draft loop drawings and control panel designs. Work shall also include updating existing drawings for existing instrument loops modified as part of this Work to reflect as-built condition.

19. Prepare the spare parts submittals.

20. Perform factory tests on panels.

21. Perform bench calibration and verify calibration after installation.

22. Oversee and certify installation.

23. Oversee, document, and certify loop testing.

24. Oversee, document, and certify system commissioning.

25. Conduct the performance test.

26. Prepare Technical Manuals.

27. Conduct training classes.

28. Prepare record drawings.

ii. Integration of the PCIS with instrumentation and control devices provided under other sections;

1. Develop requisite loop drawings and record loop drawings associated with equipment provided under other Divisions of these Specifications and OWNER-furnished and existing equipment.

2. Resolve signal, power, or functional incompatibilities between the PCIS and interfacing devices.

g. Any Instrumentation Supplier responsibilities in addition to the list above are at the discretion of the CONTRACTOR and the Instrumentation Supplier. Additional requirements in this Section and throughout Division 40 that are stated to be the CONTRACTOR's responsibility may be performed by the prequalified Instrumentation Supplier if the CONTRACTOR and Instrumentation Supplier so agree.

E. Certification of Intent

a. Each Bidder shall include with the Bid the following Certification from the selected Instrumentation Supplier:

i. The Certification shall be typed on the Instrumentation Supplier firm letterhead.

ii. It shall be signed by an authorized representative of the Instrumentation Supplier's firm.

iii. It shall include the following statements:

1. “(Corporate name of Instrumentation Supplier) hereby certifies intent to assume and execute full responsibility to the CONTRACTOR to perform all tasks defined in full compliance with the requirements of the Contract Documents."

2. It is certified that the quotation to the CONTRACTOR includes full and complete compliance with the requirements of the Contract Documents without exception."

1.02 CONTRACT SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 – Contractor Submittals and the following:

a. The CONTRACTOR shall coordinate the instrumentation Work so that the complete instrumentation and control system will be provided and will be supported by accurate Shop Drawings and record drawings.

b. Exchange of Technical Information: During the period of preparation of these submittals, the CONTRACTOR shall authorize a direct, informal liaison with the ENGINEER OF RECORD for exchange of technical information. As a result of this liaison, certain minor refinements and revisions in the systems as indicated may be authorized informally by the ENGINEER OF RECORD, but will not alter the scope of WORK or cause increase or decrease in the Contract Price. During this informal exchange, no oral statement by the ENGINEER OF RECORD shall be construed to give approval of any component or method, nor shall any statement be construed to grant exception to or variation from these Contract Documents.

i. Contractor shall engage the OWNER’s IT department to verify the current network equipment standards in place at the time of submittal preparation. Coordinate with the OWNER’s IT department to propose compatible equipment in compliance with current OWNER standards.

c. Symbology and Nomenclature: In these Contract Documents, systems, meters, instruments, and other elements are represented schematically, and are designated by symbology as derived from Instrument Society of America Standard ISA S5.1 - Instrumentation Symbols and Identification. The nomenclature and numbers designated herein and on the Drawings shall be employed exclusively throughout Shop Drawings, and similar materials. No other symbols, designations, or nomenclature unique to the manufacturer's standard methods shall replace those prescribed above, used herein, or on the Drawings.

B. Presubmittal Conference

a. The CONTRACTOR shall arrange and conduct a Presubmittal Conference within thirty (30) days after award of the Contract. The purpose of the Presubmittal Conference is to review and approve the manner in which the CONTRACTOR intends to carry out its responsibilities for Shop Drawing submittal on the WORK to be provided under this Section. The CONTRACTOR, the Instrumentation Supplier, OWNER's System Integrator and the ENGINEER OF RECORD shall attend. Both the CONTRACTOR and the ENGINEER OF RECORD may invite additional parties at their discretion.

b. The CONTRACTOR shall allot one, eight (8) hour day for the Conference.

c. The CONTRACTOR shall present the following for discussion at the Conference:

i. A list of equipment and materials required for the PCIS and the manufacturer's name and model number for each proposed item.

ii. A list of proposed clarifications to the Contract Documents along with a brief explanation of each. Resolution shall be subject to a separate formal submittal and review by the ENGINEER OF RECORD.

iii. An exact one-to-one sample of each type of submittal herein.

iv. A flow chart showing the steps to be taken in preparing and coordinating each submittal to the ENGINEER OF RECORD.

v. A bar-chart type schedule for system-related activities from the Presubmittal Conference through start-up and training. Dates of submittals, design, fabrication, programming, factory testing, deliveries, installation, field testing, and training shall be shown. The schedule shall be subdivided to show activities relative to each major item or group of items when everything in a given group is on the same schedule.

vi. An overview of the proposed training plan. The OWNER's staff and ENGINEER OF RECORD will review the overview and may request changes. Changes to the proposed training shall be resolved at the pre-submittal conference. The overview shall include the following for each proposed course.

1. Course title and objectives.

2. Prerequisite training and experience of attendees.

3. Course content - a topical outline.

4. Course duration.

5. Course format - lecture, laboratory demonstration, etc.

d. The CONTRACTOR shall furnish three (3) copies of the items above to the CONSTRUCTION MANAGER.

e. The CONTRACTOR shall take minutes of the Conference, including events, questions, and resolutions. Prior to adjournment, attendees must concur with the accuracy of the minutes and sign accordingly.

C. Shop Drawings

1. General

a. Preparation of Shop Drawings shall not commence until adjournment of the Presubmittal Conference.

b. Shop Drawings shall include the letter head or title block of the Instrumentation Supplier. The title block shall include, as a minimum, the Instrumentation Supplier's registered business name and address, project name, drawing name, revision level, and personnel responsible for the content of the drawing. The quantity of submittal sets shall be as indicated in Section 01 33 00 – Contractor Submittals.

c. Organization of the Shop Drawing submittals shall be compatible with eventual submittals for later inclusion in the Technical Manual. Submittals not so organized and incomplete submittals for a given loop will not be accepted.

d. Shop Drawing information shall be bound in standard size, 3-ring, loose leaf, vinyl plastic, hard cover binders suitable for bookshelf storage. Binder ring size shall not exceed 76.5 mm.

e. Interfaces between instruments, motor starters, control valves, variable speed drives, flow meters, chemical feeders and other equipment related to the PCIS shall be included in the Shop Drawing submittal.

2. Hardware Equipment Submittal: The CONTRACTOR shall submit a complete bound package at one time within sixty (60) days after the commencement date stated in the Notice to Proceed, including:

a. A complete index which lists each device by tag number, type, and manufacturer. A separate technical brochure or bulletin shall be included with each instrument data sheet. The data sheets shall be indexed in the submittal by systems or loops, as a separate group for each system or loop. If, within a single system or loop, a single instrument is employed more than once, one data sheet with one brochure or bulletin may cover multiple identical uses of that instrument in that system. Each brochure or bulletin shall include a list of tag numbers for which it applies. System groups shall be separated by labeled tags.

b. Fully executed data sheets according to ISA S20 - Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves, for each component, together with a technical product

brochure or bulletin. The technical product brochures shall be complete enough to verify conformance to Contract Document requirements. The data sheets, as a minimum, shall show:

i. Component functional description used in the Contract Documents

ii. Manufacturer's model number or other product designation

iii. Project tag number used in the Contract Documents

iv. Project system or loop of which the component is a part

v. Project location or assembly at which the component is to be installed

vi. Input and output characteristics

vii. Scale, range, units, and multiplier (if any)

viii. Requirements for electric supply (if any)

ix. Requirements for air supply (if any)

x. Materials of component parts to be in contact with or otherwise exposed to process media and corrosive ambient air

xi. Special requirements or features

c. Flow meter sizing calculations. Calculations shall be submitted on the instrument manufacturer letterhead and shall include the following:

i. Proposed meter size based on indicated minimum, maximum and average flow rates.

ii. Guaranteed meter accuracy based on the upstream and downstream straight runs associated with the location of each meter.

iii. Permanent head loss associated with each meter.

iv. Flow vs. differential pressure curves for each head-type device. For compressible fluids, curves shall be pressure- and temperature-compensated.

v. References to ISA standard equations used.

vi. Values used for every parameter used in calculations.

d. Priced list of spare parts for every device.

e. Instrument installation, mounting, and anchoring details shall be submitted in an electronic AutoCAD 2011 and hard copy format. Each instrument shall have a dedicated A4 sheet in detail that only pertains to the specific instrument by tag number. Each detail shall be certified by the instrument manufacturer that the proposed installation is in accordance with the instrument manufacturer's recommendations and is fully warrantable. These certifications shall be embedded in the CAD files and also appear as a stamp on the hard copies. As a minimum, each detail shall have the following contents:

i. Show necessary sections and elevation views required to define instrument location by referencing tank, building or equipment names and numbers, and geographical qualities such as north, south, east, west, basement, first floor.

ii. Ambient temperature and humidity of the environment in which the instrument is to be installed.

iii. Corrosive qualities of the environment in which the instrument is to be installed.

iv. Hazardous rating of the environment in which the instrument is to be installed.

v. Process line pipe or tank size, service, and material.

vi. Process tap elevation and location.

vii. Upstream and downstream straight pipe lengths between instrument installation and pipe fittings and valves.

viii. Routing of tubing and identification of supports.

ix. Mounting brackets, stands, and anchoring devices.

x. Conduit entry size, number, location, and delineation between power and signal.

xi. NEMA ratings of enclosures and components.

xii. Clearances required for instrument servicing.

xiii. List itemizing manufacturer makes, model numbers, quantities, lengths required, and materials of each item required to support the implementation of the detail.

3. PLC Control Logic Simulator:

a. Submit hardware and programming details for a standalone PLC control logic simulator as specified in Section 409510, PLC Control System Hardware and Software.

b. Submit details of the enclosure, backplane, power supplies, and power distribution components provided to support the simulator components.

c. Submit hardware catalog cut sheets and details for simulator PLC components, dedicated managed switch, and other simulator test bed components.

d. Submit wiring and network diagrams for the simulator. Simulator wiring diagrams shall match format and presentation used for control panels as specified in this section.

e. Submit simulation programming strategy overview as text based functional descriptions or flow chart format. Programming overview shall define and describe specifically:

   i. How the simulation I/O data will be mapped for each individual PLC with specific register space defined for both simulation and real process I/O.

   ii. Method for the simulation programming to interact to the identified target PLC

   iii. How the simulation PLC will take control for simulation override of the process PLC for factory testing

   iv. How simulated inputs and outputs will be developed for each logic case (e.g., valve operation, PID control loops, pump start and stop, plan power failure simulation, etc.).

   v. How the control logic simulator will interface to a standard system iFIX workstation

f. Submit programming logic for the simulator using identical programming requirements as used for the real-time process control specified in Section 40 95 20 – PLC SCADA System Software.

4. Testing Plan Submittals Requirement

   a. Test Procedure Submittals: Submit the procedures proposed to be followed for each test. Procedures shall include test descriptions, forms, and checklists to be used to control and document the required tests. All witnessed test will be done at District facilities on site. Include sign-off forms for each testing phase or loop (per the Specifications) with sign-off areas for the INSTRUMENTATION SUPPLIER, the District, and the ENGINEER OF RECORD. Submit separate procedures for each specified test including:

      i. Unwitnessed Factory Test (UFT): Fabrication

      ii. Unwitnessed Factory Test (UFT): Logical

      iii. Simulation Test Witnessed Factory Test (WFT): Fabrication

iv. Simulation Test Witnessed Factory Test (WFT): Logical

v. Loop Testing (Operational Readiness Test)

vi. Network speed confirmation testing (for all ethernet cabling)

vii. Pre-Commissioning

viii. Functional Testing

ix. System Commissioning Testing (30-Day Acceptance Test)

b. Submit separate sample test forms for review for each testing process as specified in this Section. For panel testing, submit separate testing signoff forms for both physical and logical panel; testing procedures customized for the respective test procedures.

c. Coordinate test procedures with the sequenced startup of the system and control panels to match sequence of installation.

d. Test Documentation: Upon completion of each required test, document the test by submitting a copy of the signed off test procedures. Testing shall not be considered complete until the signed-off test procedures have been submitted and favorably reviewed. Submittal of other test documentation, including “highlighted” I/O electrical schematic wiring diagrams with field technician notes are not acceptable substitutes for completion of the formal test documentation.

e. Provide separate testing protocol for testing the functionality of the PLC Control Logic Simulation Panel. Simulation panel testing shall include separate process area by process area verification of simulation logic to ensure development of consistent and comprehensive simulation logic for each plant process area.

5. Testing and Commissioning Workshops

a. In addition to the workshops specified in Section 40-95-20 for coordination, the INSTRUMENTATION SUPPLIER shall schedule and hold a minimum of three mandatory PCS Testing and Commissioning Workshops. The Testing and Commissioning Workshops shall include as a minimum the District, the ENGINEER OF RECORD, the Contractor, the INSTRUMENTATION SUPPLIER's Project engineer, and electrical subcontractor. District staff shall include construction managers, technicians, operators, and maintenance staff as required. The District shall determine which staff members will attend each workshop. Workshops shall all be held at the District’s headquarters located at 5700 Almaden Expressway, San Jose, CA 95118.

b. Provide separate testing workshop as specified in Section 40-95-20 for discussion and development of the PLC Control Logic Simulation Panel.

c. Testing and commissioning workshops specified in this Section shall establish general testing procedures and protocols that shall form the basis for the testing related to the specific construction phase workshops specified in Section 40-95-20.

d. Minutes from each workshop shall be submitted as a formal construction submittal per requirements of 40-95-20 within 10 working days of each workshop.

e. Schedule the Commissioning Workshops a minimum of two weeks prior to the workshop date and include a draft agenda at the time of the request for review. Within one week subsequent to each workshop, submit draft workshop minutes for review and comment; submit final minutes incorporating any comments as necessary. The INSTRUMENTATION SUPPLIER shall be responsible for facilitating the workshop and providing presentation material to all participants. The INSTRUMENTATION SUPPLIER and Contractor shall document the proceedings of the Testing and Commissioning Workshops and submit along with all materials used at the workshop.

4. Project-Wide Loop Drawing Submittal: The CONTRACTOR shall furnish a Project-wide Loop Drawing Submittal (PLDS) which completely defines and documents the contents of each monitoring, alarming, interlock, and control loop associated with equipment provided under Division 40 Sections, equipment provided under Sections in other Divisions, existing, and OWNER-furnished equipment which is to be incorporated into the PCIS. The PLDS shall be a singular complete bound package electronically drafted in AutoCAD, submitted within one hundred and twenty (120) days after Contract Award, and shall include the following:

   a. A complete index in the front of each bound volume. The loop drawings shall be indexed by systems or process areas. Loops shall be tagged in a manner consistent with the Contract Documents. Loop drawings shall be submitted for every analog and discrete monitoring and control loop. Also include Loop Drawings for existing circuits that are modified as part of this Work.

   b. Loop drawings shall also be developed for existing instrument circuits that are modified under as part of this Work. Loop Drawings for existing circuit shall be subject to the same submittal and approval process as loop drawings for new circuits. Loop drawings for existing circuit shall show all existing components, complete with instrument tagging, equipment tagging, and terminal numbers similar to new loop drawings.

   c. Drawings showing definitive diagrams for every analog and discrete instrumentation loop system. These diagrams shall show and identify each component of each loop or system using legend and symbols from ISA S5.4 - Instrument Loop Drawings. Panel drawings showing PLC I/O card wiring and field terminations are not acceptable as loop drawings. Each system or loop diagram shall be drawn on a separate drawing sheet

with no more than ten (10) loops per drawing. Loop drawings shall be developed for loops in equipment vendor-supplied packages, equipment provided under Division 40, and OWNER-furnished equipment. The loop drawings shall also show software modules and linkages. In addition to the expanded ISA S5.4 requirements, the loop diagrams shall also show the following details:

i. Functional name of each loop.

ii. Reference name, drawing, and loop diagram numbers for any signal continuing off the loop diagram sheet.

iii. MCC panel, circuit, and breaker numbers for power feeds to the loops and instrumentation.

iv. Designation, and if appropriate, terminal assignments associated with every manhole, pullbox, junction box, conduit, and panel through which the loop circuits pass.

v. Vendor panel, instrument panel, conduit, junction boxes, equipment and SCADA terminations, termination identification wire numbers and colors, power circuits, and ground identifications.

d. Itemized instrument summary. The summary shall be prepared with Microsoft Excel software and shall be submitted on memory stick, CD or DVD and hard copy. The instrument summary shall list all of the key attributes of each instrument provided under this Contract. As a minimum, attributes shall include:

i. Tag number

ii. Manufacturer

iii. Model number

iv. Service

v. Area location

vi. Calibrated range

vii. Loop drawing number

viii. Associated LCP, PLC, PCM, or RTU

5. Start-up Submittals

e. The CONTRACTOR shall submit the proposed procedures to be followed during start-up of the PCIS and its components.

f. Preliminary Submittal: Outlines of the specific procedures and examples of proposed forms and checklists.

g. Detailed Submittal: After approval of the Preliminary Submittal, the CONTRACTOR shall submit the proposed detailed procedures, forms, and checklists. This submittal shall include a statement of objectives with the test procedures.

6. Training Submittals: Comply with the requirement specified in Part 3 to provide training for all of the topics listed for Instrument Training and SCADA Training. Training Subsequent to the receipt of the OWNER's and ENGINEER OF RECORD's inputs made at the Presubmittal Conference, the CONTRACTOR shall submit a training plan which includes:

h. A resubmittal of the training plan overview from the Presubmittal Conference with incorporation of modifications agreed upon at that meeting.

i. Schedule of training courses including dates, durations, and locations of each class.

j. Resumes of the instructors who will actually implement the plan.

D. Technical Manual

1. General: Information in the Technical Manual shall be based upon the approved Shop Drawing submittals as modified for conditions encountered in the field during the WORK.

2. The Technical Manual shall have the following organization for each process:

a. Section A - Process and Instrumentation Diagrams

b. Section B - Loop Descriptions

c. Section C - Loop Drawings

d. Section D - Instrument Summary

e. Section E - Instrument Data Sheets

f. Section F - Sizing Calculations

g. Section G - Instrument Installation Details

h. Section H - Test Results

3. Signed results from Loop Testing, Precommissioning, and Performance Testing shall be included in Section H.

4. Initially, two (2) sets of draft Technical Manuals shall be submitted for review after return of favorably reviewed Shop Drawings and data required herein. Following the ENGINEER OF RECORD's review, one set will be returned to the CONTRACTOR with comments. The Manuals shall be revised and amended as required and the final Manuals shall be submitted fifteen (15) days prior to start-up of systems.

E. Record Drawings

1. The CONTRACTOR shall keep current a set of complete loop and schematic diagrams which shall include field and panel wiring, piping and tubing runs, routing, mounting details, point-to-point diagrams with cable, wire, tube and termination numbers. These drawings shall include every instrument and instrument element. One set of drawings electronically formatted in AutoCAD and 2 hard copies shall be submitted after completion of Precommissioning tasks but prior to Performance Testing. Such drawings shall be submitted for review prior to acceptance of the completed WORK by the OWNER.

1.03 SPECIAL CORRECTION OF DEFECTS REQUIREMENTS

A. Extended Period for Correction of Defects: The CONTRACTOR shall correct defects in the PCIS upon notification from the OWNER within two (2) years from the date of Substantial Completion. Corrections shall be completed within five (5) days after notification.

PART 2 -- PRODUCTS

2.01 GENERAL

A. Code and Regulatory Compliance: PCIS WORK shall conform to or exceed the applicable requirements of the National Electrical Code. Conflicts between the requirements of the Contract Documents and any codes or referenced standards or specifications shall be resolved according to Section 01 42 19 – Reference Standards.

B. Current Technology: The equipment and components specified herein were current products at the time of the design. Should the specified equipment become unavailable during construction, due to obsolescence or loss of commercial availability, the Contractor shall provide the latest product within the product line for approval or equivalent that meets the technical requirements of the specification. Meters, instruments, and other components shall be the most recent field-proven models marketed by their manufacturers at the time of submittal of the Shop Drawings unless otherwise required to match existing equipment.

C. Adverse Environmental Impact: No component of an instrumentation system shall contain liquid mercury.

D. Hardware Commonality: Instruments which utilize a common measurement principle (for example, d/p cells, pressure transmitters, level transmitters that monitor hydrostatic head) shall be furnished by a single manufacturer. Panel mounted instruments shall have matching style and general appearance. Instruments

performing similar functions shall be of the same type, model, or class, and shall be from a single manufacturer.

E. Loop Accuracy: The accuracy of each instrumentation system or loop shall be determined as a probable maximum error; this shall be the square root of the sum of the squares of certified "accuracies" of the designated components in each system, expressed as a % of the actual span or value of the measured variable. Each individual instrument shall have a minimum accuracy of plus and minus 0.5 percent of full scale and a minimum repeatability of plus and minus 0.25 percent of full scale unless otherwise indicated. Instruments that do not conform to or improve upon these criteria are not acceptable.

F. Instrument and Loop Power: Power requirements and input/output connections for components shall be verified. Power for transmitted signals shall, in general, originate in and be supplied by the control panel devices. The use of transmitters with a Devicenet communications interface is preferred. Therefore Many Instruments shall have individual power supplied in addition to the Devicenet communications connection. Individual loop or redundant power supplies shall be provided as required by the manufacturer's instrument load characteristics to ensure sufficient power to each loop component. Power supplies shall be mounted within control panels or in the field at the point of application.

G. Instrument Air: Dry, filtered control air at 30 psig nominal pressure shall be piped to field instruments and instrument panels requiring air. Each field instrument shall be provided with an integral, non-adjustable filter/regulator assembly to provide regulated air. Each instrument panel requiring air shall be provided with an adjustable filter/regulator assembly with gauge and an air manifold to provide air to pneumatic instruments. Air shall be filtered to 5-micron maximum particle size. Pressure reducers and regulators shall be furnished with additional instrumentation as required.

H. Loop Isolators and Converters: Signal isolators shall be provided as required to ensure adjacent component impedance match where feedback paths may be generated, or to maintain loop integrity during the removal of a loop component. Dropping precision wire wound resistors shall be installed at field side terminations in the control panels to ensure loop integrity. Signal conditioners and converters shall be provided where required to resolve any signal level incompatibilities or provide required functions.

I. Environmental Suitability: Indoor and outdoor control panels and instrument enclosures shall be suitable for operation in the ambient conditions associated with the locations designated in the Contract Documents. Heating, cooling, and dehumidifying devices shall be provided in order to maintain instrumentation devices 20 percent within the minimums and maximums of their rated environmental operating ranges. The CONTRACTOR shall provide power wiring for these devices. Enclosures suitable for the environment shall be furnished. Instrumentation in hazardous areas shall be suitable for use in the particular hazardous or classified location in which it is to be installed.

J. Signal Levels: If necessary, analog measurements and control signals shall be as indicated herein, and unless otherwise indicated, shall vary in direct linear proportion to the measured variable. Electrical signals outside control panels shall be 4 to 20 mA dc except as indicated. Signals within enclosures may be 1 to 5 volts dc. Electric signals shall be electrically or optically isolated from other signals. Pneumatic signals shall be 3 to 15 psig with 3 psig equal to 0 percent and 15 psig equal to 100 percent.

K. Control Panel Power Supplies: Control panels shall be provided with redundant power supplies which are configured in a fault-tolerant manner to prevent interruption of service upon failure and interruption of service necessitated by the replacement of a power supply. Power supplies shall have an excess rated capacity of 40 percent.

L. Alternative Equipment and Methods: Equipment or methods requiring redesign of any project details are not acceptable without prior written approval of the ENGINEER OF RECORD through the "or equal" process. Any proposal for approval of alternative equipment or methods shall include evidence of improved performance, operational advantage, and maintenance enhancement over the equipment or method indicated, or shall include evidence that an indicated component is not available.

2.02 OPERATING CONDITIONS

A. The PCIS shall be designed and constructed for satisfactory operation and long, low maintenance service under the following conditions:

Environment	Water treatment facility
Temperature Range	-5 through 50° C
Thermal Shock	1 degree F (0.5° C) per minute, max
Relative Humidity	20 through 90 percent, non-condensing

2.03 SPARE PARTS, SPECIAL TOOLS AND EXPENDABLE ITEMS

A. In addition to the items noted below and in the other specification Sections, the Contractor shall provide expendable items in sufficient quantities to sustain the SCADA system for a period of 3 years after final acceptance. CONTRACTOR shall include a list expendable items, as identified by manufacturers, in Submittals for approval by the ENGINEER OF RECORD.

B. Individual Sections in Division 40 of the Contract Documents identify Mandatory Spare Parts for the PCIS. These shall be identified in submittals and shall be furnished as part of this WORK.

C. The ENGINEER OF RECORD will also select the Required Spare Parts from the priced list of spare parts in the Hardware Equipment Submittal, and the CONTRACTOR shall furnish them. The CONTRACTOR will be paid from the

corresponding allowance item in the Bid, and the total price will not exceed the amount of the allowance item.

D. The CONTRACTOR shall furnish a priced list of Special Tools required to calibrate and maintain the instrumentation provided. After approval the CONTRACTOR shall furnish tools on that list.

E. All Special Tools, spare parts, and expendable items shall be furnished and delivered to the site before start-up commences, suitably wrapped and identified.

2.04 FACTORY AND SIMULATION TESTING

A. The CONTRACTOR shall arrange for the manufacturers of the equipment and fabricators of panels and cabinets supplied under this Section to allow the ENGINEER OF RECORD and OWNER to inspect and witness the testing of the equipment at the site of fabrication. Equipment shall include the cabinets, special control systems, flow measuring devices, and other pertinent systems and devices. A minimum of ten (10) days notification shall be furnished to the ENGINEER OF RECORD prior to testing. No shipments shall be made without the ENGINEER OF RECORD's approval.

B. The CONTRACTOR shall provide a PLC Control Logic Simulator, as specified in Section 40 95 10. The CONTRACTOR shall arrange for all PLC and SCADA software supplied under this section to be tested using the PLC Control Logic Simulator before the software is released for Startup and Commissioning. This is a significant task and should be factored into the Startup and Commissioning schedule.

PART 3 -- EXECUTION

3.01 PRODUCT HANDLING

A. Shipping Precautions: After completion of shop assembly, factory test, and approval, equipment, cabinets, panels, and consoles shall be packed in protective crates and enclosed in heavy duty polyethylene envelopes or secured sheeting to provide complete protection from damage, dust, and moisture. Dehumidifiers shall be placed inside the polyethylene coverings. The equipment shall then be skid-mounted for final transport. Lifting rings shall be provided for moving without removing protective covering. Boxed weight shall be shown on shipping tags together with instructions for unloading, transporting, storing, and handling at the Site.

B. Special Instructions: Special instructions for proper field handling, storage, and installation required by the manufacturer shall be securely attached to each piece of equipment prior to packaging and shipment.

C. Tagging: Each component shall be tagged to identify its location, instrument tag number, and function in the system. A permanent stainless steel or other non-corrosive material tag firmly attached and permanently and indelibly marked with the instrument tag number, as given in the tabulation, shall be provided on each piece of equipment in the PCIS. Identification shall be prominently displayed on the outside of the package.

D. Storage: Equipment shall not be stored outdoors. Equipment shall be stored in dry permanent shelters, including in-line equipment, and shall be adequately protected against mechanical injury. If any apparatus has been damaged, such damage shall be repaired by the CONTRACTOR. If any apparatus has been subject to possible injury by water, the equipment shall be replaced.

3.02 MANUFACTURER'S SERVICES

A. The CONTRACTOR shall furnish the following manufacturer's services for the instrumentation listed below:

a. Perform bench calibration.

b. Oversee installation.

c. Verify installation of installed instrument.

d. Certify installation and reconfirm manufacturer's accuracy statement.

e. Oversee loop testing, prepare loop validation sheets, and certify loop testing.

f. Prepare pre-commissioning validation sheets, oversee pre-commissioning, and certify when pre-commissioning is completed.

g. Train the OWNER's personnel.

3.03 INSTALLATION

A. General

a. Instrumentation, including instrumentation furnished under other Divisions, shall be installed under Division 40 and the manufacturers' instructions.

b. Equipment Locations: The monitoring and control system configurations indicated are diagrammatic. The locations of equipment are approximate. The exact locations and routing of wiring and cables shall be governed by structural conditions and physical interferences and by the location of electrical terminations on equipment. Equipment shall be located and installed so that it will be readily accessible for operation and maintenance. Where job conditions require reasonable changes in approximated locations and arrangements, or when the OWNER exercises the right to require changes in location of equipment which do not impact material quantities or cause material rework, the CONTRACTOR shall make such changes without additional cost to the OWNER.

B. Conduit, Cables, and Field Wiring

a. Conduit shall be provided under Division 26 without delay to the Work of Division 40.

b. Process equipment control wiring, 4 to 20 mA signal circuits, signal wiring to field instruments, Fieldbus type signal wiring and PLC input and output wiring, and other field wiring and cables shall be provided under Division 26.

c. SCADA and PLC equipment cables, communication networks shall be provided under Division 40.

d. Terminations and wire identification at PCIS equipment furnished under this or any other Division shall be provided under Division 40.

C. Instrumentation Tie-Downs: Instruments, control panels, and equipment shall be anchored by methods that comply with seismic requirements applicable to the Site.

D. Existing Instrumentation: Each existing instrument to be removed and reinstalled shall be cleaned, reconditioned, and recalibrated by an authorized service facility of the instrument manufacturer. The CONTRACTOR shall provide certification of this WORK prior to reinstallation of each instrument.

E. Ancillary Devices: The Contract Documents show necessary conduit and instruments required to make a complete instrumentation system. The CONTRACTOR shall be responsible for providing any additional or different type connections as required by the instruments and specific installation requirements. Such additions and such changes, including the proposed method of installation, shall be submitted to the ENGINEER OF RECORD for approval prior to commencing that Work. Such changes shall not be a basis of claims for extra Work or delay.

F. Installation Criteria and Validation: Field-mounted components and assemblies shall be installed and connected according to the requirements below:

a. Installation personnel have been instructed on installation requirements of the Contract Documents.

b. Technical assistance is available to installation personnel at least by telephone.

c. Installation personnel have at least one copy of the approved Shop Drawings and data.

d. Instrument process sensing lines shall be installed in conduit under Section 26 00 00 – Electrical Work, General. Individual tubes shall run parallel and near the surfaces from which they are supported. Supports shall be used at intervals of not more than 3 ft of rigid tubing.

e. Bends shall be formed to uniform radii with the proper tool without deforming or thinning the walls of the tubing. Plastic clips shall be used to hold individual plastic tubes parallel. Ends of tubing shall be square cut and cleaned before being inserted in the fittings. Bulkhead fittings shall be provided at panels requiring pipe or tubing entries.

f. Differential pressure elements shall have three (3) valve manifolds.

g. Flexible cables and capillary tubing shall be installed in flexible conduits. The lengths shall be sufficient to withdraw the element for periodic maintenance.

h. Power and signal wires shall be terminated with crimped type lugs.

i. Connectors shall be, as a minimum, water tight.

j. Wires shall be mounted clearly with an identification tag that is of a permanent and reusable nature.

k. Wire and cable shall be arranged in a neat manner and securely supported in cable groups and connected from terminal to terminal without splices unless specifically approved by the ENGINEER OF RECORD. Wiring shall be protected from sharp edges and corners.

l. Mounting stands and bracket materials and workmanship shall comply with requirements of the Contract Documents.

m. Verify the correctness of each installation, including polarity of electric power and signal connections, and make sure process connections are free of leaks. The CONTRACTOR shall certify in writing that discrepancies have been corrected for each loop or system checked out.

n. The OWNER will not be responsible for any additional cost of rework attributable to actions of the CONTRACTOR or the Instrumentation Supplier.

3.04 CALIBRATION

A. General: Devices provided under Division 40 shall be calibrated according to the manufacturer's recommended procedures to verify operational readiness and ability to meet the indicated functional and tolerance requirements.

B. Calibration Points: Each instrument shall be calibrated at 0, 25, 50, 75, and 100 percent of span using test instruments to simulate inputs. The test instruments shall have accuracies traceable to National Institute of Standards and Testing.

C. Bench Calibration: Instruments that have been bench-calibrated shall be examined in the field to determine whether any of the calibrations are in need of adjustment. Such adjustments, if required, shall be made only after consultation with the ENGINEER OF RECORD.

D. Field Calibration: Instruments which were not bench-calibrated shall be calibrated in the field to insure proper operation in accordance with the instrument loop diagrams or specification data sheets.

E. Analyzer Calibration: Each analyzer system shall be calibrated and tested as a workable system after installation. Testing procedures shall be directed by the manufacturers' technical representatives. Samples and sample gases shall be furnished by the manufacturers.

F. Calibration Sheets: Each instrument calibration sheet shall provide the following information and a space for sign-off on individual items and on the completed unit:

1. Project name
2. Loop number
3. Tag number
4. Manufacturer
5. Model number
6. Serial number
7. Calibration range
8. Calibration data: Input, output, and error at 0%, 50%, and 100% of span
9. Switch setting, contact action, and deadband for discrete elements
10. Space for comments
11. Space for sign-off by Instrumentation Supplier and date
12. Test equipment used and associated serial numbers

G. Calibration Tags: A calibration and testing tag shall be attached to each piece of equipment or system at a location determined by the ENGINEER OF RECORD. The CONTRACTOR shall have the Instrumentation Supplier sign the tag when calibration is complete. The CONSTRUCTION MANAGER will sign the tag when the calibration and testing has been accepted.

3.05 PLC CONTROL LOGIC SIMULATOR WORKSHOP

A. A minimum of 6 weeks prior to submittal of the PLC Control Logic Simulator being sent in for review, the System Integrator shall lead and facilitate one-day (eight hour) workshop to review the approach and strategy used for the PLC Control Logic Simulator test bed. The workshop shall address:

1. How the simulation I/O data will be mapped for each individual PLC with specific register space defined for both simulation and real process I/O.
2. Method for the simulation programming to interact to the identified target PLC.
3. How the simulation PLC will take control for simulation override of the process PLC for factory testing.
4. How simulated inputs and outputs will be developed for each logic case (e.g., valve operation, PID control loops, pump start and stop, plan power failure simulation, etc.).

5. How the PLC Control Logic Simulator will interface to a standard system iFIX workstation.

B. The System Integrator shall compile and distribute meeting minutes for this workshop. Minutes shall document how the items described at the workshop will be addressed.

3.06 LOOP TESTING

A. General: Individual instrument loop diagrams per ISA Standard S5.4 - Instrument Loop Diagrams, expanded format, shall be submitted to the ENGINEER OF RECORD for review prior to the loop tests. The CONTRACTOR shall notify the CONSTRUCTION MANAGER of scheduled tests a minimum of thirty (30) days prior to the estimated completion date of installation and wiring of the PCIS. After the ENGINEER's review of the submitted loop diagrams for correctness and compliance with the specifications, loop testing shall proceed. The loop check shall be witnessed by the CONSTRUCTION MANAGER.

B. Control Valve Tests: Control valves, cylinders, drives and connecting linkages shall be stroked from the operator interface units as well as local control devices and adjusted to verify proper control action, hand switch action, limit switch settings, torque settings, remote control actions, and remote feedback of valve status and position. Control valve actions and positioner settings shall be checked with the valves in place to insure that no changes have occurred since the bench calibration.

C. Interlocks: Hardware and software interlocks between the instrumentation and the motor control circuits, control circuits of variable-speed controllers, and packaged equipment controls shall be checked to the maximum extent possible.

D. Instrument and Instrument Component Validation: Each instrument shall be field tested, inspected, and adjusted to its indicated performance requirement in accordance its manufacturer's specifications and instructions. Any instrument which fails to meet any Contract requirement, or, in the absence of a Contract requirement, any published manufacturer performance specification for functional and operational parameters, shall be repaired or replaced, at the discretion of the ENGINEER.

E. Loop Validation: Controllers and electronic function modules shall be field tested and exercised to demonstrate correct operation. Control loops shall be checked under simulated operating conditions by impressing input signals at the primary control elements and observing appropriate responses of the respective control and monitoring elements, final control elements, and the graphic displays associated with the SCADA. As a minimum, the Systems Integrator shall provide the necessary PLC code to enable tests from the field instrumentation and equipment to the PLC data tables. Actual signals shall be used wherever available. Following any necessary corrections, the loops shall be retested. Accuracy tolerances for each analog network are defined as the root-mean-square (RMS) summation of individual component accuracy requirements. Individual component accuracy requirements shall be as indicated by Contract requirements or by published manufacturer accuracy specifications, whenever Contract accuracy requirements are not indicated. Each analog network shall be tested by applying simulated analog or discrete inputs to the first element of an analog network. For networks which incorporate analog elements, simulated sensor inputs corresponding

to 0, 25, 50, 75, and 100 % of span shall be applied, and the resulting element outputs monitored to verify compliance to calculated RMS summation accuracy tolerance requirements. Continuously variable analog inputs shall be applied to verify the proper operation and setting of discrete devices. Provisional settings shall be made on controllers and alarms during analog loop tests. Analog loop test data shall be recorded on test forms attached at the end of this Section which include calculated RMS summation system accuracy tolerance requirements for each output.

a. Loop testing shall take place in two phases Local Control Loop Testing and Remote Control Loop testing.

    i. Local Control Loop Testing shall be conducted to determine base loop connectivity, unit scaling, and monitoring or control operation. Contractor shall complete Local Control Loop Testing prior to start of Pre-Commissioning.

    ii. Remote Control Loop Testing shall be conducted to determine full loop functionality while from the SCADA system. Contractor shall complete Remote Control Loop Testing during Pre-Commissioning.

b. Local and Remote Control Loop Testing shall documented as being completed on the Loop Validation Sheets.

F. Loop Validation Sheets: The CONTRACTOR shall prepare loop confirmation sheets for each loop covering each active instrumentation and control device except simple hand switches and lights. Loop confirmation sheets shall form the basis for operational tests and documentation. Each loop confirmation sheet shall cite the following information and shall provide spaces for sign-off on individual items and on the complete loop by the Instrumentation Supplier:

a. Project name

b. Loop number

c. Local Control Loop Testing Completion Date

d. Remote Control loop Testing Completion Date

e. Tag number, description, manufacturer, and model number for each element

f. Installation bulletin number

g. Specification sheet number

h. Loop description number

i. Adjustment check

j. Space for comments

k. Space for loop sign-off by Instrumentation Supplier and date

I. Space for CONSTRUCTION MANAGER witness signature and date

G. Loop Certifications: When installation tests have been successfully completed for individual instruments and separate analog control networks, a certified copy of each test form signed by the CONSTRUCTION MANAGER or the CONSTRUCTION MANAGER's representative as a witness, with test data entered, shall be submitted to the CONSTRUCTION MANAGER together with a clear and unequivocal statement that the instrumentation has been successfully calibrated, inspected, and tested.

3.07 PRE-COMMISSIONING

A. General: Pre-commissioning shall commence after acceptance of wire test, calibration tests and loop tests, and inspections have demonstrated that the instrumentation and control system complies with Contract requirements. Pre-commissioning shall demonstrate proper operation of every system with process equipment operating over full operating ranges under conditions as closely resembling actual operating conditions as possible.

B. Pre-commissioning Procedures and Documentation: Pre-commissioning and test activities shall follow detailed test procedures and check lists accepted by the ENGINEER. Test data shall be acquired using equipment as required and shall be recorded on test forms accepted by the ENGINEER, which include calculated tolerance limits for each step. Completion of system precommissioning and test activities shall be documented by a certified report, including test forms with test data entered, delivered to the CONSTRUCTION MANAGER with a clear and unequivocal statement that system pre-commissioning and test requirements have been satisfied.

C. Operational Validation: Where feasible, system pre-commissioning activities shall include the use of water to establish service conditions that simulate, to the greatest extent possible, normal final control element operating conditions in terms of applied process loads, operating ranges, and environmental conditions. Final control elements, control panels, and ancillary equipment shall be tested under start-up and steady state operating conditions to verify that proper and stable control is achieved using motor control center and local field mounted control circuits. Hardwired and software control circuit interlocks and alarms shall be operational. The control of final control elements and ancillary equipment shall be tested using both manual and automatic (where provided) control circuits. The stable steady state operation of final control elements running under the control of field mounted automatic analog controllers or software based controllers shall be assured by adjusting the controllers as required to eliminate oscillatory final control element operation. The transient stability of final control elements operating under the control of field mounted, and software-based automatic analog controllers shall be verified by applying control signal disturbances, monitoring the amplitude and decay rate of control parameter oscillations (if any), and making necessary controller adjustments as required to eliminate excessive oscillatory amplitudes and decay rates.

D. Loop Tuning: Electronic control stations incorporating proportional, integral or differential control circuits shall be optimally tuned, experimentally, by applying control signal disturbances and adjusting the gain, reset, or rate settings as required to achieve a proper response. Measured final control element variable position/speed set point

settings shall be compared to measured final control element position/speed values at 0, 25, 50, 75, and 100 % of span and the results checked against indicated accuracy tolerances.

E. Pre-commissioning Validation Sheets: Pre-commissioning shall be documented on one of two (2) types of test forms as follows:

   a. For functions which can be demonstrated on a loop-by-loop basis, the form shall include:

      i. Project name

      ii. Loop number

      iii. Loop description

      iv. Tag number, description, manufacturer, and data sheet number for each component.

      v. Space for sign-off and date by both the Instrumentation Supplier and CONSTRUCTION MANAGER.

   b. For functions that cannot be demonstrated on a loop-by-loop basis, the test form shall be a listing of the specific tests to be conducted. With each test description the following information shall be included:

      i. Specification page and paragraph of function demonstrated

      ii. Description of function

      iii. Space for sign-off and date by both the Instrumentation Supplier and CONSTRUCTION MANAGER

F. Pre-commissioning Certification: The CONTRACTOR shall submit an instrumentation and control system pre-commissioning completion report which shall state that Contract requirements have been met and shall include a listing of instrumentation and control system maintenance and repair activities conducted during the pre-commissioning testing. Acceptance of the instrumentation and control system pre-commissioning testing must be provided in writing by the CONSTRUCTION MANAGER before the performance testing may begin. Final acceptance of the control system shall be based upon plant completion as stated in the General Conditions.

3.08 TESTING AND INSTALLATION

A. A. PSCI shall integrate all PLCs and SCADA system from temporary (emergency) server computers system prior to the start of Pre-Commissioning test.

   1. The new system shall be proven out during Simulation and Loop testing before the integration back to existing system

2. Once integrated into the existing system, the INSTRUMENTATION SUPPLIER shall be required to perform:

    a. Failure analysis tests on loops (power, device, and communication)

    b. All tests performed during loop test

    c. SCADA and PLC shutdown test

    d. Communication network test

    e. Redundancy test on all systems

    f. Normal Power to Generator power and back test

B. Perform all necessary interim HMI/PLC programming and configuration to support the sequencing of improvement residual system. This work includes modifications to the existing PLC/HMI systems that are required to facilitate the transition from the existing processes to the new processes and final conversion of existing PLC/HMI code to new PLC/HMI code.

C. The Instrumentation Supplier shall maintain both new and existing thick-client view workstations (View Nodes) throughout the Project construction and commissioning phases so that all view workstations that are in use by the operations staff have identical graphics, historical trending, reporting, and data access, and that all view workstations have the graphics displays that represent the process systems that are currently installed and available for plant operation. Where view workstations are required for use by the contractor for testing purposes, those view workstations shall be specifically designated and clearly identified by the CONTRACTOR, and shall not be available for general operator use.

D. The Instrumentation Supplier shall transfer and update all off site SCADA monitoring and control functions that are part of the existing iFIX SCADA application. This work shall include:

    1. Add new I/O drivers into existing iFix database.

    2. Configuration of I/O drivers to communicate with new PLC and existing PLC systems

    3. Import of database points from temporary (emergency) server computers into the existing iFIX database.

    4. Import of existing graphic displays from the temporary (emergency) server computers iFIX application to the existing iFIX SCADA server computers system. Screens shall be modified to match the look and feel of the new HMI displays and to update any screen navigation links as required, but existing process graphics and displayed data not part of the Residual project shall remain as is.

5. Updating all trends, reports, ODMS, critical beacon system, diagnostic screens, communication screens, overview screens, pager tags, configuration, and etc related to residual project

6. Update Redundant HMI Servers that was used in simulation and loop testing.

7. Document both new and existing control system components.

E. Testing

1. General

a. As part of the requirement of this Specification Section, it is the responsibility of the Instrumentation Supplier to provide a complete operational control system. Confirmation of an operational control system is dependent upon results derived from test procedures as specified in this Section.

b. Perform factory testing prior to shipment of the equipment and also testing of the equipment once installed in the field. Once the system is in operation, an additional 30- Day System Commissioning Test is required.

c. Each test shall be in the cause and effect format. The person conducting the test shall initiate an input (cause) and upon the system's or subsystem's producing the correct result (effect), the specific test requirement will have been satisfied.

d. All tests shall be conducted in accordance with prior CONSTRUCTION MANAGER approved procedures, forms and checklist all as submitted by the Instrumentation Supplier under Part 1 of this Specification. Each test to be performed shall be described and a space provided after it for signoff by the appropriate parties after its satisfactory completion. Include “punchlist” forms with the test procedure to document issues that arise during the testing. Punchlist forms shall include a resolution section that allows a description of the correction and signoff areas for Instrumentation Supplier and CONSTRUCTION MANAGER.

e. Copies of the sign off test procedures, forms and checklists will constitute the required test documentation. The test result forms shall be submitted to CONSTRUCTION MANAGER for approval at the completion of each test.

f. Provide all special testing materials and equipment. Wherever possible, perform tests using actual process variables, equipment, and data. Where it is not practical to testwith real process variables, equipment and data, provide suitable means of simulation. Define these simulations techniques in the test procedures.

g. The Instrumentation Supplier shall coordinate all required testing with the Contractor, all affected Subcontractors, the Engineer, and the District.

h. The Instrumentation Supplier shall furnish the services of field service engineers, all special calibration and test equipment and labor to perform the field tests.

i. Engineer reserves the right to test or retest all specified functions, whether or not explicitly stated on the Test Procedures, as required to determine compliance with the functional requirements of the overall system. Such testing required to determine compliance with the Specified requirements shall be performed at no additional cost to the District. Engineer's decision shall be final regarding the acceptability and completeness of all testing.

j. No equipment shall be shipped until District and Engineer have received all test results and approved the system is ready for shipment.

2. This paragraph is provided as a general narrative for the Instrumentation Supplier's testing and commissioning work. It is the responsibility of the Instrumentation Supplier to coordinate and schedule testing and commissioning required to meet the project schedule. Testing shall be performed in the following sequence.

a. Testing to be completed includes:

i. UFT and WFT for Instrumentation Supplier supplied hardware and software to be installed and commissioned during construction. This includes control panels, network components, servers, workstations, new PLC programs, modifications to existing PLC programs, implementation of interim and temporary systems, new HMI and SCADA configuration.

ii. Factory testing shall include the modifications to the District's existing SCADA system. The Instrumentation Supplier shall configure a temporary SCADA server computers system with the District's existing iFix application, and a PLC system with the Instrumentation Supplier modified PLC program. Factory testing shall include a demonstration of the transitions from the existing residual treatment processes to the interim, temporary, and revised residual treatment processes for each process system that is to be revised during construction. The Instrumentation Supplier shall fully demonstrate the system's ability to switch between new and existing controls at both the PLC and HMI level.

iii. Functional Loop Testing for the Instrumentation Supplier shall include all field process systems test that are installed and/or modified during construction for Instrumentation Supplier supplied hardware and software. Testing shall be done after the temporary HMI system has been integrated back to the existing iFix 5.8 HMI system (or current version of the time).

iv. System level testing for the Instrumentation Supplier includes the following:

i. Communication, device, and power failure testing for each loop

ii. System level diagnostic testing including turning off power to PLCs and HMI system

iii. System Level diagnostic testing including disconnecting communication cables and etc to PLCs and HMIs system.

v. Commissioning (30-Day Acceptance Test) shall be witnessed by the Instrumentation Supplier. Any major modification during 30-Day System Commissioning testing time shall require the retesting of the above steps by the Instrumentation Supplier.

vi. Upon the completion of all field process system testing and the 30-day System Commissioning Test all switching code shall be removed. Instrumentation Supplier shall witnessed and support Operations with the generally retested one loop or system one at a time.

3. Factory Testing shall be performed with all system control panels, HMIs, network equipment, and communication media in place and functional. All system programming shall be completed for PLC control logic, HMI graphic, network addressing (conforming to District addressing requirements) so that the Factory Tests are completed and verify that all system components and elements are operating properly and as specified prior to being shipped to the site.

4. Perform both Fabrication and Logical Factory Testing as specified. All control panels provided or modified under the requirements of the related technical Specification Sections shall be included in these tests. Submit summary results of UFT including certified statement of successful completion of all UFT tasks. Upon successful completion of the Factory Tests, the Instrumentation Supplier shall coordinate shipping or storage of the system elements as required by the Contractor and as specified to coordinate delivery of control system equipment to the RWTP site with the installation and commissioning of the electrical and mechanical equipment and as physical space is made available at RWTP.

5. Simulation testing shall be performed on site for all existing and new PLC system modified by this project on the temporary server computers, new view node computers, and new touch screen system.

6. Operational Readiness Test (ORT) and Functional Test (FT) shall be completed through the FT on the modified existing panels, new Contractor provided panels, and SCADA system. Successful FT control system field testing shall be completed prior to any control system operation of the process equipment. Testing of panels shall include full confirmation of successful communication to and from the SCADA system on all communication channels and media as well as verification of all remote control, failover, and monitoring logic. Testing shall include verification by the Instrumentation Supplier of all SCADA HMI addressing. Testing shall be scheduled and coordinated with the CONSTRUCTION MANAGER as specified in these Specifications. Testing shall include 100% checking all new data points to and from the District SCADA system.

7. The final 30-day System Commissioning Test is a test of the complete system.

8. Unwitnessed Factory Test (UFT) – Fabrication

   a. The entire system except for primary elements, final control elements, and field mounted transmitters shall be interconnected and tested to ensure the system will operate as specified. All analog and discrete input/output

points not interconnected at this time shall be simulated to ensure proper operation of all alarms, monitoring devices/functions and control devices/functions.

b. All panels, consoles and assemblies shall be inspected and tested to verify that they are in conformance with related submittals, Specifications and Drawings. During the tests all digital system hardware and software shall be operated for at least five Days continuously without a failure to verify the system is capable of continuous operation.

c. Tests to be performed shall include but not be limited to the following. Each of these tests shall be specifically addressed in the Test Procedure submittal.

   i. 100% wiring and database address verification of panel components and process controller I/O as applicable.

   ii. Demonstrate the data communication network, Ethernet, and protocols for transmission and receipt of data.

   iii. Demonstrate all system software functions specified including system heartbeats, clock synchronization, and data export to other application platforms.

   iv. Generate reports using test data.

   v. Test system recovery from failure scenarios including cold boot, warm boot, communication loss, power failure, process failure, redundancy backup systems, etc..

   vi. Other tests as necessary to verify complete functionality of the entire control system.

9. Unwitnessed Factory Test (UFT) – Logical

a. Perform logical testing of the PLC panel developed PLC logic and associated HMI graphic screens using the PLC Control Logic Simulation Panel specified in this Section.

b. Simulation testing shall consist of a combination of internal logic simulation within the Unity programming platform and additional process loop specific testing using the control logic simulation for dynamic testing of each process loop resident in the PLC platform under test.

c. The simulation testing shall include loading the developed process PLC code into the PLC simulation panel test bed PLC, manually establishing initial values process variable or passed PLC network variables and implementing simulation of the process loops.

d. Demonstrate analog scaling and analog alarms for analog variables on the HMI screens; verify status of all discrete variables on the HMI screens.

e. Simulate and demonstrate functionality of the process controls in conformance with the process control loop descriptions. Simulate operating conditions to verify the performance of the monitoring and control functions. Simulate functionality of permissives and logic by the new programs.

f. Demonstrate by simulating control loop response on loss of process signals from analog instrumentation, failure of controlled equipment to respond to PLC commands.

g. Demonstrate by simulating control loop response on loss of communications to other associated PLC systems or on loss of remote I/O. Confirm that output signals fail to the correct value based on the requirements of the Process Control Descriptions.

h. Demonstrate graphical user interfaces (hardware and software) for process controllers and HMI.

10. Witnessed Factory Test (WFT): Fabrication and Logical

a. Repeat the same series of tests as for the UFT but in the presence of the District and the Engineer. All elements of the WFT shall be witnessed by the District and the Engineer. Provide two weeks schedule notification to the District and the Engineer prior to performing the WFT. The WFT shall not be held until after favorable review of all hardware, software, and test procedure submittals as specified in these Specifications and successful completion of the UFT.

b. Submit WFT results for review by Engineer.

11. Field Testing - Following installation of the process control system components and conforming to the testing sequence described above perform the following:

a. Operational Readiness Test (ORT)

i. General: Prior to startup and the Functional Test, the indicated system elements shall be certified (inspected, wired, calibrated, tested, and documented) that it is installed and ready for the ORT as defined below.

ii. Loop/Component Inspections and Tests: System shall be checked for proper installation, calibrated and adjusted on a loop-by-loop and component-by-component basis to ensure that it is in conformance with related submittals and these Specifications. PID loop tuning shall be completed as specified in these Specifications. Related loops shall be tested as a system to verify interlocks, operations of functionally related loops, etc., all as specified in Section 40 90 10.

iii. The Loop/Component Inspections and Tests shall be implemented using Instrumentation Supplier developed, Engineer-approved forms and checklists. Each loop of functionally related group of loops (subsystem) shall have a Loop/Subsystem Status Report to organize and track inspection, adjustment and calibration. These reports shall include the

following information and check off items with spaces for sign off by the system supplier:

a) Project Name, Test Date, INSTRUMENTATION SUPPLIER Name, and Lead INSTRUMENTATION SUPPLIER Technician Name

b) Loop Number or Loops Numbers of a Tested Subsystem

c) Tag Number for each component.

d) Check offs/signoffs for each component:

e) Tag/identification (Loop or Subsystem name)

f) Installation

g) Termination – wiring and tubing

h) Scale, Range, and Setpoint as applicable

i) Calibration/adjustment (minimum of 5 point for analog, set point for switches) rising and falling

j) Check offs/signoffs for the loop

k) Panel interface terminations

l) I/O interface terminations

m) Inputs/Outputs operational: received/sent, processed, adjusted

n) Total loop operation and operation of subsystem associated loops.

o) Space for comments

iv. The INSTRUMENTATION SUPPLIER shall maintain the Loop Status Reports sheets at the job site and make them available to the CONSTRUCTION MANAGER at any time.

v. These inspections, calibrations, and tests do not require witnessing. However, CONSTRUCTION MANAGER shall review Loop Status Sheets and spot-check the INSTRUMENTATION SUPPLIER test process periodically. Any deficiencies found shall be corrected by the INSTRUMENTATION SUPPLIER prior to commencement of the Functional Test.

vi. Submit ORT results for review by CONSTRUCTION MANAGER.

b. Functional Test (FT).

i. General: Prior to startup, the installed instrument and control system elements as described above shall be certified that it is ready for operation. A witnessed FAT shall be performed on the system to demonstrate that it is operating and in compliance with these Specifications. All preliminary testing, inspection, and calibration shall be complete as defined in the Operational Readiness Test.

ii. Each specified function and process control shall be demonstrated on a paragraph-by- paragraph, loop-by-loop, panel-by-panel, and site-by-site basis. FAT shall be correlated to the functional verification of the process control descriptions of Section 40 90 10 addressing specific elements of overall system and sub-system control.

iii. INSTRUMENTATION SUPPLIER shall perform network testing for each network segment including equipment provided in other sections of the Contract Document. Test and coordinate operation of the network. Testing shall include performance and error tracking using standard network administration software. Testing shall confirm that network performance meets or exceeds the system and network performance criteria developed by the INSTRUMENTATION SUPPLIER and as specified in these Specifications.

iv. Loop-specific and non-loop-specific tests shall be the same as specified under Factory Tests except that the system shall be tested and all functions demonstrated using live field based data to the greatest extent possible. In addition, related loops shall be tested as a system to verify interlocks, operations of functionally related loops, etc., all as specified in Section 40 90 10.

v. Updated versions of the documentation specified to be provided for during the Factory Tests shall be made available to CONSTRUCTION MANAGER at the job site during the tests. In addition, one copy of all O & M Manuals shall be available for reference at the job site during testing.

vi. Following initial startup, the control system shall operate for a continuous 100 hours without failure before this test will be started. Network testing and performance testing shall be on-line and monitoring network operation throughout the 100-hour period.

vii. Punchlist items and resolutions noted during the test shall be documented on the Punchlist/Resolution form. In the event of rejection of any part or function test procedure, the INSTRUMENTATION SUPPLIER shall perform repairs, replacement, and/or retest within 10 Days.

viii. Submit FAT results for review by the CONSTRUCTION MANAGER.

c. 30-Day System Commissioning Test

i. After completion of the Operational Readiness and Functional Tests for each major process system, the INSTRUMENTATION SUPPLIER shall be responsible for operation of that major process system for a period of

30 consecutive days, under conditions of the 30-day System Commissioning Test specified under General Provision, Section 40 91 00, and Section 40 95 20, without a single non-field repairable malfunction. Network performance monitoring shall continue throughout the 30-day test period.

ii. During this test, operations and INSTRUMENTATION SUPPLIER personnel shall be present as required. The INSTRUMENTATION SUPPLIER is expected to provide personnel for this test who have an intimate knowledge of the hardware and software of the system. Coordinate INSTRUMENTATION SUPPLIER staffing requirements during the 30-day test to coincide with normal shift operations as much as possible. Off-shift emergencies shall be fully supported by INSTRUMENTATION SUPPLIER staff. Provide INSTRUMENTATION SUPPLIER staff with cell phones and pagers to ensure that support staff are available by phone and/or on-site within 4 hours of a request by operations staff.

iii. While this test is proceeding, District shall have full use of the system. Only plant operating personnel shall be allowed to operate equipment associated with live plant processes. Water Treatment Plant operations shall remain the responsibility of District and the decision of District's operators regarding plant operations shall be final. Only District operating personnel shall be allowed to operate equipment associated with live plant processes.

iv. Any malfunction during the tests shall be analyzed and corrections made by the INSTRUMENTATION SUPPLIER. CONSTRUCTION MANAGER will determine whether any such malfunctions are critical and warrant a repeat of this test. Network performance excursions that exceed the maximum levels for errors developed by the INSTRUMENTATION SUPPLIER and specified in these Specifications shall constitute a system malfunction.

v. Any malfunction during this 30 consecutive day test period, which cannot be corrected within 24 hours of occurrence by the INSTRUMENTATION SUPPLIER's personnel, or more than two similar failures of any duration, will be considered as a non-field-repairable malfunction.

vi. Upon completion of repairs, by the INSTRUMENTATION SUPPLIER, the test shall be repeated as specified in these Specifications.

vii. In the event of rejection of any part or function, the INSTRUMENTATION SUPPLIER shall perform repairs or replacement within 10 Days.

viii. All computer equipment, network equipment, controllers, data base, process controller logic, and graphical interface system errors must be functioning as required per the Specifications prior to the start of each test period. The 30 day test will not be considered successful until all data base points and logic functions are tested and verified to be correct.

ix. The total availability of the system shall be greater than 99.5 percent during this test period. Availability shall be defined as:

AVAILABILITY = (TOTAL TIME - DOWN TIME) / TOTAL TIME

x. Down times due to power outages or other factors outside the normal protection devices or backup power supplies provided shall not contribute to the availability test times above.

xi. Perform a final 30-day System Commissioning Test of the entire residuals management system following successful testing, start-up, and operation.

3.09 ON-SITE SUPERVISION

A. The CONTRACTOR shall furnish the services of an on-Site resident engineer to supervise and coordinate installation, adjustment, testing, and start-up of the PCIS. The I&C engineer shall be present during the total period required to effect a complete operating system. A team of engineering personnel shall be at the Site for one hundred and eighty (80) hours to check equipment, perform the tests indicated in this Section, and furnish start-up services.

3.10 COMMISSIONING

A. The entire WORK shall operate for thirty (30) days longer than the commissioning period in Section 01 75 06 without failure.

B. The CONTRACTOR shall coordinate with the Systems Integrator to satisfactorily complete commissioning tests.

C. In addition to the commissioning requirements, in Section 01 75 06, the CONTRACTOR shall furnish support staff as required to operate the system and to satisfy the repair or replacement requirements.

D. If any component fails during the performance test, it shall be repaired or replaced and the performance test shall be restarted at time zero on another fourteen (14) day period unless otherwise allowed by the CONSTRUCTION MANAGER.

3.11 TRAINING

A. General: The CONTRACTOR shall train the OWNER's personnel on the maintenance, calibration, and repair of instruments provided under this Contract. The cost of training programs to be conducted with OWNER staff shall be included in the Contract price. The training and instruction shall be directly related to the system being supplied and modiflied.

B. Instructions: The training shall be performed by qualified representatives of the equipment manufacturers and shall be specific to each piece of equipment. CONTRACTOR shall make arrangements to video-record each session and furnish recordings to the OWNER. Each rendered video recording shall be stored on a 5TB

(minimum) portable back up hard drive. The portable backup hard drives and the video content shall hence be the property of the OWNER. CONTRACTOR shall provide documentation to the OWNER transferring full ownership of all training video recordings to the OWNER.

1. The video recording camera system shall record all video in a minimum of 4K uncompressed. The recording codec shall be in 4:4:4 chroma at 12 bit depth in ProRes Raw HD. The final export of the rendered video format may be as low as 1080p MP4 for most equipment videos; however, all video showing technical content such as video recording on PLC/HMI code shall be exported in H.265 video format. PLC/HMI code can also be screen captured in 4k with voice over.

2. OWNER has HMI screens which has black text over red background (alarm summary) and video recording system and/or screen capture device must be able to capture and render such images in the same quality as what is displayed on the SCADA view node computer's monitors. Video recordings that are incomplete or that are not readily audible or with unclear clear images shall require the class to be repeated with new video recording.

C. Duration: Each training class shall cover, as a minimum, operational theory, maintenance, trouble shooting/repair, and calibration of the instrument. Each training class shall be conducted twice, at a minimum, to accommodate the differing operational shifts and work schedules for OWNER personnel.

1. Each training class duration shall be at least as long as the durations noted below. For vendor-package system with instruments, CONTRACTOR shall coordinate with the vendor to have the vendor provide specific sessions for vendor-furnished instrumentation provided with vendor packages.

2. Number of classes on each subject: A minimum of two classes on identical subject matter shall be conducted unless otherwise noted. A minimum of one class per day shall be held on consecutive days. Times shall be scheduled at the discretion of the CONSTRUCTION MANAGER. The purpose of having two classes on each subject is to accommodate the attendance of as many District personnel working different shifts as possible.

D. Instrument Training: Training shall be for instruments and systems that shall include, but shall not be limited to, the following.

Specification Section	Description	Type of Training	Minimum Number of Consecutive Days for Classes	Classes Per Day	Total No. of Classes	Number of instruction hours per class
40 91 02	Flow Measurement	Operations / Maintenance	2	1	2	4
40 91 03	Flow Switches	Maintenance	2	1	2	2
40 91 06	Level Measurement	Operations / Maintenance	2	1	2	2

Specification Section	Description	Type of Training	Minimum Number of Consecutive Days for Classes	Classes Per Day	Total No. of Classes	Number of instruction hours per class
40 91 12	Density Measurement	Operations / Maintenance	2	1	2	4
40 91 08	Pressure Measurement	Operations / Maintenance	2	1	2	2
40 91 09	Pressure Detection	Operations / Maintenance	2	1	2	2
Vendor Package	Centrifuge Controls	Operations/ Maintenance	2	1	2	2
Vendor Package	Polymer Mixing Controls	Operations/ Maintenance	2	1	2	2

E. Vendor-Specific Training

a. The Hiller Decanter Centrifuges system is a proprietary system and the CONTRACTOR shall make arrangement with Hiller for that training. All equipment in the Centrifuge panels including the profibus communication system shall be conducted by Hiller. The cost of Hiller Decanter Centrifuges training shall be part of this WORK and shall be at no additional cost to the OWNER.

b. The District shall be provided with training consisting of, as a minimum, two web-based seminars in conjunction with a conference call. One in-person classroom based training seminar shall also be conducted. The training seminars shall be minimum 2 hours each.

F. Provide PLC Control Logic Simulator Manual. These manuals shall be separately bound and shall contain all information necessary for District programming staff to expand simulation or real I/O memory mapping, make specific modifications to the simulation logic, allow access to the standalone simulation test PLC, documentation of any simulation specific modifications that may be necessary to interface the simulation PLC to the iFIX database, and other simulation specific documentation.

G. SCADA Training:

1. All SCADA training shall be video recorded as specified above.

a. CONTRACTOR shall provide minimum of 80 hours (a total of ten consecutive training days with each training day consisting of eight hours) for SCADA system training. For vender-package system with SCADA system, Contractor shall coordinate with the vendor to have the vendor provide specific sessions for vendor-furnished PLC/HMI/touch screen system.

2. Training shall be for SCADA systems that shall include, but shall not be limited to, the following:

a. PLC System Overview
    i. Review of RMP PLC design standards document
    ii. DFBs used in new programming
    iii. AI Scale
    iv. AI Alarm (High and Low)
    v. AO Scale
    vi. DI Alarm
    vii. Motor
    viii. Actuator Modulating Valve/Gate
    ix. Actuator Open/Close Valve/Gate
    x. VFD Speed
    xi. Runtime
    xii. Starts
    xiii. Manual-Off-Auto
    xiv. Open-Close-Auto
    xv. Totalizer
    xvi. Valve Solenoid
    xvii. PID
b. DDTs used in new programming
c. Special sections (the following are examples only)
    i. Initialization
    ii. Recipes
    iii. Communications
    iv. Mapping
        a. Inputs
        b. Outputs

c. Peer-to-peer comms

d. Recipe

v. Tag naming conventions used in new programming

vi. Standard program layout of new programming

d. Individual PLCs Training

i. Areas covered by in program

ii. Program layout

iii. Peer to peer communication

iv. Analog input handing

v. Discrete input handing

vi. Equipment sections (control strategy and control narrative and review each section of the code on a loop by loop basis)

vii. System control sections

viii. Analog outputs handling

ix. Discrete outputs handing

x. Modified Equipment sections (control strategy and control narrative and review each section of the code on a loop by loop bases)

xi. New system control sections

xii. New analog outputs handling

xiii. New discrete outputs handing

e. PLC defined data types

f. PLC Control Strategies

g. PLC Software Design Specifications

h. PLC Application Structures (Program Listing)

i. PLC memory map

j. PLC alarms including critical beacon alarms tags

k. PLC communication

l. PLC tag name

m. Failure Analysis Matrix

n. PLC communication statistical/diagnostic information

o. PLC statistical/diagnostic information

p. Defined Function Blocks (DFB). Each DFB shall be accompanied covered during training using an English Language detailed control narrative explaining the function of the code in a line by line fashion.

q. Complete system memory map for equipment connected to the control system under this Contract. The memory map list submitted in both a Microsoft Excel readable electronic file format on a CD and an 8-1/2 inch by 11-inch hard copy. The memory map list shall be comprehensive details of transfer of registers/names/DDT and related equipment communication processes, and shall include transfers for the following:

    i. From one PLC to another PLC

    ii. From all PLCs to all HMI

    iii. From all HMI to all PLC

    iv. From all PLCs to all touch screens

    v. From all touch screens to all PLCs

r. Maintenance training for PLC software configuration including logic and database development, programming standards, variable addressing, alarming, analog scaling, diagnostics, and troubleshooting. Training shall be based on implementation of the PLC logic as it relates to the Project control strategies.

s. Maintenance training for HMI software configuration including database development, displays, alarming, analog trending, diagnostics, and troubleshooting. Training shall be based on implementation of the PLC logic as it relates to the Project control strategies

t. Maintenance training for Paging Software configuration including setting up of the configuration file, adding new tags, and iFix configuration such as SCU, database, and paging software.

u. Maintenance training for loading and configuring all driver software configuration from PLC to HMI

v. Maintenance training for ODMS software configuration

w. Maintenance training for simulator configuration including all HMI and PLC related code

x. Additional information for PLC and HMI training: PLC training shall include detail step by steps information on all PLC DFBs, all PLC communication code logic in relationship to the memory map, all PLC logic in a loop by loop format in relationship to the project control strategies and control narrative description broken down by each PLCs provided in this project. All HMI training shall include detail step by steps information on all HMI dynamos, scripting, database setup, driver setup, and etc. on the HMI computer system provided in this project.

H. Network Training:

a. Network Overview

i. Review Contract Network Drawings

ii. Review Communication/Network Drawings.

iii. Review Fiber Allocation Network

1. Review Rack Mount Ethernet Switch Specifications

2. Review Panel Mount Switch Specifications

b. Plant Networks (SCADA, PLC & RIO)

i. Discuss Layout of the Plant Control Networks

ii. Discuss network and fiber patch connection points.

iii. Discuss Power Sources. (Utility vs UPS)

c. Diagnostic tools and HMI graphics related to Network Communications.

i. Switch Diagnostic Information

ii. Switch configuration

iii. PLC/RIO module configuration and diagnostics

iv. PLC Ethernet network interface module configuration and diagnostics

v. Interpreting OFS driver and iFix OPC interface diagnostics

vi. Interpreting PLC network message block diagnostics

vii. General Window Command Line and Network Performance Monitoring

I. Schedule: Training shall be performed during the pre-commissioning phase of the project. The training sessions shall be scheduled a minimum of three (3) weeks in advance of when the courses are to be initiated. The ENGINEER will review the course outline for suitability and provide comments that shall be incorporated.

J. Agenda: The training shall include operation and maintenance procedures, trouble shooting with necessary test equipment, and changing set points, and calibration for that specific piece of equipment.

K. Documentation: Within ten (10) days after the completion of each session the CONTRACTOR shall submit the following:

a. A list of OWNER personnel who attended the session.

b. An evaluation of OWNER personnel via written testing or equivalent evaluation.

c. A copy of the training materials utilized during the lesson with notes, diagrams, and comments.

3.12 CRITERIA FOR SUBSTANTIAL COMPLETION

A. For the purpose of this Section and all Division 40, the following conditions shall be fulfilled before the WORK is considered substantially complete:

a. Submittals have been completed and approved.

b. The PCIS has been calibrated, loop tested, and pre-commissioned.

c. The OWNER training has been performed.

d. Spare parts and expendable supplies and test equipment have been delivered to the CONSTRUCTION MANAGER.

e. Commissioning has been successfully completed.

f. Punch-list items have been corrected.

g. Record drawings in both hard copy and electronic format have been submitted.

h. Revisions to the Technical Manuals that may have resulted from the field tests have been made and reviewed.

i. Debris associated with installation of instrumentation has been removed.

j. Probes, elements, sample lines, transmitters, tubing, and enclosures have been cleaned and are in like-new condition.

3.13 CLOSE OUT DOCUMENTATION

A. Software Licenses

1. Ensure that all software license used in the project are transferred back into the District name. Work with all vendors to transfer licenses to OWNER.

2. Provide all software media used in this project.

3. If the software was downloaded and do not come with a disc, provide a copy of the software (applications, driver, documentation, literature, manuals, software licensing codes, and related items) on DVD or Blu-ray disc.

B. Program files

1. Provide backup copy of final Redundant Server HMI backup files
2. Provide copy of existing server computers HMI backup files before any changes
3. Provide copy of existing server computers HMI backup files after all changes
4. Provide copy of all PLC files before any changes
5. Provide copy of all PLC files after all changes

C. Documentation

1. Provide all I/O list
2. Provide all as-built drawings (drawings must cross reference each other)
3. Provide all SCADA control strategies
4. Provide memory maps

D. Video based O&M documentation:

1. In addition to the written hardware, software, operations, and other maintenance documentation as specified, provide additional video training to specifically describe methods for executing the following maintenance tasks. Provide electronic versions of video files on hard devices such as Blu-ray disc, USB portable drives, portable memory storage medium or equivalent permanent non-volatile storage (video links to video files shall not be acceptable).
2. Rebuild, load, and verify operational connectivity of an HMI thin client panel mounted workstation. Video shall demonstrate reloading a backup SCADA file, testing, and accessing the SCADA network data using the standard thin client HMI and SCADA software provided under this Contract.
3. Rebuild, load, and verify operational connectivity of an HMI thick client workstation. Video shall demonstrate reloading a backup SCADA file, testing, and accessing the SCADA network data using the standard thick client HMI workstation and SCADA software provided under this Contract.
4. Rebuild, load, and verify operational connectivity of an HMI server computer. Video shall demonstrate reloading a backup SCADA file, testing, and accessing the SCADA network data using the standard server computer and SCADA software provided under this Contract.

5. Rebuild, load, and verify operational connectivity of a PLC programming laptop computer. Video shall demonstrate reloading a backup PLC file, testing, and access to a PLC using the standard PLC hardware and programming software provided under this Contract.

6. Rebuild, load, and verify operational connectivity of an HMI server computer. Video shall demonstrate reloading a backup SCADA file, testing, and accessing the SCADA network data using the standard server computer and SCADA software provided under this Contract.

7. INSTRUMENTATION SUPPLIER shall work with equipment vendors to provide video based O&M documentation to Rebuild, load, and verify operational connectivity of all third parties (vendor system) SCADA systems. Video shall demonstrate reloading a backup SCADA file, testing, and accessing the SCADA network data using all third parties (vendor system) SCADA systems.

- END OF SECTION -

Appendix A – Instrument List

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40 91 00 APPENDIX A - RINCONADA INSTRUMENT LIST

Drawing Number	Instrument Tag	Instrument Type	Req. Power Supply	Instrument Range	Instrument Setpoint	Installation Detail	Specification	Comments
I-1	LI-100	Sludge Thickener # 1 Sludge Blanket Level Transmitter	120 VAC	0-25 ft	N/A		409106	
I-1	LI-102	Sludge Thickener # 1 Ultrasonic Level Transmitter	24 VDC	0-25 ft	N/A	I-201	409106	
I-1	LI-110	Sludge Thickener # 2 Sludge Blanket Level Transmitter	120 VAC	0-25 ft	N/A		409106	
I-1	LI-112	Sludge Thickener # 2 Ultrasonic Level Transmitter	24 VDC	0-25 ft	N/A	I-201	409106	
I-1	PI-104	Thickener # 1 Gearbox Pressure Transmitter	loop Powered	vendor	N/A		409108	
I-1	PI-114	Thickener # 2 Gearbox Pressure Transmitter	loop Powered	vendor	N/A		409108	
I-3	AIT-180	Sludge Density Transmitter Thickener Sample Line # 2	120 VAC	0-10%	N/A		409112	
I-3	AIT-190	Sludge Density Transmitter Thickener Sample Line # 1	120 VAC	0-10%	N/A		409112	
I-3	LAH-185	Transfer Sump HIGH HIGH Level Float Switch	24 VDC	N/A	1.5 ft	I-151	409107	
I-4	LSLL-510	Sludge Storage Tank # 1 LOW LOW Level Float Switch	24 VDC	N/A	384.67 ft	I-151	409107	
I-4	LIT-510	Sludge Storage Tank # 1 Radar LEVEL Transmitter	24 VDC	0-25 ft	N/A	I-202	409106	
I-5	LSLL-520	Sludge Storage Tank # 2 LOW LOW Level Float Switch	24 VDC	N/A	`	I-151	409107	
I-5	LIT-520	Sludge Storage Tank # 2 Radar Level Transmitter	24 VDC	0-25 ft	N/A	I-202	409106	
I-6	LIT-300	Centrate Sump B Ultrasonic Level Transmitter	24 VDC	0-25 ft	N/A	I-201	409106	
I-6	FIT-300	Centrate Sump B Magnetic Flow Transmitter	24 VDC	0-1,000 gpm	N/A	I-101	409102	
I-6	PSH-301	Centrate Return Pump 3 Discharge Pressure Switch	24 VDC	N/A	50 psi	I-301	409108	
I-6	PSH-302	Centrate Return Pump 4 Discharge Pressure Switch	24 VDC	N/A	50 psi	I-301	409108	
I-6	LAHH-302	Centrate Sump B HIGH HIGH Level Float Switch	24 VDC	N/A	380.50 ft	I-151	409107	
I-6	LALL-302	Centrate Sump B LOW LOW Level Float Switch	24 VDC	N/A	363.07 ft	I-151	409107	
I-6	PI-301	Centrate Return Pump 3 Discharge Pressure Gauge	N/A	0-60 psi	N/A	I-301	409108	
I-6	PI-302	Centrate Return Pump 4 Discharge Pressure Gauge	N/A	0-60 psi	N/A	I-301	409108	
I-7	AIT-400	Sludge Storage Tank Discharge Sludge Density Transmitter	120 VAC	0-10%	N/A		409112	
I-7	PI-460A	Centrifuge Feed Pump # 4 Flushing Water Pressure Gauge	N/A	0-100 psi	N/A	I-301	409108	
I-7	PI-460B	Centrifuge Feed Pump # 4 Discharge Pressure Gauge	N/A	0-60 psi	N/A	I-301	409108	
I-7	PSH-460	Centrifuge Feed Pump # 4 Discharge Pressure Switch	24 VDC	N/A	30 psi	I-301	409108	
I-7	FI-460	Centrifuge Feed Pump # 4 Seal Water Rotameter	N/A	0-100 gpm	N/A	I-106	409102	
I-7	FSL-460	Centrifuge Feed Pump # 4 Seal Water LOW FLOW Thermal Switch	24 VDC	N/A	20 gpm	I-152	409103	
I-7	FIT-460	Centrifuge Feed Pump # 4 Discharge Magnetic Flow Transmitter	24 VDC	0-500 gpm	N/A	I-101	409102	

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SECTION 40 91 02

IN-LINE LIQUID FLOW MEASURING SYSTEMS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. **General:** The SUB-CONTRACTOR shall furnish and install all in-line liquid flow measuring systems, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 40 91 00 - Process Control and Instrumentation Systems apply to this Section.

1.02 CONTRACTOR SUBMITTALS

A. **General:** The SUB-CONTRACTOR shall furnish submittals in accordance with Section 40 91 00 - Process Control and Instrumentation Systems

1.03 QUALITY ASSURANCE

A. **General:** The accuracy of each instrumentation system or loop shall conform to the requirements of Section 40 91 00 - Process Control and Instrumentation Systems

1.04 MANUFACTURER'S REPRESENTATIVE SERVICES

A. **General:** Manufacturers representative services shall conform to the requirements of Section 40 91 00 - Process Control and Instrumentation Systems.

1.05 PRODUCT HANDLING

A. **General:** Product handling shall conform to the requirements of Section 40 91 00 - Process Control and Instrumentation Systems.

1.06 GUARANTEE

A. **General:** Guarantees shall conform to the requirements of Section 40 91 00 - Process Control and Instrumentation Systems.

PART 2 -- PRODUCTS

General: All devices specified herein shall conform to the requirements of the Contract Documents.

2.1 MAGNETIC FLOW MEASURING SYSTEMS

A. Magnetic Flowmeter (Tube Type):

1. Magnetic flowmeter systems shall be of the low frequency electromagnetic induction type and produce a DC pulsed signal directly proportional to and linear with the liquid flow rate. Complete zero stability shall be an inherent characteristic of the flowmeter system. Each magnetic flow metering system shall include a metering tube, signal cable, and transmitter. The metering tube shall be constructed of 304 stainless steel with flanged connections, have at least 2 diametrically opposed, bullet-nosed, self cleaning electrodes, a liner material recommended by the manufacturer for the meter's intended service as described in these documents, a meter housing rated for NEMA 6 submergence conditions, and a meter coating consisting of epoxy painted finish.

2. The signal converter/transmitter shall use a DC pulse technique to drive flux-producing coils and convert the DC pulse signal from the tube to a 4-20 mA signal. The signal converter/transmitter shall have a backlit alphanumeric display housed in a NEMA 4X enclosure. It shall have integral zero return to provide a constant zero output signal in response to an external dry contact closure, an integral calibration self-test feature to verify proper operation of the electronics, high and low alarms and an automatic zero adjustment. The transmitter installation shall support integral or remote mounting (up to 300ft). Meter package shall include (2) corrosion resistant grounding rings constructed of the same material as the electrodes.

3. The meter shall be equipped with non-removable electrodes constructed of Hastelloy C. The meter shall support measurement and totalization of bi-directional flow. Installation parameters shall be as follows:

    1) Minimum 5 pipe diameters of straight pipe upstream

    2) Minimum 2 pipe diameters of straight pipe downstream

    3) Horizontal mounting only

    4) Support for lines sizes from 1-inch to 120-inches

4. Each flow metering system shall be hydraulically calibrated at a facility which is traceable to the US National Bureau of Standards. The calibration procedure shall conform to the requirements of MIL-STD-45662A and/or the more recent ANSI/NCSL Z540-1 or ISO 10012-1 requirements. A real-time computer generated printout of the actual calibration data indicating apparent and actual flows at 20, 40, 60, 80, and 100 percent of the calibrated range shall be submitted to the CONSTRUCTION MANAGER at least 14 days prior to shipment of the meters to the project site.

5. The flow metering system shall conform to the following technical specifications:

    Output (1) 4-20 mA into 600 ohms minimum;

    Time Constant = 0.5 to 100 seconds; galvanic or optic isolation

    Scaled pulsed output for totalization

HART protocol compatible

Accuracy:	± 0.25% of flow rate from 10 to 100% full scale
Repeatability:	± 0.05% at ± 0.0008 ft/s
Environmental Limits:	- 10 to + 60º C
Power Consumption:	20VA or less
Power Requirements:	24Vdc, +/- 10%

Accessories:

1. Furnish and install stainless steel sunshield for outdoor/exposed transmitter.
2. Furnish remote mount flow transmitter with a minimum cable length of 50 feet where indicated on contract drawings.
3. Provide stainless steel stanchions for mounting of remote transmitter no less than 4 feet above grade (reference mounting details on Installation Detail sheets).
3. Provide manufacturer digital calibration verification unit with necessary accessories to interface with the furnished magnetic flow meter.
4. Furnish one spool piece for every size magmeter supplied.

Magnetic flow measuring systems shall be as manufactured by:

1. Endress & Hauser – Model Promag W 400 for water applications; Model Promag H 500 for chemical applications

2. Yokogawa – Model AXF

Refer to Appendix A of Section 40 91 00 - Process Control and Instrumentation Systems for the complete instrument schedule.

2.2 ROTAMETER LIQUID FLOW MEASURING SYSTEMS

A General

1. Rotameters in chemical solution lines and where indicated shall have vertical bottom Inlets and top outlets with ANSI 150-lb flanged ends for vertical mounting.

2. The meters shall have Hastelloy C floats, 10-inch long scales, and a range of 10:1 with an accuracy of plus or minus 2 percent. Meters shall be rated for a minimum working pressure of 150 psi. Flanged rotameters for chemical solutions and where indicated shall be calibrated in gallons per minute.

3. The bodies shall have union ends for ease of maintenance, polysulphone tubes, aluminum or brass end fittings, Type 316 stainless steel internal parts and scales suitable for the indicated capacity range.

4. The meters shall have an accuracy of not less than plus and minus 5 percent over the capacity range indicated.

B Application Requirements

1. Meters in air and pump seal flushing lines shall be of the modified rotameter design with screwed ends, spring-loaded pistons, and union bodies for mounting in any position.

2. For activated carbon solution, bodies shall be Type 316 stainless steel construction with magnetically actuated float and scale.

3. For other chemicals, bodies shall have Type 316 stainless steel ends with heavy borosilicate glass tubes and packing glands or other best suitable material.

4. Rotameters with NPT screwed ends for water, air, and fuel gas service shall be calibrated in gallons per minute or cubic feet per minute. The scales shall be suitable for the capacity ranges indicated.

   Approved Manufacturers:

   a. Chemicals: **Brooks GT130x Series** or ENGINEER OF RECORD approved equal.

   b. Water service: **Headland-Badger variable area "In-Line" Meters** or ENGINEER OF RECORD approved equal**.**

   Refer to Appendix A of Section 40 91 00 - Process Control and Instrumentation Systems for the complete instrument schedule.

2.3 INSERTION TYPE ELECTROMAGNETIC FLOW METER

A. GENERAL

3. The flow meter shall consist of two components: an electromagnetic sensor and a converter. The 1” (25mm) electromagnetic sensor shall installed in an upstream port of a Singer Valve from diameters from 4 in. (100mm) to 36 in. (900mm) in clean water applications.

4. The flow meter shall determine the volumetric flow rate by means of the Continuity Equation where flow rate “Q” equals mean velocity “V” times cross sectional area “A” (Q = V x A). The velocity measurement must be taken at a known location, then, through empirically established equations, the sensed velocity will be converted to a mean velocity.

5. The electromagnetic flowmeter shall have no moving parts or sensors that are prone to damage and inaccuracy due to particulate matter and/or vibration.

6. The electromagnetic flowmeter shall be capable of being powered by from 90 to 265V, 45-66 Hz AC voltage source. It shall have a power draw of 25VA. *(or 10-35V DC voltage source. It shall have a power draw of 21W)*

7. The electromagnetic flowmeter shall have an accuracy of 2% of reading. Accuracy based on full scale is not allowed.

8. Each flowmeter shall be calibrated at the manufacturer's factory with calibrated test equipment traceable to standards such as NIST. Calibration certificates shall be submitted to the CONSTRUCTION MANAGER or CONSTRUCTION MANAGER Representatives prior to delivery of equipment.

9. The electromagnetic flowmeter shall have operating and storage temperature rating from -4° to 140°F (-20°C to +60°C).

10. The flowmeter shall be guaranteed for satisfactory performance and against manufacturing defects for a period of one year.

B. CONVERTER

11. The flow meter converter shall be microprocessor based with a keypad for instrument set up and LCD displays for totalized flow, flow rate engineering units and velocity.

12. The converter shall power the flow-sensing element and provide a galvanically isolated Dual 4-20mA output. It shall be possible, in the test mode; to easily set the converter outputs to any desired value within the range.

13. The 4-20mA scaling, time constants, pipe size, flow proportional output, engineering units and test mode values shall be easily set via the keypad and display.

14. Four separate fully programmable alarm outputs shall be provided to indicate empty pipe, forward/reverse, polarity (normally open/close), analog over-range, fault conditions, high/low flow rates, % of range, and pulse cut-off.

15. The converter shall periodically perform self-diagnostics and display any resulting error messages.

16. All set up data and totalizer values may be protected by a password.

17. The converter shall have an IP67 rating for protection against temporary immersion in water and ingress of dust (dust tight)

C. SENSOR

18. The flow-sensing element shall be of an electromagnetic single point type design and factory calibrated to traceable standards, such as NIST.

19. The sensor shall be made of polyurethane with pure carbon electrodes exposed to flow.

20. To eliminate erroneous readings due to pipe wall effects, the sensor must have its electrodes located at 1/8th pipe diameter from the pipe wall and be designed with a curved tip shape, so as not to collect debris while in the operating position. Flat tipped or Doppler sensors shall not be acceptable.

21. The sensor shall have an IP68 rating for protection against the effects of continuous immersion in water.

    Approved Manufacturers:

    Water service: The meter shall be equivalent to the SPI-MV Single Point Insertion Electromagnetic Flow Meter as manufactured by McCrometer, Inc., in Hemet, California, and supplied for use, specifically, with Singer Valve Inc. Main Valves.

D. COMPONENTS

22. The sensor cable is 20 feet of multi-conductor, abrasive resistant, PVC jacketed submersible cable flexible to -40°F. The sensor cable shall be permanently bonded to the sensor. Additional sensor cable, up to 200 feet, shall be available as an option.

23. The stainless steel insertion tube shall be rated for 250 PSI @ 160°F (71°C). Hardware must allow sensor to be secured by bolts when sensor is being inserted and retracted. A stainless steel compression seal assembly shall also be supplied.

PART 3 -- EXECUTION

3.01 GENERAL: Electrical interface and code compliance shall conform to the requirements of Section 40 91 00 - Process Control and Instrumentation Systems.

3.02 CALIBRATION: The calibration of all devices shall conform to the requirements of Section 40 91 00 - Process Control and Instrumentation Systems.

3.03 INSTALLATION: The installation of all devices shall conform to the requirements of Section 40 91 00 - Process Control and Instrumentation Systems.

3.04 LOOP TESTING: The loop testing of all devices shall conform to the requirements of Section 40 91 00 - Process Control and Instrumentation Systems.

3.05 PRECOMMISSIONING: The pre-commissioning of all devices shall conform to the requirements of Section 40 91 00 - Process Control and Instrumentation Systems.

3.06 ON-SITE SUPERVISION: On-site supervision shall conform to the requirements of Section 40 91 00 - Process Control and Instrumentation Systems.

3.07 PERFORMANCE TESTING: On-site performance tests shall conform to the requirements of Section 40 91 00 - Process Control and Instrumentation Systems.

3.08 RECORD DRAWINGS: Record drawings shall conform to the requirements of Section 40 91 00 - Process Control and Instrumentation Systems.

3.09 TRAINING: Training shall conform to the requirements of Section 40 91 00 - Process Control and Instrumentation Systems.

3.10 ACCEPTANCE: Acceptance shall conform to the requirements of Section 40 91 00 - Process Control and Instrumentation Systems.

END OF SECTION

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SECTION 40 91 03

LIQUID FLOW DETECTION DEVICES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. **General:** The SUB-CONTRACTOR shall furnish and install all in-line liquid flow detection systems, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 40 91 00 – Process Control and Instrumentation Systems apply to this Section.

1.02 CONTRACTOR SUBMITTALS

A. **General:** In addition to the Shop Drawing requirements of Section 40 91 00 – Process Control and Instrumentation Systems, the SUB-CONTRACTOR shall furnish submittals in accordance with Section 40 91 00 – Process Control and Instrumentation Systems.

1.03 QUALITY ASSURANCE

A. **General:** The accuracy of each instrumentation system or loop shall conform to the requirements of Section 40 91 00 – Process Control and Instrumentation Systems.

1.04 MANUFACTURER'S REPRESENTATIVE SERVICES

A. **General:** Manufacturers representative services shall conform to the requirements of Section 40 91 00 – Process Control and Instrumentation Systems.

1.05 PRODUCT HANDLING

A. **General:** Product handling shall conform to the requirements of Section 40 91 00 – Process Control and Instrumentation Systems.

1.06 GUARANTEE

A. **General:** Guarantees shall conform to the requirements of Section 40 91 00 – Process Control and Instrumentation Systems.

PART 2 -- PRODUCTS

2.01 THERMAL FLOW SWITCHES

A. Thermal flow switches shall be thermal dispersion type with no moving parts. Flow shall be detected by measuring the differential temperature between two RTD's while maintaining a constant current to the heater. The probes, electronic circuits, and relay shall all be part of an integral unit with a non-ferrous cast housing. Wetted parts shall be

constructed of 316SS or Hastelloy C depending on chemical compatibility with the process. In horizontal pipe runs the unit shall be side mounted. All switches shall be equipped to function in an environment where the probes are not always immersed. Output relay shall be configurable to energize on increasing or decreasing flow and have (1) DPDT or (2) SPDT contacts rated 5A, 24 VDC minimum. Contact transfer point shall be field adjustable from .003 -19 gpm in water. Response time shall be adjustable from 0.5 to 150 seconds. The trip flow point shall not be affected by process fluid changes in the range of 32 to 140 degrees F and shall have a repeatability of plus or minus 5 percent. The contact unit shall operate within the indicated repeatability in an ambient temperature range of 25 to 120 degrees F. The unit shall have a pressure rating of 150 psi or greater and shall be suitable for installation in pipe sizes of 0.5-inch diameter and greater. Unit shall include 24 VDC power supply in a stainless steel NEMA-4X box.

B. Thermal flow switch with flanged fittings (material to match installation pipe) shall be as manufactured by:

1. **Fluid Components, Inc. Model FLT93 Series**
2. **ENGINEER OF RECORD Approved equal.**

C. Thermal Flow Switches shall be provided for all eyewash/shower flow detection applications depicted in the contract drawings, appropriately rated to detect minimum flow associated with eyewash operation only. Refer to Appendix A of Section 40 91 00 - Process Control and Instrumentation Systems for the complete instrument schedule.

PART 3 -- EXECUTION

3.01 GENERAL: Electrical interface and code compliance shall conform to the requirements of Section 40 91 00 - Process Control and Instrumentation Systems.

3.02 CALIBRATION: The calibration of all devices shall conform to the requirements of Section 40 91 00 – Process Control and Instrumentation Systems.

3.03 INSTALLATION: The installation of all devices shall conform to the requirements of Section 40 91 00 – Process Control and Instrumentation Systems.

3.04 LOOP TESTING: The loop testing of all devices shall conform to the requirements of Section 40 91 00 – Process Control and Instrumentation Systems.

3.05 PRECOMMISSIONING: The pre-commissioning of all devices shall conform to the requirements of Section 40 91 00 – Process Control and Instrumentation Systems.

3.06 ON-SITE SUPERVISION: The on-site supervision of all devices shall conform to the requirements of Section 40 91 00 – Process Control and Instrumentation Systems.

3.07 PERFORMANCE TESTING: The performance testing of all devices shall conform to the requirements of Section 40 91 00 – Process Control and Instrumentation Systems.

3.08 RECORD DRAWINGS: Record Drawings shall conform to the requirements of Section 40 91 00 – Process Control and Instrumentation Systems.

TRAINING: Training for all equipment and software shall conform to the requirements of Section 40 91 00 – Process Control and Instrumentation Systems.

3.09 ACCEPTANCE: All acceptance testing shall conform to the requirements of Section 40 91 00 – Process Control and Instrumentation Systems.

END OF SECTION

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SECTION 40 91 06

LEVEL MEASURING SYSTEMS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. **General:** The SUB-CONTRACTOR shall provide liquid level measuring systems, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 40 91 00 - Process Control and Instrumentation Systems apply to this Section.

1.02 CONTRACTOR SUBMITTALS

A. The SUB-CONTRACTOR shall furnish submittals in accordance with Section 40 91 00. – Process Control and Instrumentation Systems.

1.03 QUALITY ASSURANCE

A. **General:** The accuracy of each instrumentation system or loop shall conform to the requirements of Section 40 91 00 – Process Control and Instrumentation Systems.

1.04 MANUFACTURER'S REPRESENTATIVE SERVICES

A. **General:** Manufacturers representative services shall conform to the requirements of Section 40 91 00 – Process Control and Instrumentation Systems.

1.05 PRODUCT HANDLING

A. **General:** Product handling shall conform to the requirements of Section 40 91 00 – Process Control and Instrumentation Systems.

1.06 GUARANTEE

A. **General:** Guarantees shall conform to the requirements of Section 40 91 00 – Process Control and Instrumentation Systems.

PART 2 -- PRODUCTS

2.01 NON-CONTACT ULTRASONIC LEVEL MEASUREMENT

A. Where non-contact sonic types are indicated (excluding radar), sonic level measuring systems shall consist of an electronic controller-transmitter, a non-contact sonic transducer, and interconnecting cables. The controller-transmitter shall generate the sonic signal to drive the transducer, detect the return echo and convert the elapsed time to a level. The controller-transmitter shall have the following features: solid state design, integral level indicator, process temperature compensation, (2) dry- relay contacts (to be configured as shown on the Contract Drawings), (1) programmable alarm contact, 4-20

mA output signal linearly proportional to level or OCM flow and HART protocal compatibility. Input power shall be 24Vdc. The transmitter shall be housed in a Nema 4X IP65 rated enclosure constructed of corrosion resistant material suitable for use in a Class 1 Division 1 hazardous area. The sonic transducer shall be housed in a submersible NEMA 6 enclosure constructed of corrosion resistant materials suitable for use in a Class I Division I hazardous area.

A. Sonic level measuring systems shall be as manufactured by:

1. **Endress & Hauser Prosonic FMU 90 Series transmitter with FDU9x Series transducer**

2. **Siemens HydroRanger Plus Model**

B. Where indicated on the contract drawings, sufficient cable shall be furnished to support remote mounting of the transmitter and manufacturer recommended pipe nozzle (to suit sensor model) shall be furnished and installed. For storage tank applications, furnish probe with 316 SS ANSI Class 150 flange with 1-inch NPT bore. SUB-CONTRACTOR shall furnish sufficient sensor cable to allow for remote mount of indicating transmitter at ground level (approximately 5 feet above grade) for all tank level measurement applications. Refer to Appendix A of Section 40 91 00 for the complete instrument schedule.

2.02 NON-CONTACT RADAR LEVEL MEASUREMENT

A. Where non-contact radar types are indicated (excluding sonic), time-of-flight radar level measuring systems shall consist of an electronic controller-transmitter, a non-contact signal rod-antenna, interconnecting cables and remote level indicator (as shown on the contract drawings). The controller-transmitter shall generate the radar impulse, detect the return echo and convert the elapsed time to a level or volume. The measurement shall not be affected by changing media, temperature changes, gas blankets or steam. The transmitter shall include functions to suppress interference echoes that may be produced by edges or weld seams and shall support K-band and/or C-band frequencies. The antenna performance shall not be affected by condensation build-up. The controller-transmitter shall have the following features: solid state design, integral level indicator (where indicated on the contract drawings), 2-wire loop power, 4-20 mA output signal linearly proportional to the calculated level or volume and HART protocol compatibility. Measuring error shall be no greater than 0.1% of measuring range with a resolution of 0.03% of measuring range. Upon detection of sensor failure the transmitter shall be configured to immediately reduce output to 3.8mA. The radar level measurement assembly, including transmitter, antenna and antenna horn, shall be constructed of corrosion resistant material suitable for use in a Class 1 Division 1 hazardous area and installed in an intrinsically safe manner.

B. Radar level measuring systems shall be as manufactured by:

1. **Endress & Hauser Micropilot M FMR2XX Series with FHX 40 Nema 4X remote display or Micropilot M FMR5XX Series with FHX 50 Nema 4X remote display.**

2. **Rosemount 5400 Series with Nema 4X remote display**

C. Instrument shall be furnished with manufacturer recommended 316L SS mounting bracket. Note: where used to measure level of an aerated surface, the transmitter shall include the advanced dynamics option (or Rosemount equivalent) to ensure measurement accuracy and repeatability within manufacturer published specification. Refer to Appendix A of Section 40 91 00 for the complete instrument schedule.

2.03 SLUDGE BLANKET LEVEL MEASUREMENT

A. Automatic sludge blanket tracker:

1. Sludge depth Sensor:

   a. Based on light transmission of NIR light technology.

   b. Sensor drift: less than 1 percent per year.

   c. Sensor to be 316SS construction with polyurethane cable.

   d. Automatic self-diagnostics LED sensor compensation loop.

   e. Maximum sensor pressure: 30 psig.

   f. Sensor installation: Handrail mountain from 1-1/2 inch handrail up to 6 inch angle case and sensor and polyurethane cable.

   g. Wetted material: Epoxy, polyurethane, PVC, or 316 Stainless Steel.

   h. Environmental Requirements:

      Temperature range: -10 degrees Celsius to 50 degrees Celsius, with built-in heater and fan.
      Humidity range: 15 percent to 95 percent relative humidity.

2. Performance:

   a. 0 to 26 feet.

   b. Repeatability: ±1 percent.

3. Transmitter:

   a. Micro-processor based dual channel analyzer that will accept any combination of up to 4 sensors and automatically configure for the correct sensor operation.

   b. Response time: 90 percent value in less than 60 seconds.

   c. Display: LCD readout.

   d. Enclosure rating: NEMA 4X.

e. Ambient temperature is from 0 to 50 degrees Celsius.

f. Operation modes: Run mode; setup mode and test mode.

g. Power supply: 1)120 VAC

1) Power consumption: 25 VA, 250 VA with heater.

2) Outputs:

3) Up to 4 isolated 4-20mA DC.

4) Relay outputs:

5) 2 contacts adjustable for 24VDC, or dry contacts.

6) Rated 5A amps at 24 VDC.

7) Programmable.

4. Components:

a. Supplied with automatic cleaning function.

b. Sensor to transmitter cable supplied with equipment.

D. Sludge Blanket measuring systems shall be as manufactured by:

1. Cerlic CBX

2. **Endress & Hauser CUC101**

PART 3 -- EXECUTION

3.01 GENERAL: Electrical interface and code compliance shall conform to the requirements of Section 40 91 00 – Process Control and Instrumentation Systems.

3.02 CALIBRATION: The calibration of all devices shall conform to the requirements of Section 40 91 00 – Process Control and Instrumentation Systems.

3.03 INSTALLATION: The installation of all devices shall conform to the requirements of Section 40 91 00 – Process Control and Instrumentation Systems.

3.04 LOOP TESTING: The loop testing of all devices shall conform to the requirements of Section 40 91 00 – Process Control and Instrumentation Systems.

3.05 PRECOMMISSIONING: The precommissioning of all devices shall conform to the requirements of Section 40 91 00 – Process Control and Instrumentation Systems.

3.06 ON-SITE SUPERVISION: The on-site supervision of all devices shall conform to the requirements of Section 40 91 00 – Process Control and Instrumentation Systems.

3.07 PERFORMANCE TESTING: The performance testing of all devices shall conform to the requirements of Section 40 91 00 – Process Control and Instrumentation Systems.

3.08 RECORD DRAWINGS: Record Drawings shall conform to the requirements of Section 40 91 00 – Process Control and Instrumentation Systems.

3.09 TRAINING: Training for all equipment and software shall conform to the requirements of Section 40 91 00 – Process Control and Instrumentation Systems.

3.10 ACCEPTANCE: All acceptance testing shall conform to the requirements of Section 40 91 00 – Process Control and Instrumentation Systems.

END OF SECTION

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SECTION 40 91 07

LEVEL DETECTION SWITCHES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. General: The SUB-CONTRACTOR shall provide level detection switches, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 40 91 00 - Process Control and Instrumentation Systems apply to this Section.

1.02 CONTRACTOR SUMITTALS

A. The SUB-CONTRACTOR shall furnish submittals in accordance with Section 40 91 00.

1.03 QUALITY ASSURANCE

A. **General:** The accuracy of each instrumentation system or loop shall conform to the requirements of Section 40 91 00 – Process Control and Instrumentation Systems.

1.04 MANUFACTURER'S REPRESENTATIVE SERVICES

A. **General:** Manufacturers representative services shall conform to the requirements of Section 40 91 00 – Process Control and Instrumentation Systems.

1.05 PRODUCT HANDLING

A. **General:** Product handling shall conform to the requirements of Section 40 91 00 – Process Control and Instrumentation Systems.

1.06 GUARANTEE

A. **General:** Guarantees shall conform to the requirements of Section 40 91 00 – Process Control and Instrumentation Systems.

PART 2 -- PRODUCTS

2.01 VIBRONIC LEVEL SWITCHES (NOT USED)

2.02 SUSPENDED FLOAT LEVEL SWITCHES

A. Tipping float (mercury-free) level switches shall consist of a switch, a moving float, and a connecting cable which is anchored at the midpoint of a differential band. As the level rises and falls the float rights itself or inverts causing switching actions. The cable anchoring point shall be protected by strain relief. The hermetically sealed switches shall be SPDT with a minimum rating of 12 Amps at 24 VDC. Process wetted materials shall be Teflon.

B. Tipping float level switches shall be as manufactured by **MAGNETROL T10** or ENGINEER OF RECORD approved equal. Refer to Appendix A of Section 40 91 00 for the complete instrument schedule.

PART 3 -- EXECUTION

3.01 GENERAL: Electrical interface and code compliance shall conform to the requirements of Section 40 91 00 – Process Control and Instrumentation Systems.

3.02 CALIBRATION: The calibration of all devices shall conform to the requirements of Section 40 91 00 – Process Control and Instrumentation Systems.

3.03 INSTALLATION: The installation of all devices shall conform to the requirements of Section 40 91 00 – Process Control and Instrumentation Systems.

3.04 LOOP TESTING: The loop testing of all devices shall conform to the requirements of Section 40 91 00 – Process Control and Instrumentation Systems.

3.05 PRECOMMISSIONING: The pre-commissioning of all devices shall conform to the requirements of Section 40 91 00 – Process Control and Instrumentation Systems.

3.06 ON-SITE SUPERVISION: The on-site supervision of all devices shall conform to the requirements of Section 40 91 00 – Process Control and Instrumentation Systems.

3.07 PERFORMANCE TESTING: The performance testing of all devices shall conform to the requirements of Section 40 91 00 – Process Control and Instrumentation Systems.

3.08 RECORD DRAWINGS: Record Drawings shall conform to the requirements of Section 40 91 00 – Process Control and Instrumentation Systems.

3.09 TRAINING: Training for all equipment and software shall conform to the requirements of Section 40 91 00 – Process Control and Instrumentation Systems.

3.10 ACCEPTANCE: All acceptance testing shall conform to the requirements of Section 40 91 00 – Process Control and Instrumentation Systems.

END OF SECTION

SECTION 40 91 08

PRESSURE MEASURING

PART 1 -- GENERAL

1.01 THE SUMMARY

A. General: The CONTRACTOR shall provide pressure measuring systems, complete and operable, in accordance with the Contract Documents.

1.02 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Section 40 91 00 - Process Control and Instrumentation Systems.

B. Applicable Sections in Division 40 – Instrumentation and Control for Process Systems.

C. Division 26 – Electrical.

1.03 ACTION SUBMITTALS / INFORMATIVE SUBMITTALS

A. Submittals shall be provided in accordance with the requirements specified in Section 40 91 00 – Process Control and Instrumentation Systems.

PART 2 -- PRODUCTS

2.01 PRESSURE GAUGES

A. Manufacturers: Shall be

1. **Ashcroft 1279.**

2. **Ametek Solfrunt Series 1900**

3. **ENGINEER OF RECORD approved equal.**

B. Performance / Design Criteria: Gauge Protection: Gauges shall be protected with the appropriate components as indicated in the data sheet.

C. Materials / Components:

1. Pressure gauges shall be 4-1/2 inches, with white laminated dials and black graduations, and have either a shatterproof glass or acrylic window as indicated in the data sheet. The gauges' bottom connection size shall be as indicated in the data sheet.

2. Sensing element shall be bourdon tube with welded, stress-relieved joints. Sensing element material shall be as recommended by the manufacturer and as indicated in the data sheet. Gauges shall have an accuracy of plus and minus 1/2-percent of full scale.

3. Body material shall be as recommended by the manufacture and as indicated in the data sheet.

4. Gauge shall be either dry or liquid-filled as indicated in the data sheet.

5. Gauges shall be provided with a 316 stainless steel pulsation dampener (snubber), unless otherwise noted in the data sheet. The pulsating dampener shall absorb system pressure pulses.

2.02 PRESSURE GAUGES - LOW-RANGE AND DIFFERENTIAL PRESSURE

A. Manufacturers for low differential pressure gauges shall be

1. **Ashcroft 1131 for ranges of 5-100 PSID**

2. **Ashcroft 1132 for ranges of 1-60 PSID**

3. **or equal.**

B. Manufacturers for Low-Range Differential Pressure Gauges

1. For non-corrosive gas service: **Dwyer Series 2000 Magnehelic,** or equal.

2. For non-corrosive liquid service: **Dwyer Series 4000 Capsuhelic**, or equal.

C. Description

1. Differential pressure gauges shall measure a differential pressure range between two independent pressure sources using a rolling diaphragm actuator to separate the high and low pressure ports. The gauges shall not be used with incompatible media.

2. Low-Range differential pressure gauges shall measure a differential pressure range between two independent pressure sources of air and non-combustible, non-corrosive, compatible gases using frictionless Magnehilic ® gage movement.

D. Performance / Design Criteria:

1. Differential pressure gages:

a. Differential pressure gages shall be able to measure various differential range from 0-1 psid to 0-100 psid,

b. Differential pressure gauges shall be 4-1/2 inches in diameter with white laminated dials and black graduations, and have either a shatterproof glass or acrylic window as indicated in the data sheet. The gauges' bottom connection size shall be as indicated in the data sheet.

c. Body material and rating shall be as recommended by the manufacturer for the intended installation and service application and as indicated in the data sheet.

d. Wetted parts material shall be as recommended by the manufacturer for the intended service and installation application, unless otherwise indicated in the data sheet. Gauges shall have an accuracy of plus and minus 2-percent of full scale.

2. Low-Range Differential Pressure Gauges

a. Low-range differential pressure gages shall be able to measure various differential ranges of 0.05 inches of WC to 60 ft. of WC.

b. Body material shall be as recommended by the manufacturer and as indicated in the data sheet. Gauge design shall resist shock, vibration and over-pressure.

c. Wetted parts material shall be as recommended by the manufacturer for the intended service and installation application and as indicated in the data sheet.

d. Gauges shall be 4-inches in diameter with white laminated dials and black graduations and acrylic cover. The gauges shall have two 1/8-inch connections. Mounting orientation shall be vertical position.

2.03 ELECTRONIC GAUGE PRESSURE TRANSMITTERS

A. Manufacturersfor Electronic Pressure Transmitter Manufacturer shall be

1. **Rosemount model 3051TG or 3051CG**

2. **Foxboro IGP10 series**

3. **Yokogawa EJA series**

4. **ENGINEER OF RECORD approved Equal.**

B. Description: Gauge pressure transmitters shall measure the in-line process pressure using a sensor with sealed fill fluid and isolation/sensing diaphragm. The sensor shall convert the process pressure variations to a linear 4-to-20 mA DC output signal at 24 VDC, 2-wire type, proportional to the pressure variation, with an allowable loop load of not less than 600 ohms. A temperature compensation unit shall also be part of the sensing module.

C. Performance / Design Criteria:

1. Continuously (external) adjustable span, zero and dampening (internal) adjustment.

2. Accuracy shall be at least plus minus 0.14 percent of span.

3. Ambient operating range of minus 40 degree F to plus 250 degrees F.

4. Provide vent, drain, block and bleed valve plugs.

5. Transmitter output shall be compatible with HART protocol.

6. Sensor or transmitter failure alarm - High or low failure mode - shall be provided and shall be user selectable.

D. Materials / Components

1. Sensor fill fluid shall be silicon.

2. Process wetted parts and diaphragm shall be as recommended by the manufacturer for the intended service and installation application and as indicated in the data sheet.

3. As a minimum, housing material shall be 316 stainless steel or as recommended by the manufacturer for the intended service and installation application and as indicated in the data sheet. As a minimum, housing shall be rated NEMA 4X, unless otherwise indicated in the data sheet. Explosion proof rated housing shall be available.

4. Non-wetted parts shall be as recommended by the manufacturer for the intended service and installation application and as indicated in the data sheet.

5. Transmitter shall have an integral digital LCD indicator scaled in linear engineering units.

6. Process connection style shall be ½-inch NPT or flange. Connection style and flange size rating and material shall be as recommended by the manufacturer and as indicated in the data sheet for the intended service and installation application.

7. Provide mounting hardware suitable for the intended service and installation application (e.g. surface mounting, 2-inch pipe, etc.)

2.04 DIAPHRAGM SEALS FOR PRESSURE MEASURING SYSTEMS

A. Manufacturers:

1. For liquids containing solids, and pulsating flow applications: **Ashcroft Model 100 or 101, U.S. Gauge (Ametek) SG, Marshalltown Series 225-01, or equal.**

2. For chlorine and sulfur dioxide under pressure applications: **Ashcroft,** or equal.

B. Description: Operating Principles The diaphragm seal shall attach to the inlet connection of a pressure instrument in order to isolate its measuring element from the process fluid due to incompatibility and/or high process fluid temperature. The space between the diaphragm and the pressure element shall be completely filled with a suitable liquid. Displacement of the liquid fill in the pressure element through the movement of the diaphragm shall transmit process pressure changes directly to a gauge, transmitter, switch, or other pressure instrument.

C. Materials / Components:

1. Diaphragm seals shall consist of bottom housing, lower ring, diaphragm capsule, fill screw, flushing connection, and a top housing.

2. The bottom housing shall be removable in order to permit servicing. Bottom housing material shall be compatible with the process liquid as recommended by the manufacturer and as indicated in the data sheet.

3. As a minimum, top housing and bolts shall be 316 stainless steel, or as recommended by the manufacturer for the intended service and installation application and as indicated in the data sheet.

4. Diaphragm capsule material shall be compatible with the process liquid as recommended by the manufacturer and as indicated in the data sheet.

5. The diaphragm seal shall be factory-assemble to the corresponding pressure instrument and factory-filled. The space between the diaphragm and the pressure element shall be completely filled with a suitable liquid as recommended by the manufacturer for the intended service and installation application and as indicated in the data sheet.

6. Material of exposed surfaces, housings, and diaphragm shall be as recommended by the manufacturer for the intended service and installation application and as indicated in the data sheet.

7. The seal shall be provided with a ring, flushing port connection, and fill/bleed connection.

8. The diaphragm seal shall be shipped a tag reading "Do not disassemble for installation.

9. Manufacturers and models shall be as follows:

PART 3 -- EXECUTION

3.01 FIELD QUALITY CONTROL

A. Pressure measuring systems shall be handled, installed, calibrated, loop-tested, pre-commissioned, and performance tested in accordance with Section 40 91 00 Process Control and Instrumentation Systems. Manufacturer’s service, supervision, and training shall also be in accordance with Section 40 91 00 Process Control and Instrumentation Systems.

END OF SECTION

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SECTION 40 91 09

PRESSURE DETECTION SWITCHES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. **General:** The SUB-CONTRACTOR shall furnish and install all pressure detection systems, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 40 91 00 – Process Control and Instrumentation Systems apply to this Section.

1.02 CONTRACTOR SUBMITTALS

A. **General:** The SUB-CONTRACTOR shall furnish submittals in accordance with Section 40 91 00 – Process Control and Instrumentation Systems.

1.03 QUALITY ASSURANCE

A. **General:** The accuracy of each instrumentation system or loop shall conform to the requirements of Section 40 91 00 – Process Control and Instrumentation Systems.

1.04 MANUFACTURER'S REPRESENTATIVE SERVICES

A. **General:** Manufacturers representative services shall conform to the requirements of Section 40 91 00 – Process Control and Instrumentation Systems.

1.05 PRODUCT HANDLING

A. **General:** Product handling shall conform to the requirements of Section 40 91 00 – Process Control and Instrumentation Systems.

1.06 GUARANTEE

A. **General:** Guarantees shall conform to the requirements of Section 40 91 00 – Process Control and Instrumentation Systems.

PART 2 -- PRODUCTS

2.01 ADJUSTABLE PRESSURE SWITCH

A. Unit shall be operated by a diaphragm and plunger actuating a snap switch (mercury switches shall not be accepted). Pressure switch shall have dual adjustments with two SPDT contacts rated for a minimum of 5 Amps at 24 VDC. The dead band shall be adjustable up to 100 percent of full scale. Set points shall fall between 20 and 80 percent of the adjustable range. The diaphragm shall be Buna-N, unless otherwise indicated, and the lower housing shall be 316 stainless steel with a ¼-inch bottom sensing connection, unless otherwise indicated.

B. Adjustable pressure switches shall be as manufactured by **Ashcroft, Series P for Nema 7/9 applications and Series G for Nema 4X applications** or ENGINEER OF RECORD approved equal. Unless noted otherwise, pressure switches represented on the contract drawings are to be provided by the SUB-CONTRACTOR. Refer to Appendix A of Section 40 91 00 – Process Control and Instrumentation Systems for the complete instrument schedule.

2.02 DIFFERENTIAL PRESSURE SWITCH

A. Differential pressures switches shall be diaphragm-actuated with two independently adjustable SPDT snap action switches (mercury switches shall not be accepted). Contacts shall be rated for a minimum of 5 Amps at 24 VDC. The dead band shall be adjustable up to 60 percent of full scale. Set points shall fall between 20 and 80 percent of the adjustable range. The diaphragm shall be Buna-N, unless otherwise indicated, with a 1/4-inch brass or 316 stainless steel bottom sensing connection, unless otherwise indicated.

B. Differential pressure switches shall be as manufactured by **Ashcroft, Series P for Nema 7/9 applications and Series G for Nema 4X applications** or ENGINEER OF RECORD approved equal. Unless noted otherwise, pressure switches represented on the contract drawings are to be provided by the SUB-CONTRACTOR. Refer to Appendix A of Section 40 91 00 – Process Control and Instrumentation Systems for the complete instrument schedule.

2.03 DIAPHRAGM SEALS FOR PRESSURE MEASURING SYSTEMS

A. (See Section 40 91 08 - Pressure Measuring Device, Paragraph 2.3 for diaphragm seals)

PART 3 -- EXECUTION

3.1 GENERAL: Electrical interface and code compliance shall conform to the requirements of Section 40 91 00 – Process Control and Instrumentation Systems.

3.2 CALIBRATION: The calibration of all devices shall conform to the requirements of Section 40 91 00 – Process Control and Instrumentation Systems.

3.3 INSTALLATION: The installation of all devices shall conform to the requirements of Section 40 91 00 – Process Control and Instrumentation Systems

3.4 LOOP TESTING: The loop testing of all devices shall conform to the requirements of Section 40 91 00 – Process Control and Instrumentation Systems.

3.5 PRECOMMISSIONING: The pre-commissioning of all devices shall conform to the requirements of Section 40 91 00 – Process Control and Instrumentation Systems.

3.6 ON-SITE SUPERVISION: The on-site supervision of all devices shall conform to the requirements of Section 40 91 00 – Process Control and Instrumentation Systems.

3.7 PERFORMANCE TESTING: The performance testing of all devices shall conform to the requirements of Section 40 91 00 – Process Control and Instrumentation Systems.

3.8 RECORD DRAWINGS: Record Drawings shall conform to the requirements of Section 40 91 00 – Process Control and Instrumentation Systems.

3.9 TRAINING: Training for all equipment and software shall conform to the requirements of Section 40 91 00 – Process Control and Instrumentation Systems.

3.10 ACCEPTANCE: All acceptance testing shall conform to the requirements of Section 40 91 00 – Process Control and Instrumentation Systems.

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SECTION 40 91 12

ANALYTICAL INSTRUMENTATION

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. General: The CONTRACTOR shall provide all process monitoring systems, complete and operable, in accordance with the Contract Documents.

1.02 RELATED WORK AND REQUIREMENTS SPECIFIED ELSEWHERE

A. Section 40 91 00 - Process Control and Instrumentation Systems.

B. Applicable Sections in Division 40 – Instrumentation and Control for Process Systems.

C. Division 26 – Electrical.

PART 2 -- PRODUCTS

2.01 GENERAL

A. Power Requirements: Power Input to the analyzer or controller shall be as indicated in the data sheet.

B. Ambient Conditions: Analyzers shall be suitable for continuous automatic on-line analysis of the parameter specified for each analyzer under the conditions indicated herein and/or in the data sheet.

1. The analyzer shall operate satisfactorily in ambient temperatures between -20 and 120 °F, or shall be provided with an isothermal enclosure so that the specified accuracy is not impaired. Relative humidity shall be from 5 to 95 percent, non-condensing.

2. Process fluid temperatures will range between 40 and 100 °F, unless otherwise noted in the data sheet.

C. Process fluid temperatures and pressure range shall be as recommended by the manufacturer and as indicated in the data sheet for each analyzer application.

D. Sample condition such as pressure, temperature, pH level, flow rate range and optimum flow setting, shall be as recommended by the manufacturer for the intended service application and as indicated in the data sheet.

E. Reagents, Electrolyte and Buffer Solutions: Unless otherwise specified, each analyzer shall be reagent-less, which means that the analyzer measuring system shall not introduce a reagent solution, electrolyte or buffer solution into the sample or the process.

F. Local Indication: Each analyzer shall be provided with an integral local indication scaled in process units.

G. The interconnecting cable between the sensor and the analyzer/controller/transmitter shall be either integral with the sensor or furnished by the instrument manufacturer and shall be of sufficient length to allow proper installation of the analyzer.

H. The analyzers and sensors shall be provided with all the necessary mounting and connation hardware suitable for the intended installation application.

I. Single manufacturer: All components of analyzers measuring the same parameter shall be products of a single manufacturer.

2.02 INLINE DENSITY ANALYZER

A. The Inline Density Analyzer sensor shall be suitable for the determination of the amount of suspended solids in continuous process liquid streams and provide a measurement of density of the process medium. The system shall consist of an sensor probe mounted in the process flow stream and shall include a transmitter with local indicator. The measuring system shall measure density using non-ionizing microwave radiation transmitted by the unit through the process medium. The radiation shall be completely contained inside the process piping. The time-of-flight for this transmission to traverse the process stream shall be used to calculate the density of the medium. Measurements methodology shall provide accurate readings independent of process media material type, and shall be insensitive to flow rate.

B. Sensor:

1. The Sensor shall consist of flush-mounted antennas installed on opposite sides of an inline pipe length suitable for installation in process piping, to allow measurement to take place through the pipe. The inline section shall include the microwave transmitter and the receiver. The sensor shall also include integral temperature and pressure sensors. CONTRACTOR shall install the unit where the entire sensor pipe is always full. CONTRACTOR shall provide a unit matching the pipe diameter of the installation.

2. The operating/measuring range for solids shall be up to a maximum of 50% total solids with reading repeatability of +/- 0.01% of total solids and sensitivity of 0.001% of total solids. Pressure reading shall be 0 to 360 psig.

3. The wetted parts and mounting hardware material shall be 316 stainless steel. Sensor shall be rated NEMA 4X.

4. Ambient Operating Temperature: -4°F to 158°F. Process media temperature shall be between 32°F and 212°F.

5. Sensor Mounting: The TSS shall be able to be installed in-line. The appropriate mounting hardware and fittings shall be provided in accordance with the intended installation application and as indicated in the data sheet. Sensor and related mounting hardware shall be suitable for mounting in ANSI 150 class pipe.

C. Analyzer Controller/Transmitter

1. The analyzer shall be provided with a controller/transmitter unit that shall accept and process the input from one sensor to produce the required output(s). The controller shall accommodate the number of analyzers/sensors as indicted in the data sheet. The transmitter shall be furnished with an interconnecting cable to connect the sensor and the transmitter. Transmitter power shall be 120 VAC. Transmitter shall be rated NEMA 4X.

2. The controller shall use a menu-driven operation system and an auto-ranging digital LCD display.

3. Analyzer system enclosure shall be wall mounted, or as indicated in the data sheet. Enclosure shall be rated for the intended installation application and as indicated in the data sheet.

4. Controller Output:

    1. Transmitter shall generate two isolated 4-20 mA DC signals capable of driving 600 ohms load. Transmitter analog outputs shall be HART compatible.

    2. A minimum of two SPDT relay outputs shall be provided for user-configurable operation. Contact rating shall be 2 amps at 240 VAC and 220 VDC.

D. The Inline Density manufacturer and model shall be **Valmet-Metso with model TS-FT series sensor with Valmet Bridge Operating Terminal Transmitter**, or equal.

PART 3 -- EXECUTION

3.1 GENERAL

A. Process monitoring systems shall be handled, installed, calibrated, loop-tested, pre-commissioned, and performance tested in accordance with Section 40 91 00 Process Control and Instrumentation Systems. Manufacturer's service, supervision, and training shall also be in accordance with Section 40 91 00 Process Control and Instrumentation Systems.

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SECTION 40 95 10

PLC CONTROL SYSTEMS HARDWARE AND SOFTWARE

PART 1 -- GENERAL

1.01 REQUIREMENTS

A. The CONTRACTOR, through the use of the Instrumentation Supplier and qualified electrical installers, shall provide the PLC-based control system (PLCS) complete and operable, in accordance with the Contract Documents.

B. INSTRUMENTATION SUPPLIER: The INSTRUMENTATION SUPPLIER is a third party subcontracted to the CONTRACTOR. The INSTRUMENTATION SUPPLIER is responsible for PLC and SCADA software development to support this Contract except as required of equipment Manufacturers for their control panels. The INSTRUMENTATION SUPPLIER shall be responsible for the application programming of the PLCs and SCADA software per the Control Strategies and other Sections of the Specifications.

C. Instrumentation Supplier: The exact contractual relationship and scope definition shall be established exclusively between the CONTRACTOR and the Instrumentation Supplier. The Instrumentation Supplier, under the direction of the CONTRACTOR, shall assume full responsibility for the following, as a minimum:

1. The Instrumentation Supplier shall be singularly responsible for selecting, configuring, and verifying correct operation of compatible hardware.

2. The Instrumentation Supplier shall be the integrator of all hardware.

3. Procurement of all PLC hardware required for conformance to these specifications.

4. Design and submit PLCS hardware and spare parts submittals.

5. Perform all required PLCS tests, adjustments, and calibrations.

6. Furnish qualified labor to supervise PLCS installation and to perform start-up activities.

7. Furnish all required PLCS tools, test equipment, spare parts, supplies, operations and maintenance manuals and reproducible record drawings as specified herein.

1.02 COMMUNICATION NETWORK SYSTEM AND DISTRICT SANITATION POLICY

A. Local Area Network General Requirements: the Contract Drawings and Contract Documents define multiple separate and distinct Ethernet networks. Where equipment is required to interface with multiple networks, a separate network interface card or module shall be installed for each network connections. There shall be no physical interconnection or direct routing of data between the separate networks. Ethernet

cabling shall be run separately from power and not in the same conduit. Ethernet cables shall be at minimum Cat6A, minimum 22 AWG, and shielded cable. SCADA network cables shall be rated at 500Mhz frequency and 10 gigabits per second data transfer as a minimum. PLC and RIO Ethernet network cables shall be CAT8 cables rated at 2 GHz Frequency, and 40 gigabits per second data transfer rate. The separate networks and their cable color coding include:

1. PLC Related Communications:
    a. PLC Network 0 – Red
    b. PLC Network 1 - Black
2. Remote I/O Networks (separate networks for each Process Area PLC system) - Brown
3. SCADA Network - White
4. SCADA Failover Sync Network - Light Purple
5. PLC Hot Standby Communication Cable Network - Dark Purple
6. District Business Network (also referred to as the District Network or Business Network)
    a. Security System Network (Door Access Badge Reader, CCTV, etc.) - Pink
    b. Telephone/Data Network - Yellow
    c. Power Monitoring - Grey
    d. Fire System - Magenta
7. Relay Protection Network - Green
8. Modicon TCP Network – Blue
9. Encryption device Network – Orange

B. The INSTRUMENTATION SUPPLIER shall furnish and install the complete IEEE 802.3 compliant Ethernet Local Area Networks (LANs) capable of supporting communications between all switches, HMIs, PLCs as shown on the system architecture block diagram. The INSTRUMENTATION SUPPLIER shall furnish all necessary cables, face plates, connectors, modems, transceivers, repeaters, modules, splice kits, etc. required for a complete and operational LAN. The system shall be designed to accommodate an increase of 100% PLC units and workstations.

C. Alarms shall be provided on each computer to alert plant personnel of communication link cable break, stalled or malfunctioning communication director and security disconnect of malfunctioning remote systems units.

D. Provide additional, spare network taps as part of each Ethernet network to connect a laptop computer to the networks. The taps must be easily accessible for connectivity.

E. Sanitation Policy: The District's existing and new networks as shown on the Drawings are for connection of District owned or controlled equipment only for security and operational reliability purposes. Any equipment being connected to any of the District's networks shall undergo equipment sanitizing by District IT staff that will effectively remove any and all software that does not meet District criteria including non-authorized Windows patches, all unauthorized software, and all non-District related e-mails, documents, and data files. District sanitizing procedures, scheduling constraints, and methods for connection to District networks shall conform to the requirements of the Special Provisions.

1.03 CONTRACTOR SUBMITTALS

A. Shop Drawings: PLCS submittals shall be in accordance with the applicable requirements of Section 40 91 00. PLCS submittals shall, however, be made separately from other process control and instrumentation system submittals.

B. Hardware Submittals: The PLCS hardware submittal shall be a single submittal that includes at least the following:

1. A complete index appearing in the front of each bound submittal volume.

2. Complete grounding requirements for the entire PLCS including any requirements for PLCS communication networks and control room equipment.

3. Requirements for physical separation between PLCS components and one hundred and twenty (120) volt, four hundred and eighty (480) volt elements.

4. Data sheets shall be included for each PLCS component provided by the INSTRUMENTATION SUPPLIER together with a technical product brochure or bulletin. The data sheets shall include the following:

a. Show the component name as used within the Contract Documents.

b. The manufacturer's model number or other identifying product designation.

c. The project tag number.

d. The project system of which it is a part.

e. The input and output characteristics.

f. The requirements for electric power.

g. The ambient operating condition requirements.

h. Details on materials of construction.

5. Complete and detailed bills of materials: A bill of material list, including quantity, description, manufacturer, part number, serial number, vendor name with phone and spare part list with unit price where required, shall be submitted for each of the PLCS system components. Submittals shall also include the list of required spare parts as specified in Part 2 below. Bills of material shall include all items within an enclosure.

    a. Coordinate the list of spare parts with the minimum required spare parts listed in Part 2 below. Contractor shall add spare parts to supplement items listed as recommended by manufacturers of each component included in the PLCS hardware submittal.

6. Site-specific arrangement and construction drawings for all equipment cabinets, including dimensions identification of all components, preparation and finish data, nameplates, and the like. Drawings shall be scaled and show the position of the equipment on its intended installation location. Drawings must show a scaled representation of the placement of all equipment and its spatial relationship to all other equipment located in the abutting and adjoining areas. All acquired access and clearances associated with the equipment must be shown with a statement of compliance to manufacturer's recommendations, NEC, and other applicable codes.

7. Calibration, adjustment, and test details for all PLCS components.

8. Submit certification from the PLC manufacturer that the networking components provided shall be compatible with and achieve rated network performance when installed in conformance with the manufacturer’s recommendations.

C. OWNER’s Manuals: General requirements for OWNER’s Manuals are as described in Section 40 91 00. The following items shall also be included in the PLCS manual:

1. A documented PLC panel configuration.

2. Operation and maintenance manuals for all of the PLC I/O cards and all communication cards.

1.04 SERVICES OF MANUFACTURER'S REPRESENTATIVE

A. The CONTRACTOR/Instrumentation Supplier shall arrange for visits by, and services of, technical field representatives of the PLC manufacturer for installation certification, system testing, and start-up. These services shall be part of the WORK.

1.05 STORAGE AND HANDLING

A. All equipment and materials delivered to the Site shall be stored and handled in a manner that shall afford maximum protection to the equipment and materials. It is the CONTRACTOR’s responsibility to assure proper handling and on-site storage.

1.06 SPECIAL WARRANTY REQUIREMENTS

A. Special warranty requirements shall be in accordance with the applicable requirements of Division 0.

B. The complete PLCS included therein shall be guaranteed to meet or exceed the design requirements set forth in the Contract Documents.

C. Equipment and materials that do not achieve design requirements after installation shall be replaced or modified by the Instrumentation Supplier to attain compliance. The cost for doing so shall be the CONTRACTOR's responsibility. Following replacement or modification, the CONTRACTOR shall retest the system and perform any additional procedures needed to place the complete PLCS in satisfactory operation and attain design compliance approval from the ENGINEER OF RECORD.

D. The CONTRACTOR warrants the materials and workmanship used for the PLCS equipment and materials and further guarantees the materials and workmanship used for any equipment and materials produced and furnished hereunder as a part of the Work to be as required and agreed upon, free from injurious defects, and in all respects satisfactory for the service required.

E. The CONTRACTOR warrants/guarantees the satisfactory performance of the equipment and materials under operating conditions for a period of two (2) years after the date of final acceptance of the entire PLCS (i.e., completion of all contractual items including a successful full system-wide thirty (30) day performance test as specified in Part 3). In the event that tests and inspections disclose latent defects or failure to meet the specified requirements, the Instrumentation Supplier upon notification by the OWNER shall proceed at once to correct or repair any such defects or non-conformance or to furnish, at the delivery point named in the Contract Documents, such new equipment or parts as may be necessary for conformity to the requirements, and shall receive no additional compensation therefore. In case of any required repairs or other corrective or remedial work covered under warranty, the warranties on all such corrections, repairs, new equipment, or parts shall be extended for an additional twenty four (24) months from the date of final acceptance or twelve (12) months from the date of completion of any such corrections, repairs, new equipment, or parts, whichever date is later. If the OWNER performs repair, the CONTRACTOR shall reimburse the OWNER for all costs incurred in the removal of the defective material and installation of the replacement.

PART 2 -- PRODUCTS

2.01 GENERAL

A. The requirements of Section 40 91 00 apply to this Section.

B. All materials and all PLCS equipment furnished under this Contract by the INSTRUMENTATION SUPPLIER shall be new, free from defects, of first quality, and produced by manufacturers regularly engaged in the manufacture of these products.

C. Hardware Commonality: Where there is more than one (1) item of similar equipment being furnished all such similar equipment shall be the product of a singular manufacturer.

D. Where PLC redundant processor systems are shown on the Contract Documents, I/O cards shall not be installed in the primary (CPU) racks. Redundant processor I/O cards shall be installed in separate racks with remote I/O cabling, Network cabling, and/or Fiber Optic to the redundant processor racks.

E. The I/O count and type shall be provided by the INSTRUMENTATION SUPPLIER as required to implement the functions specified, as shown on the P&ID Drawings, and including the requirement for active spares as noted below as necessary.

F. PLCS Growth Provisions:

1. All equipment and resources, including PLC I/O cards and implementation services, shall be provided such that at least twenty (20) % project growth can be implemented into the PLCS without any additional cost to the Owner. The I/O points included in the twenty (20) % project growth requirements shall be termed “implemented spare I/O”. The twenty (20) % implemented spare I/O is twenty (20) % of the total project I/O listed in the appendix and may be implemented in any one or more I/O racks at the direction of the Owner at any time throughout the duration of the project until the beginning of factory testing. Subsequent to factory testing the unused implemented I/O, if any, shall be delivered to the Owner as spare I/O.

2. All equipment and resources shall be able to modularly accept any anticipated future expansion without the need to replace or retire any PLCS component or resource.

2.02 PLCS ENCLOSURES

A. The corresponding CPU, I/O modules, power supply module(s) and communication interface device(s) for Ethernet shall be mounted inside the newly fabricated PLC Panel. Please refer to P&ID General Sheet ID-10.

2.03 PROGRAMMABLE LOGIC CONTROLLER HARDWARE (PLC)

A. The OWNER has standardized on the Schneider Modicon M580 family of products. The following equipment is therefore specified.

B. Programmable Logic Controllers (PLCs) shall be:

1. Schneider Modicon M580 BMEH580.040 ,or approved equal.

C. Communication Capabilities:
1. The PLC shall directly support 10/100Mb Modbus TCP Ethernet, ASi V2 Master, Modbus, ASCII, and CANopen without the need for third party modules.

2. Ethernet capabilities:

   a. 10/100MB Ethernet with connection via RJ45 connectors

   b. A memory card slot for storage of memory

   c. Built-in web server supplied with pre-developed and installed system diagnostics screens viewable from any commercial web-browser, and the capability of adding custom developed screens

   d. Support for bus, star, ring and tree topographies with CSMA/CD methodology to access the network and prevent collisions

   e. Modbus TCP messaging

   f. Use of ARP and RARP protocols to insure IP and MAC address correspondence

   g. Ability to be configured as a BootP client or DHCP server

   h. Ability to be configured as Faulty Device Replacement (FDR) server.

      1) When configured, a replaced FDR compatible device will request the FDR server for parameters. When this request is received, the PLC will transfer the desired IP address and all configuration parameters to the replaced device.

   i. Support of SNMP

   j. Global Data support for up to 64 station in each group

   k. I/O scanning that allows automatic read and write of distributed I/O without programming over Modbus TCP protocol.

D. Power Supplies: All Main, Expansion and Remote I/O Chassis shall have their own separate redundant power supplies.

E. Power Supplies for the Schneider Modicon M580 shall be as follows:

   1. Schneider Modicon -BMXCPS4022, or approved equal.

F. Input/Output (I/O) Modules: All I/O housings and modules shall be suitable for industrial environments as described in Section 40 91 00 – Process Control and Instrumentation Systems. All I/O modules shall be isolated and conform to IEEE Surge Withstand Standards and NEMA Noise Immunity Standards. The I/O shall be twenty four (24) VDC for discrete inputs and dry relay contacts for safe discrete outputs. Modules shall be removable without having to disconnect wiring from the module's terminals by means of plug-in wiring connectors.

1. The PLC cabinet shall contain the I/O modules required to provide all of the I/O points (including designated future I/O points) contained in the I/O List that is included in Appendix A at the end of this specification. All spare I/O points provided shall be wired and connected to the field terminal strip.

2. For the Rinconada Remediation PLC Panel, the I/O modules shall be as follows.

   a. Discrete Input Modules: The digital input cards shall be Modicon BMXDAI1602 (16 Channel - 24 VDC) or approved equal.

   b. Discrete Output Modules: The digital Output cards shall be Modicon BMXDDO1602 (16 Channel - 24 VDC) or approved equal.

   c. Analog Input Modules: The analog input cards shall be Modicon BMXAMI0810 (8 channel - voltage/current) or approved equal.

   d. Analog Output Modules: The analog output cards shall be Modicon BMXAMO0802 (8 Channel - voltage/current) or approved equal.

G. Ethernet Communications Modules

1. Identical ethernet modules shall be used for PLC Network 0 and PLC Network 1 connections. For these PLC Panel redundant ethernet connections the Ethernet modules shall be as follows:

   a. Modicon BMENOC0301, or approved equal.

H. PLC PROGRAMMING AND CONFIGURATION SOFTWARE

1. Provide a PLC configuration and application development software package complete with documentation and disks. The PLC software package shall be utilized for system configuration using the laptop computer specified in these Specifications. All software licenses and warranties shall be assigned to the District by the INSTRUMENTATION SUPPLIER.

2. Support on-line/off-line program development, annotation, monitoring, debugging, uploading and downloading of programs to the PLCs via the Ethernet data highway.

3. The software package shall be completely menu driven and shall be distributed on standard CD-ROM.

4. Provide software license agreement granting the District full rights to use the software as required for any current or future modification, documentation, or development of the PLC's furnished for this Project.

5. The software shall be capable of the following IEC 61131-3 functions. However, only function block programming and relay ladder logic shall be acceptable under this Contract unless specifically approved by the District.

a. Function block editor

b. Relay ladder logic

6. Programming Environment

a. The CPU shall be capable of being programmed by an external Microsoft Windows compatible computer via either a serial communication port on the CPU, an Ethernet communication module, or a USB communication port. Serial programming shall be possible without the use of a workstation interface board.

b. The programming device shall have access to the application program, the system configuration, all registers, I/O, system fault status, I/O override, and system diagnostic relays.

c. Application programs may be loaded or stored while the CPU is running with minimal impact on the scan time.

d. If contacts or entire rungs are intentionally deleted from an existing logic program, the remaining program shall be automatically repositioned to fill this void. Whenever contacts or entire rungs are intentionally inserted into an existing program, the original program shall automatically be repositioned to accommodate the expanded program.

e. The number of times a normally open (N.O.) and/or normally closed (N.C.) contact of an internal output can be programmed shall be limited only by the memory capacity to store these instructions.

f. Support multiple industry standard IEC 61131-3 programming languages. As a minimum, ladder diagram, function block diagram, instruction list, structured text and Sequential Function Chart (SFC) programming shall be provided. The District prefers function block diagram programming to match existing developed programming code but will accept relay ladder logic. Instruction list, SFC, or structured text programming shall not be used unless fully developed formats, data structures, layouts, and proposed program structures are submitted by the INSTRUMENTATION SUPPLIER and specifically approved by the ENGINEER OF RECORD. All hardware and software necessary to program the CPU in function block diagram and standard ladder shall be supplied.

7. Instruction Set

a. Perform the same functions as a conventional relay logic system, including relays, timers, counters, and high-level instructions (math, compare, memory pointers, etc.)

b. Perform all functions of conventional three-mode proportional-integral-derivative (PID) analog controllers. Each PID loop shall incorporate an anti-windup algorithm on reset.

c. Address software timers and software counters in any combination and quantity up to the limit of available memory. All management of these instructions into memory shall be handled by the CPU. Instructions shall permit programming timers in the "ON" or "OFF" delay modes. Include the capability to interrupt timing without resetting the timers. Counters shall be programmable using up-increment and down-increment.

d. Provide for grouping contiguous 16 bit data words into a file. The system shall address up to 1000 files with up to 1000 words per file. Support file manipulation instructions such as high speed "file copy" and "file fill", "file to file" move, "element to file" move, "file to element" move, and "first in-first out".

e. Provide asynchronous and synchronous 16 bit word shift registers. Provide synchronous bit shift registers.

f. Support a “GO TO” instruction to jump over portions of the user program to a portion marked by a matching label instruction.

g. Dynamically manage all data types to ensure consistent data types are maintained.

h. Support execution of ladder or program subroutines. It shall be possible to program several subroutines and define each subroutine by a unique program file designator. The processor will support nesting of subroutines up to seven levels deep. The program format as displayed on the CRT shall clearly define the main program and all subroutines. It shall be possible to pass selected values (parameters) to a subroutine before its execution. Subroutines shall not be nested more than one layer deep.

i. Provide "HELP" instructions which, when called by the programmer, will display a list of instructions and all data and keystrokes required to enter an instruction into the system memory.

j. Support entry of comments for all programming platforms. For example, support comment entry for ladder logic rungs, memory addresses, function or programs blocks, or within high level code. Programming platform shall allow engineering comments at the time the programming code is entered.

k. Fault recovery support: When a major system fault occurs in the system, the fault recovery routine shall be executed and the system shall determine if the fault has been eliminated. If the fault is eliminated, program execution resumes. If the fault still exists, the system will shut down. A user shall have the option to either resume operation or to shut down upon fault detection.

l. Provide programmable interrupt routines executed regularly over user specified intervals in the range of 1 to 65,535 milliseconds or executed based upon the input condition of one of 16 discrete hardware inputs in the processor chassis.

m. Support indexed and indirect addressing of inputs and outputs, along with all data table words (integer, binary, floating point, timers, and counters) for the software instruction set.

n. Supported trigonometric instructions must include Sine, Cosine, Tangent, Inverse Sine, Inverse Cosine, and Inverse Tangent. These instructions must fully support floating point math.

o. Additional floating point instructions: Log 10, Natural Log, and Exponential.

p. Support complex, combined calculations in a single instruction, such as flow totalizing or equations of the format ((A+((B-C)*D))/E).

q. Supported file function instructions shall include Sort, Average, Square Root, and Standard Deviation.

r. Support for ASCII string manipulation instructions such as search, concatenation, extraction, compare, and to/from integer conversion.

s. Support ladder functions providing ASCII port control such as read, write, handshake line control, buffer examination, etc..

t. It shall be possible to divide user logic into multiple program blocks (structured programming).

8. The PLC programming platform shall be Microsoft Windows-based and run in a Windows 10 environment and include a 64-bit simulator. The software shall have an extensive online Windows-based help screens. Annotation shall be possible from any Microsoft Windows application. Full text import and export of reference data shall also be possible.

9. The software shall include security features including preventing unauthorized personnel from modifying or downloading the program by or to unauthorized devices.

10. PLC programming software shall be Schneider Electric Modicon, Unity Pro, no equal, to match existing District programs. Provide updates to the PLC programming software to the latest version authorized for use by the District before Acceptance.

11. Once the Phase 2 factory testing is completed, the INSTRUMENTATION SUPPLIER shall maintain a software manufacturer's support agreement that includes all PLC programming software licenses and applications that are currently installed, throughout the duration of the project. The support agreement shall be licensed to the District and shall include 24-hour telephone or internet technical support, and automatic shipment of software and license upgrades when new versions of the software are released. The INSTRUMENTATION SUPPLIER shall maintain the new PLC programs with the most recent releases of software revisions and service packs. Firmware for processor and communications modules shall be upgraded as required to maintain compatibility with the most recent release of the PLC programming software.

12. The INSTRUMENTATION SUPPLIER shall provide a three (3) year manufacturer's software support subscription service for PLC programming and configuration software, including all licensed software applications and options provided for this project. The software support subscription service shall be licensed to the District and include 24-hour per day telephone and internet support, and furnishing all manufacturer issued software updates that are released during the term of the subscription. The three year support subscription shall coincide with the project guaranty period as defined in the Special Provisions. The cost of the software support subscription shall be included in the bid price for the project.

I. Uninterruptable Power Supplies (UPS)

1. Provide and install online UPSs where indicated.

2. Each UPS shall maintain power to all of its loads for a minimum of thirty (30) minutes. The equipment submittal shall include sizing calculations which support the unit selected.

3. Switching or line-interactive type UPS' are not allowed.

4. The UPS manufacturer shall be:

   a. APC Smart UPS series (1900W).

   b. Tripplite SmartOnline series on-line

   c. Eaton 9PX series UPS.

   d. Or Approved Equal.

2.04 NETWORK HARDWARE

1. **Cisco IE3300** series Ethernet switch, no substitutions, shall be mounted within the PLC Control panel as shown on the General Sheet GI-12. The unit shall be furnished with the latest firmware module. The switch shall have a minimum of (8) Ethernet 10/100/1000 ports with Power over Ethernet (PoE) support for each of the ports and two (2) dual-purpose 100/1000 and SFP port. Each switch shall be provided with dual 54 VDC power supplies for power supply redundancy. Each power supply shall be sized to power the switch while also providing a total of 360 watts of PoE power for PoE ports. Provide each unit with Cisco Network Essentials firmware with perpetual license. Each unit shall be DIN-Rail mount. Switch shall be rated for an operating temperature of -40°F to 140°F. Switch shall include an alarm relay contact output rated for 1 amp at 24VDC. Switch shall be UL listed. Switches shall come with a 3 years Cisco maintenance support contract. Contract shall start at the end of Substantial Completion.

2. The network shall be provided such that each switch provided under this contract shall have a minimum of 100 percent spare ethernet ports. Provide a second switch identical to the first switch where it is required to provide this number of spare ports.

B. Fiber Equipment/Module

1. Provide Small Form-factor Pluggable (SFP) modules for the SFP ports on the IE3300 switch. SFP modules shall be provided for 1000 Base-LX/LH single mode fiber (nominal wavelength 1310 nm). SFP Modules shall be Cisco model GLC-LH-SM or approved equal.

2. The SFP Module in the Cisco SFP port has duplex LC type connectors with PC type polish. The Contract Drawings require a fiber patch panel that has LC type connectors. The Fiber Patch Cable shall be compatible with the above specified equipment, these shall be Belkin F2F802LL-02M or approved equal.

3. Belkin F2F802L7-02M fiber optic-LC/SC Duplex Patch Cable (8.3/125 mm single mode) with PC type polish, or approved equal, shall be provided for connection to an SC Type connector patch panel.

2.05 HMI SERVER COMPUTER

A. General

1. HMI servers provided shall be rack mounted server class computer systems. All server computer systems and related hardware shall be as specified in these Specifications or the equivalent ENGINEER OF RECORD approved platform at time of order.

2. Provide HMI server computers as shown on the Drawings. Server computers shall include, as a minimum, systems shown as Backup SCADA Server.

B. Hardware

1. Provide HMI servers with the latest version of Microsoft Windows Server 2016 R2 with latest service packs approved for installation by the District.

2. Server computers shall be the latest Hewlett-Packard ProLiant DL380 Gen10 with the specified features, or ENGINEER OF RECORD approved equivalent at time of ordering. Servers shall include all hardware required for 19” rack mounting and occupy a 2U rack space.

3. Monitors associated with servers shall be rack mounted fold-out 17” monitors. Keyboards and pointing devices shall be draw-out type designed for mounting in a standard 19” equipment rack. Provide monitors, keyboards, and KVM switches as shown on the Drawings.

4. Server computers shall include the following options at a minimum:

a. Intel Xeon Platinum series.

b. Cache: 38.5 MB L3 Minimum

c. RAM: 128 GB RAM DDR4 Dual Channel Memory at 2666 MHz.

d. Ports:

1) Integrated Audio Channel

2) Five - Integrated 10/100/1000 Mbps Ethernet (RJ45) Ports (with one reserved for Remote Management).

3) Integrated serial RS232C port

4) Four USB 2.0 Minimum

e. Video Card: Radeon Pro WX 5100 Graphics Adapter

f. Seven 900 GB 6G SAS Hot Plug Hard Drive.

g. DVD/CD-RW drive

h. Minimum three years manufacturer warranty.

i. Additional Network Card or Cards providing a minimum of four RJ45 Ethernet ports.

j. Modem card compatible with Win 911 pager software.

k. Provide the software packages listed below on the server. Packages shall be licensed and fully functional. Contractor shall coordinate version with OWNER to ensure versions are compatible OWNER software.

1) Microsoft Word

2) Microsoft Excel

3) Adobe Acrobat Pro (Adobe Acrobat Reader shall not be acceptable)

2.06 HMI THICK-CLIENT WORKSTATIONS

A. GENERAL

1. HMI thick-client workstations shall be workstation, mini-tower type Microsoft Windows 10 Professional, 64-bit compatible machines. All computer systems and related hardware shall be as specified in these Specifications or the equivalent ENGINEER OF RECORD approved platform at time of order.

2. Provide HMI thick-client workstation computers as shown on the Drawings. Thick-client workstations shall include, as a minimum, systems shown as Operator Workstations and Engineering Stations.

B. Hardware

1. Provide HMIs with the latest version of Microsoft Windows 10 Professional, 64-bit version, with latest service packs approved for installation by the District.

2. View Nodes used for thick-client operator desktop computer shall be Dell Optiplex 7071 or ENGINEER OF RECORD approved equivalent at time of ordering.

3. Each computer shall be provided with a minimum of two monitors. Provide additional monitors where shown on the drawings.

    a. Aspect ratio: 16:9

    b. Resolution: 1920 x 1080 at 60 Hz

    c. Panel backlight: LED

    d. Ports: minimum of 1 upstream and 3 downstream USB 2.0 high speed ports.

    e. 120VAC power supply.

    f. Energy Star 6 compliant.

    g. Monitors shall be 27” monitors (Dell Part # P2719H), or equal.

4. Operator general workstations shall include the following options at a minimum:

    a. Processor: Intel Core i7 series, 8 Core, 3.1 GHz (minimum), latest available generation of processor series.

    b. Cache: 16MB L2 Minimum

    c. RAM: 32 GB RAM DDR4 Dual Channel Memory operating at 2133 MHz clock speed.

    d. Ports:

        1) Integrated Audio Channel

        2) Two - Integrated 10/100/1000 Mbps Ethernet (RJ45) Ports

        3) Integrated serial RS232C port

        4) Four USB 2.0 Minimum

    e. Video Card: Radeon Pro WX 5100 Graphics Adapter

    f. 256 GB SSD Hard Drive.

    g. Mouse: Optical Mouse

    h. Keyboard: Standard USB 104-key Windows Keyboard

    i. DVD/CD-RW drive

j. Additional installed software:

1) Microsoft Word, latest offline version

2) Microsoft Excel, latest offline version

3) Adobe Acrobat Reader, latest offline version

k. Minimum three years manufacturer warranty.

2.07 HMI THIN CLIENT WORKSTATIONS

A. GENERAL

1. HMI thin-client workstations provided shall be industrial duty panel mounted Microsoft Windows 10 based machines. All computer systems and related hardware shall be as specified or the equivalent ENGINEER OF RECORD approved platform at time of order.

2. Provide thin-client panel mount workstations as shown on the Drawings.

B. Hardware

1. Provide thin-client workstations with the latest version of Microsoft embedded Windows 10 with latest service packs approved for installation by the District.

2. Thin-client panel mount workstations shall be American Industrial Systems model, or equal.

3. Panel mount workstations shall be rugged, fan less thin-client computers designed for front of panel installation in harsh environments. Enclosure shall be brushed stainless steel and rated IP65. Minimum operating temperature range shall be 0 to 45ºC.

4. Unless otherwise noted on the Contract Drawings, display shall be minimum 21” diagonal with active matrix TFT LCD display.

a. Aspect ratio: 16:9

b. Resolution: 1920 x 1080 HD

c. Resistive Touch Screen

5. Industrial PC Thin-client panel mount workstations shall include the following options at a minimum

a. Processor: Intel i7, minimum 4 mB Cache, minimum 3.3 GHz, latest generation available.

b. RAM: 8 GB RAM DDR4

c. Ports:

1) DVI and VGA

2) Two USB 2.0 Minimum

3) One RS232 Serial

4) Displayport or HDMI video connections

d. 10/100/1000 Base T Gigabit Ethernet

e. Minimum three years manufacturer warranty.

2.08 LAPTOP

A. General

1. Provide a single laptop computer for programming, testing, and troubleshooting the PLCs and other equipment specified under this Contract. All laptop resident software shall be furnished and installed on the hard disk as a single user license transportable to another machine. INSTRUMENTATION SUPPLIER shall provide any additional components required (including cables, software drivers, and etc) to use the laptop for remote or local PLC programming, operator workstation, training/demonstration tool and as described above.

B. Hardware - each laptop computer shall include as a minimum:

1. CPU: Intel Core i7 processor, 8 Core, minimum 2.3 GHz to 5.10 GHz, latest generation available.

2. Cache: 8 MB L2 Minimum

3. RAM: 32 GB RAM DDR4 1600 MHz Dual Channel.

4. Pointing device: Touch Pad and separate optical wireless mouse with USB adapter.

5. One 17 pin video and S-Video out connector. Unit shall also com with Displayport or HDMI video connections.

6. Display: 15" Wide Screen, 16:9 aspect ratio, 1920x1080 resolution

7. Video Card: Graphics capable of driving 2 additional external monitors at 4K resolution.

8. Hard Drive: 500 GB SATA Solid State Hard Drive

9. Optical Drive: DVD+/-RW Drive capable of burning 25 GB capacity Blu-ray disc.

10. Network Interface: One 10/100 PCI Ethernet Network Interface Card

11. Wi-Fi Wireless Card: unit shall be provided without Wi-Fi cards and without Bluetooth cards. WiFi functionality shall not be acceptable with Laptop unit.

12. Ports: One serial, and two USB minimum

13. Operating System: Microsoft Windows 10 Professional, 64-bit version, and shall be compatible with the operating systems provided with the Thick Client Workstations specified above.

14. PLC Online and Offline programming software, cables and license as specified in these Specifications.

15. Accessories:

    a. Docking station: One docking station with spare 120VAC power supply and cord

    b. Case: One carrying case

    c. Battery: One spare battery

    d. Installed software:

        1) Microsoft Word, latest offline version

        2) Microsoft Excel, latest offline version

        3) Adobe Acrobat Pro, latest offline version

16. Documentation: Manufacturer's standard user manuals and training CDs

17. Warranty: 3 Yr Limited Manufacturer's warranty

18. FCC certification: Class B.

19. Manufacturer: Dell Latitude Rugged, Panasonic Toughbook; or equal.

2.09 PLC CONTROL LOGIC SIMULATOR

A. Provide a PLC Control Logic Simulation Panel for use by the Contractor and the District for testing purposes. This Simulation Panel shall be turned over to the District at the completion of the Project for subsequent operator and maintenance staff training use.

B. Provide Simulation Panel hardware consisting of:

1. Painted steel panel backplane with terminal blocks, wiring channels, circuit breakers, and power supplies, and other components all as specified in Section 13420. All terminal points on the panel shall have plastic barriers to protect against accidental exposure to live parts. All backplane components shall include permanent identification nameplates.

2. Two Modicon M580 PLCs, no substitutions, to match existing District standards as specified above. One PLC shall be the Plant Simulation PLC that shall contain the plant simulation logic. The second PLC shall be the Test Bed PLC shall be loaded with the final developed PLC code for testing or training purposes. Each PLC system shall include 4-card rack, power supply, CPU, and network interface.

3. Industrial network switch as specified above and provided with additional communication modules and firmware installed that are needed to establish a standalone simulation network linking the Plant Simulation PLC, Test Bed PLC, and Redundant HMI Servers. Switch shall be configured as needed to provide this network linking connectivity.

4. Provide all necessary DIN rails, chassis assemblies, mounting hardware, interconnecting cables, power supplies, terminal blocks, and appurtenances for a fully functional simulation testing system.

5. With the Simulation panel, provide a dedicated Test Bed HMI Server with HMI and PLC programing software installed. Configure the Test Bed HMI Server as a standard iFIX Server for HMI testing purposes to work with Plant Simulation PLC. HMI Server software shall be installed per the requirements of Section 40 95 20 - PLC and with SCADA Software - and HMI software on the Test Bed HMI Server shall be fully programmed, developed, tested, debugged and proven to work to allow the server to be deployed as a fully functional HMI Test Bed server as part of this Work. The Test Bed HMI Server shall be provided with software as required by the requirements of Section 40 95 20 pertaining to HMI Workstation Configuration Software. Software shall be Licensed as required by Section 40 95 20 defined for PLC/SCADA Software & Licenses. Temporary HMI Server shall be configured as required by Section 40 95 20 for Operator Interface Application Software Configuration (Programming).

6. Provide a Redundant HMI Server Pair loaded with iFix software and configured as a Redundant HMI Server pair. Redundant HMI Server shall be a standard iFIX Server for final deployment as an HMI Redundant Server pair for this Work to be integrated with all PLCs provided as part of this Work. HMI Server software shall be installed per the requirements of Section 40 95 20 - PLC and SCADA Software - and HMI software on the Redundant HMI Servers shall be fully programmed, developed, tested, debugged and proven to work to allow the server to be deployed as a fully functional HMI server as part of this Work. The Temporary HMI Server shall be provided with software as required by the requirements of Section 40 95 20 pertaining to HMI Workstation Configuration Software. Software shall be Licensed as required by Section 40 95 20 defined for PLC/SCADA Software & Licenses. Temporary HMI Server shall be configured as required by Section 40 95 20 for Operator Interface Application Software Configuration (Programming). Server computers shall be server-class computers as specified in this Section.

2.10 SPARE PARTS

A. The list below identifies Mandatory Spare Parts. CONTRACTOR shall also provide a priced list of spare parts as described in Part 2 of Section 40 91 00 – Process Control and Instrumentation System. Required Spare Parts from this list shall also be furnished.

1. Ten percent (10%) spare (minimum of two) non-redundant PLC Processor Modules of each type provided under this Contract. Processors shall be provided pre-installed with the firmware version matching versions installed in active units. Provide spare units installed with removable memory, as applicable, identical to memory installed in active units.

2. Ten percent (10%) spare (minimum of two) redundant PLC Processor Modules of each type provided under this Contract. Processors shall be provided pre-installed with the firmware version matching versions installed in active units. Provide spare units installed with removable memory, as applicable, identical to memory installed in active units.

3. Ten percent (10%) spare (minimum of two) power supplies of each type provided under this contract.

4. Ten percent (10%) spare (minimum of two) I/O modules of each type provided under this Contract.

5. Ten percent (10%) spare (minimum of two) PLC dedicated rack mounted communication cards of each type provided under this Contract.

6. Ten percent (10%) spare (minimum of two) Ethernet network switches of each type provided under this Contract.

7. Ten percent (10%) spare (minimum of two) spare communication interface device of each type provided under this Contract.

8. Ten percent (10%) spare (minimum of two) spare backplane of each type provided under this Contract.

9. Ten percent (10%) spare (minimum of two) spare power supply of each type provided under this Contract, including cable assemblies and redundancy hardware.

10. Ten percent (10%) spare (minimum of 2) of each type of miscellaneous components such as switches, lights, field-removable memory cards, batteries, cable connectors, fiber optic converters, and other field replaceable system components provided under this Contract.

11. Ten percent (10%) spare (minimum of 4) of each type of master PLC headend network cards (network 0 and network 1 cards) for each redundant CPU head end units provided under this Contract.

12. Ten percent (10%) spare (minimum of 2) of each type of slave PLC headend network cards (network 0 and network 1 cards) for each type CPU head units provided under this Contract.

13. Ten percent (10%) spare (minimum of 2) of each type of PLC headend RIO Ethernet network cards for each CPU head units provided under this Contract.

14. Ten percent (10%) spare (minimum of 2) of each type of PLC RIO fiber network cards for each type of RIO rack under this contract provided under this Contract

15. Ten percent (10%) spare (minimum of 2) of each type of PLC RIO Ethernet network cards for each type of RIO rack provided under this Contract.

16. Ten percent (10%) spare (minimum of 2) of each type of PLC RIO fiber network cards for each type of RIO unprovided under this Contract.

17. Ten percent (10%) spare (minimum of 2) of each type of profibus card provided under this Contract.

    Ten percent (10%) spare (minimum of 1) of HMI Thin Client workstations (touch screen) HMI/OIT system provided under this Contract.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. The CONTRACTOR shall utilize personnel to accomplish, or supervise the physical installation of all elements, components, accessories, or assemblies that it provides. The CONTRACTOR shall employ installers who are skilled and experienced in the installation and connection of all elements, components, accessories, and assemblies it provides.

B. All components of the PLCS including all communication cabling shall be the installation responsibility of the CONTRACTOR unless specifically noted otherwise. The installation of the communication network shall be the complete installation responsibility of the CONTRACTOR including all cables, connectors, transceivers, and any required electrical grounds. Grounding shall be shown on submittal drawings. After installation of the PLCS is completed, the installation shall be inspected jointly by the CONTRACTOR and the Equipment Manufacturer's representatives. Any problems shall be corrected, and when both are satisfied with the installation, a written certification of the installation shall be delivered to the CONSTRUCTION MANAGER. The certification shall state that all PLC communication and I/O modules, modems, system grounds, communication network, workstations, printers, and all other components of the PLCS System have been inspected and are installed in accordance with the manufacturer's guidelines.

C. The CONTRACTOR shall provide one day services of a PLC factory representative to certify the PLC system.

3.02 PLC CONTROL LOGIC SIMULATION

A. PLC Control Logic Simulation backplane fabrication including component mounting and wiring shall be in conformance to Section 40 91 00, Section 40 95 10, and Section 40 95 13.

3.03 TESTING, AND INSTALLATION

A. The requirements of Section 40 91 00 apply to this Section.

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APPENDIX A – I/O LIST

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SECTION 40 95 13

CONTROL PANELS

PART 1 -- GENERAL

1.01 REQUIREMENTS

A. The CONTRACTOR shall provide control panels, complete and operable, in accordance with the Contract Documents.

B. The provisions of this Section apply to local panels provided in equipment systems specified in other sections unless indicated otherwise in those sections.

C. The CONTRACTOR shall provide control panels in accordance with NEC Article 409 except where indicated otherwise.

1.02 CONTRACTOR SUBMITTALS

A. **General:** Submittals shall be furnished in accordance with Section 00200 – Instructions to Bidders.

B. **Control Panel Engineering Submittal:** The CONTRACTOR shall submit a control panel engineering submittal (CPES) for each control panel and enclosure provided under Division 40. The CPES shall completely define and document the construction, finish, layout, power circuits, signal and safety grounding circuits, fuses, circuit breakers, signal circuits, internally-mounted instrumentation and SCADA system components, faceplate-mounted instrumentation components, internal panel arrangements, and external panel arrangements. Panel drawings shall, as a minimum, be "B" size with data sheets and manufacturer specification sheets being "A" size. The submittal shall be in conformance with ISA S20 - Standard Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves, shall be submitted as a singular complete bound volume or multi-volume package within one hundred and twenty (120) days after Notice to Proceed, and shall have the following contents:

1. A complete index shall appear in the front of each bound volume. Drawings and data sheets associated with a panel shall be grouped together with the panels being indexed by systems or process areas. Panel tagging and nameplate nomenclature shall be consistent with the requirements of the Contract Documents.

2. Scale construction drawings which define and quantify the type and gauge of steel to be used for panel fabrication, the ASTM grade to be used for structural shapes and straps, panel door locks and hinge mechanisms, type of bolts and bolt locations for section joining and anchoring, details and proposed locations for "UNISTRUT" members, stiffener materials and locations, electrical terminal box and outlet locations, electrical access locations, print pocket locations, writing board locations, and lifting lug material and locations.

3. Scaled physical arrangement drawings drawn to scale which define and quantify the physical groupings comprising control panel sections, auxiliary panels, subpanels, and racks. Cutout locations with nameplate identifications shall be shown.

4. The CONTRACTOR shall verify that panels supplied as part of this contract will fit into the available space.

5. Front of panel layouts for control panels.

6. Schematic/elementary diagrams shall depict control devices and circuits and their functions.

7. Wiring/connection diagrams shall locate and identify electrical devices, terminals, and interconnecting wiring. These diagrams shall show interconnecting wiring by lines, designate terminal assignments, and show the physical location of electrical and control devices.

8. Interconnection diagrams shall locate and identify external connections between the control panel/control panel devices and associated equipment. These diagrams shall show interconnecting wiring by lines, designate terminal assignments, and show the physical locations of panel ingress and egress points.

9. Control sequence diagrams to portray the contact positions or connections required to be made for each successive step of the control action. Written descriptions explaining the control sequence diagrams and system operation shall be furnished.

    a. Completed ISA S20 data sheets for instrumentation devices associated with each control panel supplemented with manufacturer specification sheets which verify conformance to the requirements of the Contract Documents.

10. A bill of material which enumerates devices associated with the control panel.

11. A priced listing of analog spare parts in conformance with Section 409100.

1.03 EXTENDED PERIOD FOR CORRECTION OF DEFECTS

A. The CONTRACTOR shall correct defects in accordance with Section 409100.

PART 2 -- PRODUCTS

2.01 GENERAL

A. **Environmental Suitability:** Indoor and outdoor control panels and instrument enclosures shall be suitable for operation in the ambient conditions associated with the locations designated in the Contract Documents. Heating, cooling, and dehumidifying devices shall be provided in order to maintain instrumentation devices 20 percent within the minimums and maximums of their rated environmental operating ranges. The CONTRACTOR shall provide power wiring for these devices. Enclosures suitable for the environment shall be provided. Instrumentation in hazardous areas shall be suitable for use in the particular hazardous or classified location in which it is to be installed.

B. All Control panels shall be 24 VDC and have an associated Power Supply Panel with transformers and internal power supplies dependent on the AC supply to that panel. PLC Control Panels shall incorporate a Power Supply Panel that be supplied by one hundred and twenty (120 VAC), this Power Supply Panel shall contain 24 VDC power supplies that in turn feeds the control panel circuits. Where the electrical power supply to the control panel is two hundred and forty (240) VAC single-phase or four hundred and eighty (480) VAC three (3) phase, the associated Power Supply Panel to the control panel shall be provided with a control panel transformer. Control conductors shall be provided in accordance with the indicated requirements.

C. The control panel shall be the source of power for any solenoid valves interconnected with the control panel. Equipment associated with the control panel shall be ready for service after connection of conductors to equipment, controls, and control panel.

D. The main feeder disconnect shall have a door-mounted handle unless otherwise indicated.

E. Unless indicated otherwise, control panels shall be housed in NEMA rated enclosures in accordance with Division 26. Control panels shall be either freestanding, pedestal-mounted or equipment skid-mounted, as indicated. Internal control components shall be mounted on an internal back-panel or side-panel as required.

F. Each source of foreign voltage shall be isolated by providing disconnecting or pull-apart terminal blocks or a disconnect operable from the control panel front. Each control panel shall be provided with identified terminal strips for the connection of external conductors. The CONTRACTOR shall provide sufficient terminal blocks to connect twenty five (25) % additional conductors for future use.

G. Motor starters, where required, shall be in accordance with Section 260440 – Motor Control Centers. Each motor starter shall be provided with contact closures for motor overload, local indication, and remote alarm. Electrical components shall be of standard American manufacture.

H. Discrete outputs from the control panel shall be provided by electrically-isolated contacts rated for five (5) amps at twenty four 24 VDC. Analog inputs and outputs shall be isolated 4 to 20 mA, 2 wire signals with power supply.

I. Control panel mounted devices shall be mounted a minimum of three 3-ft above finished floor elevation. Provide combination motor starters not furnished in a MCC but specified in Section 46 01 00 – Equipment General Provisions.

J. **Painting:** Steel control panels shall be thoroughly cleaned and sand blasted per Society for Protective Coatings SP6 (Commercial Blast), after which surfaces shall receive manufacturer's standard prime plus finish coats. The CONTRACTOR shall match the finish color of new panels to existing for those being integrated into existing panel suites. The finish color shall be grey unless otherwise indicated. Interior of the control panel, back-panel, and side panels shall have a white finish coat. The CONTRACTOR shall furnish 2 one pint containers of the finish coat for future maintenance purposes.

2.02 CONTROL PANELS

A. **Materials & Fabrication:** Panel enclosures shall be manufactured by Hoffman Modular Enclosure systems or equal and in full accordance with NEC Article 409.

B. **Instrument Finishing:** The final coats applied to painted surface of instrument cases, doors, or bezels which are visible from the front of panels shall be manufacturer's standard unless otherwise indicated. Black japan or "crinkle" finishes on instrument cases are not acceptable.

C. Mounting of Instruments

1. The panel vendor shall provide cut-outs and shall mount instrument items indicated to be panel mounted, including any instruments indicated to be furnished by other vendors but installed in the panel.

2. The panel vendor shall also mount behind the panels other instrument accessory items as required for functionality as indicated.

3. Equipment mounted at the rear of panel shall be installed to allow for commissioning adjustments, servicing requirements, and cover removal.

4. Spare space shall be kept clear of wiring, etc., to give maximum space for future additions.

D. Electrical Requirements

1. Control panels shall not contain any 120 VAC circuits.

2. Control panels shall be supplied with redundant 24 VDC power supply via an adjacent Power Supply Panel that itself is fed from a 120 VAC supply and separate UPS supply.

3. The CONTRACTOR shall provide conduit, wireways, switches, wire, and electrical fittings for twenty four volt circuits to instruments and other electrical devices as required for a complete and operable installation.

4. Conduit, wireways, junction boxes, and fittings shall be provided for signal wire, thermocouple, or resistance thermometer lead wire. Conduit or wireway runs shall include those required between temperature sensors and temperature transmitters and between the thermocouple wireway or junction box and instruments.

5. Each terminal connection shall have a plastic plate with a terminal and instrument tag number. Wiring shall be identified with stamped tubular wire end markers.

6. Freestanding panels shall be provided with switched LED back-of-panel lights, each that utilize 24 VDC input power. One light shall be provided for every four (4) ft of panel width and shall be mounted inside and in the top of the back-of-panel area. **Provide Phoenix Contact PLD E 608W 315/B series light, model 2702227**, or equal.

7. Adjacent power supply panels to the PLC control panels shall be provided with a fifteen (15) amp, one hundred and twenty (120) volt, service outlet circuit within the back-of-panel area.

8. Wall-mounted or pedestal-mounted panels shall be sized to adequately dissipate heat generated by equipment mounted in or on the panel.

9. Wall-mounted or pedestal-mounted panels outside or in unshaded areas shall be provided with thermostatically-controlled heaters that maintain inside temperatures above four (4)° C.

10. **Wiring Methods:** Wiring methods and materials for panels shall be in accordance with the NEC requirements for General Purpose (no open wiring) unless otherwise indicated.

E. Signal and Control Circuit Wiring

1. **Wire type and sizes:** Conductor shall be flexible stranded copper machine tool wire, UL listed Type MTW, and shall be rated six hundred (600) volts. Wires for instrument signal circuits and alarm input circuits shall be 14 AWG. Other wires, including shielded cables, shall be 16 AWG minimum.

2. **Wire Insulation Colors:** Insulation for twenty four (24) VDC conductors shall be blue.

3. **Wire Marking:** Wire numbers shall be marked using white numbered wire markers made from plastic-coated cloth, Brady Type B 500 or equal, or shall be heat shrink plastic.

4. Flexible conduit is not acceptable except when specifically approved by the ENGINEER OF RECORD in writing.

5. Conduit fittings shall be Crouse Hinds cast fittings or equal.

6. Splicing of wires will only be allowed in junction boxes. Splices shall be either soldered or pressure crimped type.

7. For case grounding, panels shall be provided with a 1/4-inch by one-inch copper ground bus complete with solderless connector for one four (4) AWG bare stranded copper cable. The copper cable shall be provided by the CONTRACTOR and be connected to a system ground loop.

8. Provide interposing relays for all outputs where solid state outputs are used. In situations where remote devices have a mix of 120 VAC circuits and 24 VDC circuits for signals, provide interposing relays on the Digital Input circuits in the PLC panel receiving signals from these remote devices.

F. Electrical Locations

1. When the Contract Documents call for thermocouple-actuated instruments, the thermocouple lead wire shall be installed without junction by the CONTRACTOR.

The panel vendor shall provide dedicated empty conduits or wireways running from the instruments to the top or bottom of the panel as called for in the material specifications or as otherwise required. Sizing of the conduit or wireway shall be in accordance with the capacity of the instruments.

2. Single case (no remote logic) annunciator units shall be installed at the top of panel and may be considered as a terminal box when top of panel wire entry is indicated. If bottom of panel entry is indicated, a terminal box shall be provided at the bottom of the panel and be wired to the annunciator unit. Terminals shall be identified with plastic marker strips.

3. Terminal boxes for incoming and outgoing signal leads shall be located at the top or bottom of the panel as indicated in the material specification or as otherwise required.

G. Power Supply Wiring

1. Unless otherwise indicated, instruments and alarm systems shall operate on twenty four (24) VDC circuits.

2. At a location near the top of the panel (or bottom), the panel fabricator shall provide terminal box connections for the main power supply entry.

3. Power supply switches for alarm units shall be three (3) pole type, arranged to open both power circuits and alarm circuits. Each annunciator unit shall be equipped with a separate switch.

4. Instruments located on the same panel section and serving the same process unit may be connected to a common branch circuit from the power supply. The number of circuits depends on the circuit load as noted herein. A fifteen (15) amp, two (2)-pole circuit breaker shall be provided in each branch circuit. The circuit load shall not exceed ten (10) amp. Different panel sections or different process units must not use common branch circuits. When instruments do not come equipped with integral fuses, provide fuses as required for the protection of individual instruments against fault currents. Fuses shall be mounted on the back of the panel in a fuse holder, and each fuse shall be identified by a service name tag. Fuses shall be as manufactured by Bussmann Manufacturing Division, Type KAW TRON or equal.

5. Each potentiometer type instrument, electronic transducer, controller, or analyzer shall have an individual disconnect switch. Disconnect switches shall have metal or plastic tags indicating instrument tag numbers. Individual plug and cord set power supply connections may be used without switches when indicated in the material specification.

6. Where alarm units are single unit types, one switch may be used to disconnect not more than six (6) alarm units located on the same or adjacent panels.

H. **Alarm Wiring:** The panel vendor shall install and wire alarms including light cabinets, audible signal units, test and acknowledge switches, and remote logic units as indicated. Interconnecting wiring to panel mounted initiating devices shall also be wired by the panel vendor. The wiring from external initiating devices shall be provided by the

CONTRACTOR. Where plug and cord sets are provided for component interconnection, the panel vendor shall harness and support the cables in neat and orderly fashion. Where separate wire is required, panel vendor shall install sixteen (16) AWG with dual rated THWN/THHN insulation between components.

I. Signal Wiring

1. Signal Wire - Non Computer Use

a. Signal wire shall be twisted pair or triads in conduit or troughs. Cable shall be constructed of sixteen (16) AWG copper signal wires with THWN or THHN insulation.

b. Color code for instrument signal wiring shall be as follows:

c. Positive (+): Black

d. Negative ( ): Red

e. Multiconductor cables where indicated shall consist of 16 AWG copper signal wires twisted in pairs with 90-C, 600 V fault insulation. A copper drain wire shall be provided for the bundle with a wrap of aluminum polyester shield. The overall bundle jacket shall be PVC.

J. Signal Wire - Computer Use

1. Signal wires shall be similar to those for non-computer use but each pair shall be triplexed with a copper drain wire and aluminum polyester tape shall be applied over the triplexed group. Cable shields, including thermocouple extension leads shall be terminated in the central control room at the computer system grounding bus. Continuity of the shield shall be maintained throughout the cable runs.

2. Multi-conductor cables, wireways, and conduit shall be sized to allow for ten (10) % spare signal wire.

K. Specification

1. Nominal voltage: 5 VDC.

2. Maximum continuous operating voltage: 5.2 VDC.

3. Nominal current: 450 mA. f) Voltage protection level at 1 kV/micro-second: 55 V.

4. Nominal discharge surge current: 10 kA.

5. Voltage protection level at 1 kV/micro-second: 55 V.

6. Shall withstand a maximum discharge surge current (8/20-micro second combination wave) of 10 kA.

7. Operating Temperature Range: -40 to 85° Celsius.

2.03 SCADA SYSTEM ENCLOSURES

A. Each SCADA system PLC and remote I/O system and corresponding housing, I/O modules, power supply modules, communication interface devices, and peripheral equipment shall be mounted inside a NEMA enclosure in accordance with Section 26. I/O wiring from the field to the remote I/O system shall be terminated on terminal blocks in the lower portion of the enclosure. A nameplate shall be mounted on the outside of the door of the enclosure and be engraved with "PLC-X" or "RIO-X" where "X" is the number as shown on the Drawings. Where indicated, PLCs mounted in free-standing enclosures shall be as defined on the respective P&IDs. Enclosures shall be as manufactured by Hoffman, or equal and in full accordance with NEC Article 409.

2.04 HUMAN-MACHINE-INTERFACE ENCLOSURE

A. Provide Human-Machine-Interface (HMI) Enclosures where shown on the Contract Drawings. HMI Enclosure shall house a SCADA Workstation and related network equipment servicing the workstation. HMI Enclosures shall also be provided with a Radio Frequency ID type badge reader to allow authentication of authorized users accessing the workstation.

B. HMI Enclosure requirements:

1. HMI Enclosure shall be Free-Stand Single Access with 3-Point Latches, Type 4X – by nVent-Hoffman, or approved equal.

2. Enclosure shall be rated NEMA 4X. Material of construction shall be stainless steel, type 304 or type 316. Enclosure minimum dimensions shall be 66 inches high by 36 inches wide by 24 inches deep. Enclosure steel shall be minimum thickness 12 gauge.

3. All seams shall be continuously welded and ground smooth.

4. Enclosure openings shall be provided with oil-resistant gaskets.

5. Enclosure doors shall be removable.

6. Enclosure shall be provided with ground studs on door and body.

7. Enclosure shall have stainless steel front door with cutout to accommodate HMI Monitor.

8. Enclosure shall have integral mounting channels welded on sides of interior body for mounting panels, racks, mounting angles and shelves. Provide the enclosure with stationary vented shelf for supporting workstation computer, keyboard and mouse.

9. Enclosure shall be free-standing. Provide enclosure with stainless steel lifting eyes.

C. HMI Enclosure Required Accessories:

1. Provide each HMI Enclosure with a Radio Frequency ID (RFID) Reader unit for reading security cards and allowing access to HMI systems.

    a. RFID Reader shall be RFIdeas Wave ID Solo Keystroke HID Proximity reader model RDR-6081AKU, no substitutions.

    b. RFID Requirements:

        1) RFID Reader shall operate at 125 kHz.

        2) Reader interface shall be via USB and shall be plugged into the HMI workstation.

        3) Reader shall be provided with six feet of connecting cable.

        4) Reader shall be desk-top form-factor type reader suitable for placement on the HMI Enclosure integral keyboard shelf.

        5) Reader enclosure rating shall be IP67 and shall me mounted on the exterior of the HMI enclosure..

        6) Reader shall have LED indicator light and dual-tone beeper.

        7) Environmental Operating Temperature: -22°F to 150°F.

        8) Reader shall be compatible with Windows 10.

2. Provide each workstation with RFID Security Software to unlock the workstation when a valid RFID card is presented to the RFID Reader.

    a. RFID Security Software shall be TSL-RFID by ESM Software (e-motional.com / Kirkland, Quebec), no substitutions.

    b. RFID Security Software Requirements:

        1) Supports unlocking the system using an RFID Card, or a user's Window's logon credentials, or a set password.

        2) Supports dual-factor authentication: requiring both the RFID card and a password to be entered to access the system.

        3) Configuration allows for users with different authorization levels such as administrator, operator, or other configurable roles.

        4) Configuration based on user groups

        5) Configurable control or blocking of control-alt-delete key sequence

        6) Supports Administrator-only configuration of the software. Software shall support remote administration to allow management all of software settings remotely.

7) Supports local or network event Log File.

8) Software shall lock the system after a preset timed interval of inactivity.

9) Software shall support multiple monitors.

10) Software shall support remote desktop terminal server. Software shall be compatible with Windows 10, 32 and 64 bit.

11) Provide TSL-RFID ESM Software licenses for all SCADA view node computers and SCADA view node server computers that requires a RFID reader. Registered each licence under user name Willen Wong, location 5750 Almaden Expy, San Jose, CA 95118, United States.

3. Provide each HMI Enclosure with keyboard and mouse and Thin-Net client. Configure client to use local HMI Monitor as a touch screen interface and to also allow use of keyboard and mouse for operator interface. Primary operational interface shall be the touch screen interface, with keyboard and mouse interfaces for maintenance purposes.

2.05 SPARE PARTS AND SPECIAL TOOLS

A. Mandatory Spare Parts, control panel Required Spare Parts selected by the ENGINEER OF RECORD Special Tools, and Expendable Items shall be furnished in accordance with Section 409100.

B. Mandatory Spare Parts furnished for Control Panels shall include the items listed below:
1. Fuses: 20 percent spares of each size and type used, but no less than 10 of each size and type.

2. Indicating LED: 20 percent spares of each size, color, and type used, but no less than 5 of each type.

3. 24V Loop DC Power Supplies and Redundancy Modules: 20 percent spares of each size and type used, but no less than three of each size and type.

4. Ten percent (10%) spare (minimum of 2) of each type of miscellaneous components such as switches, batteries, fiber optic converters, and other field replaceable system components provided under this Contract.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Preparation for Shipment and Shipping

1. Panels shall be crated for shipment using a heavy framework and skids. Panel sections shall be cushioned to protect the finish of the instruments and panel during shipment. Instruments that are shipped with the panel shall have suitable shipping stops and cushioning material installed to protect parts that could be damaged due

to mechanical shock. Each separate panel unit shall be provided with removable lifting lugs to facilitate handling.

B. Shipments shall be by air ride van unless otherwise indicated.

C. Control panel testing and inspection shall be performed prior to shipping.

D. Control panels shall be installed in accordance with Section 409100.

3.02 CONTROL PANEL SIGNAL AND CONTROL CIRCUIT WIRING

A. **Wiring Installation:** Wires shall be run in plastic wireways except (1) field wiring, (2) wiring between mating blocks in adjacent sections, (3) wiring from components on a swing out panel to components on a part of the fixed structure, and (4) wiring to panel-mounted components. Wiring run from components on a swing out panel to other components on a fixed panel shall be made up in tied bundles. These bundles shall be tied with nylon wire ties and shall be secured to panels at both sides of the hinge loop so that conductors are not strained at the terminals.

B. Wiring run to control devices on the front panels shall be tied together at short intervals with nylon wire ties and be secured to the inside face of the panel using adhesive mounts.

C. Wiring to rear terminals on panel-mount instruments shall be in plastic wireways secured to horizontal brackets above or below the instruments in about the same plane as the rear of the instruments.

D. Shop Drawings shall show conformance to the above wiring installation requirements.

E. **Wire Marking:** Each signal, control, alarm, and indicating circuit conductor connected to a given electrical point shall be designated by a single unique number which shall be shown on Shop Drawings. These numbers shall be marked on conductors at every terminal.

3.03 CALIBRATION, TESTING, AND INSTRUCTION

A. **General:** Calibration, testing, and instruction shall be performed in accordance with Section 409100 – Process Control and Instrumentation.

B. Inspection and Approval

1. Panel fabricator shall conduct the following tests prior to arrival of the ENGINEER OF RECORD or before shipment, if the ENGINEER OF RECORD chooses not to witness factory testing.

   a. Alarm circuits rung out to determine their operability.

   b. Electrical circuits checked for continuity and where applicable, operability.

   c. Any other test required to place the panel in an operating condition.

C. It shall be the responsibility of the CONTRACTOR to furnish necessary testing devices and sufficient manpower to perform the tests required by the ENGINEER OF RECORD.

D. Field Testing: Each control panel shall be tested again for functional operation in the field after the connection of external conductors and prior to equipment startup.

END OF SECTION

SECTION 40 95 20

PLC AND SCADA SOFTWARE

PART 1 -- GENERAL

1.01 REQUIREMENTS

A. The CONTRACTOR, through the use of the INSTRUMENTATION SUPPLIER shall co-ordinate the delivery, set-to-work and site based commissioning activities to provide a PLC/SCADA based control system complete and operable, in accordance with the Contract Documents.

B. INSTRUMENTATION SUPPLIER: The exact contractual relationship and scope definition shall be established exclusively between the CONTRACTOR and the INSTRUMENTATION SUPPLIER. The INSTRUMENTATION SUPPLIER, under the direction of the ENGINEER, shall assume full responsibility for the following, as a minimum:

1. Procurement of the Fix SCADA Development Software and associated Licenses. These shall include as a minimum the necessary runtime licenses in addition to a build license.
2. Procurement of the Schneider EcoStruxture Control Expert (formerly Unity Pro) PLC Programming Software and license.
3. Provide a fully programmed Programmable Logic Controller (PLC) for the new Remediation PLC that integrates the process control and instrumentation signals shown on the Piping and Instrumentation (P&ID's) in conjunction with the Control Systems narratives into a single functional treatment system.
    a. Programming works shall also include moving the monitoring and control functionality currently residing in the existing PLC710, which interfaces with the existing RIO rack in panel RSDSCP3A, to the new RREMCP01 PLC.
4. Provide a fully programmed Programmable Logic Controller (PLC) for the Loadout PLC that integrates the process control and instrumentation signals shown on the Piping and Instrumentation (P&ID's) in conjunction with the Control Systems narratives into a single functional treatment system.
5. All of the PLC's to be programmed shall wherever possible, utilize the existing District PLC programming standards.
    a. In particular, programming methodology shall follow the existing code in place in the existing PLC710 when integrating the PLC710 RIO rack into the new system. The current program uses function block programming and new programming shall use this programming type for this Work.
6. Modify the existing Plant SCADA Operator Interface to integrate the process control and instrumentation signals shown on the Piping and Instrumentation (P&ID's) in conjunction with the Control Systems narratives. This existing SCADA system shall encompass status and controls for the signals that are terminated on

the new Remediation PLC and also the Centrifuge vendor package PLC's that interface to the new Remediation PLC as well as its own vendor provided Operator Interface.

7. All iFix SCADA screens developed shall adhere to the existing District graphic standards. Screens developed for use on the new Temporary HMI Server shall be developed using iFIX version 5.8

8. The OWNER's existing iFix point database related to the existing Residuals Management Project PLC Point database is contained within an iFIX version 5.1 server. Contractor shall be migrate these points from the existing iFix version 5.1 server to the new Temporary HMI Server configured with iFix version 5.8. Contractor shall also upgrade existing Residuals Management Project graphics configured using iFix version 5.1 to iFix version 5.8 and rework these upgraded screens to use the newly migrated points on the Temporary HMI server to animate screen objects. See Appendix 1 of this Section with a list of IO points that shall be migrated. Graphics shall use the OWNER's current graphic standards, point configuration standards, tagging convention, and related standards when developing these points and graphics. Migrated IO points shall be configured to use the existing plant Historian to store historical data.

9. The Centrifuge Vendor provided PLC and Operator Interface shall be capable of operating in isolation from the existing plant SCADA system.

10. Collaborate with the equipment vendors of the new Remediation PLC/SCADA systems to integrate these system into the overall plant SCADA system by defining a communications interface and programming new PLCs and the configuring the new iFix servers to provide status and control of the Centrifuge systems on the main plant SCADA system.

11. Collaborate with the integrators of the existing plant SCADA systems to log historical data necessary to support local government reporting requirements.

12. Perform all required PLC/SCADA Factory Acceptance Tests (FAT) before start-up and commissioning commences.

13. Perform all required PLC/SCADA Software Factory Acceptance Tests (SFAT) in the Owner's simulated environment before start-up and commissioning commences.

14. Furnish qualified labor to perform PLC/SCADA integration, offline software simulated tests and to perform start-up and commissioning activities.

1.02 CONTRACTOR SUBMITTALS

A. Shop Drawings: The Programmable Logic Control Systems (PLCS) submittals shall be in accordance with the applicable requirements of Section 40 91 00. PLCS submittals shall, however, be made separately from other process control and instrumentation system submittals.

B. Software Submittal: The Software Submittal shall be a singular all-inclusive submittal the scope of which shall include at least the following:

1. Complete description of the standard application software programs, operating system, and utility program to be furnished, including modifications and

explanation of how the specific functional requirement will be met. A cross reference between the specification and the software submittal shall be provided in order to provide the ENGINEER OF RECORD the ability to identify how each specified section or function is being met by the CONTRACTOR.

2. A complete set of all available software algorithms with:
   a. Individual coil register and variable description.
   b. Program, group of program, subroutine, and complete section detail comments.
   c. Memory, coil, register, and variable usage mapping.
   d. Source code of all high level program language which is specifically created by the INSTRUMENTATION SUPPLIER for this project.
3. A complete set of control strategies which depict all monitoring and control functions on a loop by loop basis.
4. An English language narrative of each data acquisition or control loop mission and anticipated action. Narratives shall enumerate the signal point name, signal description, associated PLC or RIO number, associated graphic displays, and system functions activated by the signal (i.e., interlocks, alarms, logs, etc.).
5. A complete set of module configuration sheets depicting each loop linkage.
6. A complete listing of the PLC data base for each data point with relevant parameters such as range, active state, contact orientation, limits, incremental limits, I/O card byte, I/O hardware address and PLC assignment. The list shall be divided and grouped by PLC and RIO, and divided into type of I/O. In addition to the active I/Os, the list shall also include implemented spare I/O. Final format shall be approved by the OWNER.
7. Detailed descriptions of procedures used to implement and modify control strategies and data base construction.
8. One complete set of all workstation accessible displays which are unique to this project. These displays shall be a full size color graphic format arranged in hierarchical order.
9. Submit details of the HMI application packages to be used. Indicate all standard and optional features provided. Include copies of license indicating licenses to belong the District. Any deviation of the software platforms from the preliminary software submittal included in the Project Plan shall be described in detail.
10. Submit details of the PLC programming and configuration application packages to be used. Indicate all standard and optional features provided. Include copies of license indicating licenses belong to the District. Any deviation of the software platforms from the preliminary software submittal included in the Project Plan shall be described in detail.
11. Submit details of the PLC Defined Function Blocks (DFB) to be used. All associated detail code of each DFB shall be provided.
12. PLC program development submittals shall be submitted in the sequence listed below with a favorable review by the ENGINEER OF RECORD and the District prior to any work being performed on subsequent submittals. The

INSTRUMENTATION SUPPLIER shall submit the following PLC program development submittals for each PLC system that is installed or modified as part of the Instrumentation Supplier's scope of work.

13. PLC define function block submittal
    a. PLC define data type submittal
    b. PLC Control Strategies Submittal
    c. PLC Software Design Specifications
    d. PLC Application Structures (Program Listing)
    e. PLC memory map submittal
    f. PLC alarms including critical beacon alarms tags
    g. PLC communication submittal
    h. PLC tag name Submittal
    i. Failure Analysis Matrix submittal
    j. PLC communication statistical/diagnostic information submittal
    k. PLC statistical/diagnostic information submittal
14. HMI program development submittals shall be submitted in the sequence listed below with a favorable review by the ENGINEER OF RECORD and the District prior to any work being performed on subsequent submittals. The INSTRUMENTATION SUPPLIER shall submit the following HMI program development submittals for each HMI system that is installed or modified as part of the INSTRUMENTATION SUPPLIER scope of work.
    a. HMI driver submittals
    b. HMI database submittals
    c. HMI screens Submittals
    d. HMI Software Design Specifications
    e. HMI Application Structures (Program Listing)
    f. HMI tag group editor submittals
    g. HMI alarms including critical beacon alarms tags
    h. HMI buttons navigation and buttons alarming structure
    i. Scripting submittals
    j. Trends submittals
    k. Alarm summary submittals
    l. Pop up screens submittals
    m. HMI object legend submittals
    n. HMI tag name structure submittals
    o. HMI reports including ODMS submittals

p. Call Paging System (currently Win 911 Pager) submittals

q. HMI standardize dynamo/objects/text/animation/etc. submittals

r. HMI Diagnostic (Network Communication, Server Failure, Sync cable (PLC/HMI), PLC failures, IO Cards, any PLC/HMI diagnostic available, and etc.) submittals

s. OS/HMI scheduler program submittals.

15. Submit details of the PLC/HMI programming and configuration application packages to be used. Indicate all standard and optional features provided. Include copies of license indicating licenses belong to the District. Any deviation of the software platforms from the preliminary software submittal included in the Project Plan shall be described in detail.

16. Provide detailed 4k-resolution video clips with audio narrative of all the PLC/HMI programming and configuration for the above PLC/HMI submittals for all items that has multi-state animation/conditions to demonstrate all color, texts, values, mode, function, and etc.

17. PLC Control Logic Simulator program development submittals shall be submitted in the sequence listed below with a favorable review by the ENGINEER OF RECORD and the District prior to any work being performed on subsequent submittals. The INSTRUMENTATION SUPPLIER shall submit the following Simulation program development submittals for each Simulation system that is installed or modified as part of the INSTRUMENTATION SUPPLIER scope of work. Simulation Program shall contain check off tables and forms shall include but not limited to the following:

a. All pre-check items (SCU, DDT, DFB, Dynamo, Object, tag group, and etc) submittal.

b. All drawings of Lab equipment and network submittal.

c. All field permissive Input and Output items submittal.

d. All simulated Input and Output for all I/O list/drawing items submittal.

e. All section 40 90 10 control strategies will incorporate field permissive testing submittal.

f. All section 40 90 10 control loops will incorporate field permissive testing submittal.

g. All PLC to PLC communication functional test submittal.

h. All failure analysis matrix (communication, Power, Device) submittal.

i. All PLC to HMI communication functional test submittal.

j. All PLC and HMI redundancy functional test submittal.

k. All reports functional test submittal.

l. All totalizer functional test submittal.

m. All alarms and critical beacon alarms functional test submittal.

n. All navigational buttons functional test submittal.

o. o. All Call Paging alarm submittal.

p. All Network, PLC, HMI, RIO, Synchronization Cable and related diagnostics and communication-error related diagnostic function test submittal.

q. All SCADA Equipment (PLC, HMI, Network Switches) reboot functional test submittal.

18. Each DFB shall be accompanied by an English Language detailed control narrative explaining the function of the code in a line by line fashion. Each DFB shall then be explained in detail using the control narrative during training sessions. The training session shall be videotaped in 4K-resolution video with a descriptive voice over.

19. Complete system Input/Output (I/O) list for equipment connected to the control system under this Contract shall be submitted. The I/O list shall be submitted in both a Microsoft Excel readable electronic file format on a CD and an 8-1/2 inch by 11-inch hard copy. The I/O list shall be prepared using the existing, District provided standard template format. Points anticipated to be subject to field or process specific adjustments shall be identified with initial or default settings to be used for initial system development purposes. The I/O list shall be sorted in order by:

    a. Physical location: Panel, Rack, CPU Name, or Remote I/O Drop

    b. Source interface: Hardwired I/O, Ethernet or Modbus (network transfer)

    c. I/O Type: AI, AO, DI, DO etc.

    d. Loop Number

    e. Source device Tag

20. Submit complete system memory map for equipment connected to the control system under this Contract. The memory map list submitted in both a Microsoft Excel readable electronic file format on a CD and an 8-1/2 inch by 11-inch hard copy. The memory map list shall be comprehensive details of transfer of registers/names/DDT and related equipment communication processes, and shall include transfers for the following:

    a. From one PLC to another PLC

    b. From all PLCs to all HMI

    c. From all HMI to all PLC

    d. From all PLCs to all touch screens

    e. From all touch screens to all PLCs

21. Submit complete block diagram showing the inter-connections between major hardware components, media types between components, raceway requirements (conduit, wireway, etc.), raceway identification, network protocol used at each network level, and all hardware components showing the interconnection of all modules, interface devices, modems, and plug-in circuit boards.

22. Submit power consumption (watts) of critical loads powered by the UPS

23. Submit a list of all hardware electrical and environmental characteristics and requirements. All planning information, site preparation instructions, grounding and bonding procedures, cabling diagrams, plug identifications, safety precautions or guards, and equipment layouts in order to enable the Contractor to proceed with the detailed site preparation for all equipment.

C. Display and Report Submittals: After all Software Submittals have been approved by the OWNER, the CONTRACTOR shall submit the following items. Favorable review and implementation of these submittals is required prior to the start of system testing (i.e. the SCADA must be operational prior to any process system test).

1. All Operator Interface displays (both graphic displays and trend displays) submittals shall be in full color as they will appear on the screen. This submittal shall be prepared after the requisite Graphics Meetings in this Section.

2. Each display shall be uniquely titled. Locations for process data shall be clearly identified either through the use of simulated data or by showing variables on the displays and providing a reference list describing those variables. All dynamic points shall be identified by tag number as a minimum and their operation shall be described on separate sheets (color change, symbol change, etc.). Three sets of submittals (with screen prints in color) are required for review by the OWNER. One set will be returned with comments.

3. All periodic reports for the entire PLC system. Locations for process data shall be clearly identified, either through the use of simulated data or by showing variables on the report and providing a reference list describing those variables. Three sets of reports shall be submitted for review by the OWNER. One set will be returned with comments.

D. Operations Reference Manual: The CONTRACTOR shall prepare and submit an Operations Manual for the workstation system for use by the plant operators. This manual shall be a white view binder, K&M VS11-20WE, or equal and shall contain the following:

1. An index to the manual.

2. Software – Related: Submit 15 days prior to the plant operational test.

   a. All program manuals supplied by the manufacturer(s) with the standard software packages.

   b. All original programs on USB or CD Data Storage media supplied by the manufacturer(s) with the standard software packages, including any program revisions or updates issued by the manufacturer(s) during the construction period.

   c. All PLC program and Operator Interface configuration program files stored on labeled CD's or stored on USB data storage media. The PLC program and Operator Interface configuration file disks shall also be updated as required if any changes or corrections are required in this programming prior to project completion.

d. A change of ownership registration form for each standard software package supplied under this project to allow the OWNER to register the software with the manufacturer.

e. A list of Operator Interface display screens, trends, and reports, with display name and description.

f. A list of the control screens with the display names and description. It shall also provide a summary of possible commands and operator inputs to these screens including setpoints. All control actions shall be included.

g. A PLC block diagram with names and locations of major components.

h. Instructions for manually printing screens or reports, both real time and historical as applicable.

i. A summary of security levels and their privileges and limitations.

j. Spaces for operators to make notes.

E. OWNER's Manuals: General requirements for OWNER's Manuals are as described in Section 40 91 00. The following items shall also be included in the PLCS manual:

1. A documented Operator Interface configuration.

2. Operation and maintenance manuals for the PLC, RIO, Operator Interface, Ethernet switches, Communications drivers and all other equipment configured.

1.03 SERVICES OF MANUFACTURER'S REPRESENTATIVE

A. The CONTRACTOR shall arrange for visits by, and services of, technical field representatives of the PLC/SCADA manufacturer for installation certification, system testing, and start-up. These services shall be part of the WORK.

1.04 STORAGE AND HANDLING

A. All equipment and materials delivered to the Site shall be stored in a location that shall not interfere with the operations of the OWNER's personnel or interfere with construction. Storage and handling shall be performed in a manner that shall afford maximum protection to the equipment and materials. It is the CONTRACTOR's responsibility to assure proper handling and on-site storage.

1.05 SPECIAL WARRANTY REQUIREMENTS

A. Special warranty requirements shall be in accordance with the Contract Documents.

B. The complete PLC/SCADA included therein shall be guaranteed to meet or exceed the design requirements set forth in the Contract Documents.

C. Equipment and materials that do not achieve design requirements after installation shall be replaced or modified by the CONTRACTOR to attain compliance. The cost for doing so shall be the CONTRACTOR's responsibility. Following replacement or modification, the CONTRACTOR through the INSTRUMENTATION SUPPLIER shall retest the system and perform any additional procedures needed to place the complete PLC/SCADA System in satisfactory operation and attain design compliance approval from the OWNER.

PART 2 -- PRODUCTS

2.01 GENERAL

A. The application software shall be the latest versions of **Unity Pro PLC Programming and GE iFix SCADA - Version 5.8,** running on the latest Owner-approved version of Microsoft Windows operating system. Coordinate with Owner for approved version of operating systems, update levels and related configurations.

B. All tagnames, both PLC-based and tags used in Operator Interface (OI) units, shall adhere to the Owner's tag naming standards.

C. The INSTRUMENTATION SUPPLIER shall provide customized software, fully installed and configured for the process control and instrumentation system (PCIS). The software the s INSTRUMENTATION SUPPLIER provides shall be the latest generation, field proven, fully debugged and supported software package for this application.

D. Software is described in broad, functional categories. The INSTRUMENTATION SUPPLIER shall furnish a complete software package including the functional requirements along with whatever additional software is required for proper and efficient operation. Customized or specially written software that is commercially available shall be furnished if required to meet all of the functional requirements indicated. Any custom applications software required shall be fully integrated into the basic software and shall not require unique command structures.

E. The software package shall provide a system capable of controlling system level functions, and a higher level process control language allowing the operator to monitor and control the process through an interactive OI. The software environment shall support a multiprogramming atmosphere allowing concurrent execution of more than one program in a background/foreground mode or multi-tasking mode.

F. Throughout the execution of all software modules, the Operator shall be presented with all of the commands or operation choices available at that point in the program using sufficient verbiage or symbols to make the choices self-explanatory and unambiguous. Question and answer or fill-in-the-blank requests shall only be permitted where tag names, or other unique text or numerical information is required.

G. SCADA Control Strategies shall be developed by the INSTRUMENTATION SUPPLIER based on the requirements of section 40 90 10 and the District's SCADA Programming Design and Coding Guidelines. A separate Control Strategy shall be provided for each common function that will be performed by the PLC (e.g. Analog Scaling, Discrete Alarms, Analog Alarms, Pump Alternation, Flow Control Valves, ASD Flow Control, etc.). INSTRUMENTATION SUPPLIER and CONTRACTOR shall also Work with Vendor Manufacturers to develop those SCADA Control Strategies. Control Strategies shall include:

1. An introduction that defines the scope and purpose of the function being performed.
2. Cross references to other documents and control strategies used to perform the function.

3. A context description that defines the inputs and outputs of the function, including data types that are to be used.
4. A detailed description of the function being performed that includes the structure and organization of the function.
5. A documented PLC program listing of any Defined Function Blocks (DFB) that the INSTRUMENTATION SUPPLIER intends to use for development of the PLC programs.
6. A documented PLC program listing of all Defined Data Type that the INSTRUMENTATION SUPPLIER use for development of the PLC programs to the HMI programs.
7. A documented SCADA program listing of all Tag Group Editor that the Instrumentation Supplier use for development of the HMI programs.
8. A failure analysis matrix that defines the description of any fields' permissive used in all schematic drawings in relationship to all loops used in the PLC/HMI programs.
9. A failure analysis matrix that defines the description of any communication lost, power lost, and device failure functions in relationship to all loops used in the PLC/HMI programs. Additionally for PLC/HMI system all Operational processes must have an failure matrix analysis table developed to detail out what will happen in the event of a power failure, communication failure, and equipment failure.
10. A documented listing of all Memory Map used throughout the SCADA system.
11. Specifics on all PLC to PLC communication.

2.02 PLC PROGRAMMING AND DOCUMENTATION GUIDELINES

A. Programming

1. The PLC shall be programmed in line with the Owner's – PLC Programming Standards.
2. All programs shall be written and function in an efficient manner.
3. Programming for Centrifuge monitoring and control shall be similar to the existing routings and methodology used in existing PLC710. While it is the Owner's intent to use existing routines and methodologies, it is also desired to update specific programming functions to take advantage of greater computational efficiencies now available with more modern programming features and environments.
    a. For this existing PLC, the starting point for the new program shall be a result of the PLC manufacturer's Program Conversion utility that converts from this prior version of the program to one that is compatible with the PLC hardware specified for this Work.
    b. This conversion process and technical support, licenses, fees or other manufacturer-furnished processing services for this program conversion shall be provided as part of this WORK and shall be at no additional cost to the OWNER.

4. Wherever possible, use a modular approach to programming by making use of User Defined Function Blocks (UDFB's) and User Defined Types (UDT's) to control commonly used equipment such as pumps and valves such that changes to a singular UDFB and/or UDT instance is reflected throughout the project(s).

5. All function block, rung or structured text programming shall be in a clear, logical, easy to follow format sufficiently annotated to understand the codes purpose.

6. Avoid using abbreviations in comments and titles.

B. Documentation

1. Documentation shall be provided for new program and for additions or modifications of existing programs and shall be broken down into the following categories:

   a. Philosophy

   b. Detailed Description

   c. Points List

2. Philosophy

   a. The written philosophy shall include the purpose of the program and a description of the sequence of events that the program follows to achieve its objective.

3. Detail Description

   a. Description shall give a detailed explanation for each program section and event (e.g. what closes, when and why etc.)

   b. Description of each program element, coil and register.

   c. Documentation shall be generated for the whole program not just the additions.

4. Points List

   a. Points List shall include Rack, Slot, Point Address, or Tagname and Description. Preliminary points list has been prepared (Section 40 90 10).

5. Presentation

   a. After the program has been successfully written and tested, a formal presentation shall be made to the ENGINEER OF RECORD and OWNER. The author shall describe the program section by section.

C. Execution

1. Functional Description

   a. A draft functional description shall be submitted to the ENGINEER OF RECORD and OWNER for review prior to commencement of programming.

2. Tag Names

a. An I/O points List shall be submitted to the OWNER for review of tag names.

3. Training

a. Documentation and presentation shall occur prior to system acceptance.

2.03 PLC PROGRAMMING DIAGNOSTICS

A. The INSTRUMENTATION SUPPLIER shall coordinate with all vendor suppliers (new load-out, conveyor, Centrifuge, and etc.) to ensure that all new PLCs have the following capabilities. The PSCI shall work with the vendor suppliers to ensure the vendor suppliers program the following diagnostics in their HMI/OIT screens. The INSTRUMENTATION SUPPLIER shall also program all of those vendor suppliers diagnostic signals into the main plant HMI system and the temporary plant HMI system.

1. Read the inputs, perform all system logic, conduct on-line diagnostics, and control the outputs. Diagnostics shall include memory checks, communications monitoring, I/O bus monitoring, watchdog timing, and user program validation.

2. Monitor the health of every module in the local and Remote I/O backplanes. A single bit shall show the active or inactive state of each module. Information shall be accessible from the program, from programming software, or remotely from the HMI/OIT.

3. All diagnostic information shall be accessible at the programming terminal which attaches to the CPU. A diagnostic page on the PLC programming terminal shall provide information which identifies the nature of the fault, the absolute memory or I/O address of the fault, and the date and time of occurrence of the fault.

4. PLC diagnostic information shall be accessible to the host communications interfaces.

5. The CPU shall have LED indicators or an LCD display to show status such as PLC GOOD, PROGRAM RUN, and BATTERY GOOD. If any of the above conditions occur, provide an internal PLC diagnostic fail alarm contact output. The CPU within the system shall perform internal diagnostic checking and give visual indication to the user by illuminating a "green" indicator when no fault is detected and a "red" indicator when a fault is detected.

6. All NOE card must be configured for Built-in web server supplied with pre-developed and installed system diagnostics screens viewable from any commercial web-browser, and the capability of adding custom developed screens.

7. Monitor PLC condition and central processing unit, power supplies, I/O points, and other components using integral PLC diagnostics. Develop PLC system HMI monitoring graphics for displaying PLC component conditions and alarms.

B. INSTRUMENTATION SUPPLIER shall work with all vendor suppliers so that the system can monitor the health of communication links for all SCADA server to PLC communications and PLC-to-PLC communications. Upon failure of a communication link, issue a respective communication link failure alarm at the HMI. Provide similar heartbeat scheme for monitoring health between PLC and HMI, PLC and vendor PLCs, and for all other network links shown on the Drawings. Provide details of acceptable heartbeat

strategy during the PLC CONTROL LOGIC SIMULATOR WORKSHOP specified in Section 40-91-00. All NOE cards on the hot standby M580 system must be configured for Built-in web server supplied with pre-developed and installed system diagnostics screens viewable from any commercial web-browser, and the capability of adding custom developed screens.

C. INSTRUMENTATION SUPPLIER shall work with all vendor suppliers so that PLC-to-PLC communications shall be limited to data that is required for controls and interlocks. PLC-to-PLC communications shall be programmed as follows:

1. The PLC that requires the data for control shall initiate the data read request from the remote PLC. PLCs shall not write data into another PLC's memory.
2. Data that is required by remote PLCs shall be packed into contiguous data arrays that can be read from a single read request by the remote PLCs. These data arrays shall include a minimum of 50% allocated spare memory capacity for all data types included in the array.
3. Data arrays that are read by remote PLCs shall include a heartbeat integer register. The heartbeat register shall continuously count from 0 to 9999 and then roll over back to zero. If the remote PLC detects that the heartbeat register stops changing, the remote PLC shall generate a PLC-to-PLC heartbeat failure alarm that is annunciated at the HMI.
4. PLC-to-PLC data transfers shall be optimized and timed by the INSTRUMENTATION SUPPLIER to provide sufficient data update frequency to maintain smooth process control without burdening the Ethernet network with unnecessary traffic.
5. This project shall use I/O scanning as the prefer communication method of distributive PLC-to-PLC communications. Read var/write var communication is allowed, but this communication method shall only be used as exception based communication. PLC-to-PLC communication shall be programmed for both PLC network 0 and PLC network 1 for the entire Solid System (existing and new). Please reference Schneider Electric technical reference for maximum sockets allows when using read var and write var

D. INSTRUMENTATION SUPPLIER shall ensure that all transfer shared data using the communication networking interfaces between PLCs and other equipment platforms using block/array transfers only conforming to existing OWNER programming standards. All process data shall be passed as REAL values. All discrete data shall be passed in packed 32-bit word arrays. Should data blocks/arrays be transferred on different time intervals, each time interval shall utilize separate arrays. Specific process control variables/parameters to be monitored via the network interfaces shall be as specified in these related Sections. Process control data acquired via the network links shall be polled between devices, PLCs, and HMI processed and displayed in an identical fashion as traditional I/O. Variables shall be arranged in contiguous registers for polling efficiency. Network link updates shall be based on a minimum polling/update time of 1 second between each device with HMI polling rates set at approximately 2 seconds.

E. PCSI program all PLC diagnostic features into the SCADA system to match the existing HMI diagnostic screens.

2.04 OPERATOR INTERFACE APPLICATION SOFTWARE CONFIGURATION AND PROGRAMMING

A. Graphic Display Programming Configuration and Programming Methodology

1. The intent of this workshop is to present proposed graphic standards and to discuss specifics on how to proceed with programming while balancing the retention of existing routines versus adopting newer software features. Instrumentation Supplier shall review and understand the existing program and be prepared with suggestions on how to adopt new features.

2. It is the responsibility of the systems integrator to configure the Operator Interface and to develop, design, engineer, configure and test all of the graphic displays required for this project. Work shall also include programming that shall use Function Block programming and shall follow routines similar to those in the existing programs in the OWNER's PLC710 PLC. All of this work shall take into account the specific needs of the Owner. The INSTRUMENTATION SUPPLIER shall review the Owner's existing displays and sketches if available from the Owner. The INSTRUMENTATION SUPPLIER shall bring to the meeting samples of displays from past projects.

3. The screens shall be developed in line with the Owner's - Operator Interface (OI) Standards.

4. Instrumentation Supplier shall then suggest modifications that take advantage of more modern software or programming environment features for discussion with the OWNER.

5. The Contractor shall prepare the appropriate submittals and their schedule as specified in Section 40 91 00 – Process Control and Instrumentation Systems

6. In order to facilitate this work, the Contractor shall conduct the following meetings with the Owner. The Contractor shall allow one day, eight hour each day, for each meeting.

   Graphics and Programming Meeting No. 1

   1) The Contractor shall chair and develop an agenda for a meeting which shall address the basic criteria to be adhered to in the configuration and development of the graphic displays. At this meeting, which shall be attended by the Owner, INSTRUMENTATION SUPPLIER and the Contractor. The Contractor shall distribute sample display formats for illustration purposes. As a minimum, this meeting shall address the following issues:

      a) Programming shall be presented that follows "PLC Programming and Documentation Guidelines" noted above. Instrumentation Supplier shall also show the results of the PLC Manufacturer's program conversion utility in converting existing programs to the be compatible with new PLC hardware in this WORK. Instrumentation Supplier shall be prepared at this workshop to demonstrate

their knowledge of the existing program by presenting the converted program and describing to the OWNER how the program works. Instrumentation Supplier shall summarize suggestions, and conclusions for inclusion in the submittal that is a required deliverable for this Workshop.

b) Program-graphic interfacing shall also be presented and suggestions for modernization shall be presented and discussion with the Owner. Instrumentation Supplier shall summarize suggestions, and conclusions for inclusion in the submittal that is a required deliverable for this Workshop.

c) All in- plant and remote site areas and conventions for identifying tag names and descriptors.

d) An itemization of the type of display to be used at each level in the graphic hierarchy (e.g., preformatted displays, templates, custom graphics, etc.).

e) Organization of the systems universal display hierarchy.

f) Paging schemes to be used to enable the movement from one display to another.

g) Definitions of all display select commands that enable the operator to move within the display hierarchy.

h) Definition of graphic symbolism to be used on the project. This listing shall include but not be limited to symbols to be used for process instrumentation, process equipment, piping, vessels and valves. All symbolism must be specific as opposed to generic in that shapes must define both function and type (e.g., specific symbols for each valve design, each pump design, each type of flow meter, etc.). If the Contractor's library of shapes does not adequately describe plant or system conditions, the Contractor shall develop additional shapes to meet the system requirements. Standard displays will include: open/close, modulating valves, on/off, tanks, etc.

i) Color convention to be employed on all graphics for the annotation of various status information, differentiation between alarms on the basis of alarm priority, background colors, static field colorization, and dynamic field colorization. Color change that indicates change of state of equipment or mode, shall be accompanied by text message. Provide a legend screen(s) in the system to indicate one of each type of equipment symbol and color standard and the meaning of each color. The legend screen shall be accessible from the main menu.

j) Definition of control input commands which enable the operator to interact with faceplates control stations and

custom graphic displays to implement control outputs/functions.

k) Definition of data input commands which enable the operator to enter/download numeric values into the PLCs.

l) Definition of control and/or alarm set points display next to its associated analog value or equipment.

m) Any device that has a selectable mode (e.g. auto-manual, local-remote, etc.) either in the field or at the control center, that mode shall be displayed next to its associated device.

n) The utilization of cursor movement commands which enable the operator to move within a display.

o) Definition of the utilization of “poke” points or fields which are dynamically sensitive to operator inputs to facilitate operator entry directly into graphic displays.

p) The utilization of blinking and conditional text.

q) Designation of groups within each process area along with tag names and descriptors.

r) The assignment of individual control loops and inputs to specific groups.

s) A review of graphic generation procedures.

2) Subsequent to the graphics meeting No. 1 the INSTRUMENTATION SUPPLIER shall prepare and formalize a document titled “GRAPHICS CRITERIA” which shall contain detailed meeting minutes and a definition of all graphic guidelines to be adhered to. This report shall be supplemented by graphic examples which illustrate the incorporation and application of each graphic criterion. The report shall be submitted as indicated in the submittal requirements in Section 40 91 00 – Process Control and Instrumentation Systems.

b. Graphics and Programming Meeting No. 2

1) Subsequent to the finalization of the overall system-wide program and graphics criteria, the systems integrator shall develop graphic and program packages for all of the Operator Interface and PLCs being furnished under this project. At this meeting the systems integrator shall submit the number of copies specified in Section 40 91 00 – Process Control and Instrumentation Systems - including:

a) A review of the graphic package and programs developed for the process areas for content and completeness.

b) A review of the function blocks and program methodologies.

c) A review of all data fields that display automatically updated process information.

d) A review of all required input commands, output statuses and associated data transfer functions for graphic access and control manipulation within the PLC, within the HMI, and between the PLC and the HMI.

B. Graphic Displays Layout and Style:

1. The style and the symbols of all the graphic displays shall be uniform. Similar facilities shall have a uniform layout. The graphic display of each facility/site shall be a diagrammatic presentation of the equipment and the piping system of the facility including the suction and discharge piping, with the proper captions

2. As a minimum, the following graphic displays shall be developed for this project (as minimum):

a. Plant overview display.

b. All processes including all existing interfacing to the PCIS of this project. For remote sites, a station graphic display with a control screen shall be configured. This shall include symbols for pumps, valves, alarm symbols, and operational data.

c. PCIS network and nodes

d. All group alarm displays.

e. All analog faceplate displays with graduation of engineering unit values.

f. All custom displays for operator to enter set points and recipe displays.

g. All historical real time trending display.

h. Control system network configure and diagnostic.

i. Communication status and diagnostics display(s)

j. All local nodes diagnostic (include PLC's, Operator Interfacing Units and Instruments).

2.05 PLC/SCADA SOFTWARE & LICENSES

A. The Client has standardized on Schneider M580 PLC hardware and GE IFix SCADA Software version 5.8. Therefore, the following additional software components and licenses shall be procured to support the PLC/SCADA system within the design.

1. GE IFix SCADA Development and Runtime License:

a. Software:

1) GE IFix Runtime Licenses

2) GE iFix unlimited development Build Licenses

3) GE IGS licenses

4) PLC to HMI driver licenses (Driver shall be based on agreed upon Instrumentation Supplier recommendation from SCADA workshop.

Drivers must not interfere with the functionalities of the current OFS driver in the current iFix 5.8 redundant server computers)

2. PLC Programming License
   a. Software
      1) Schneider Unity Pro License

3. RFID Licenses for USB RFID card readers:
   a. Software
      1) Transparent Screen Lock RFID for Windows Operating System
4. Reichard Intellution iFix animated objects:
   a. Current iFix graphics use Reichard Intellution dynamos. These dynamos shall be used for consistency and to match look and feel of current system.
   b. Software
      1) Reichard Intellution licenses (http://www.reichard.com/intellution/index.html)

B. All software provided shall be installed and used within the terms of the software manufacturer's license agreement. All software purchased by the CONTRACTOR shall be registered to the CONTRACTOR during the construction phase of this project. During that time, the CONTRACTOR shall be responsible for providing and incorporating minor software package updates issued by the software manufacturer. For example, if version 3.1 of a program is purchased, and version 3.2 and 3.3 were released prior to project completion, the CONTRACTOR shall be responsible for incorporating these later versions into the final project. The CONTRACTOR would not be responsible for incorporating major software revisions such as the release of a version 4.0 or 4.1.

C. Prior to substantial completion of this project, the CONTRACTOR shall re register all provided software packages to the OWNER and provide the ENGINEER OF RECORD and OWNER with written confirmation of having done so.

2.06 PLC CONTROL LOGIC SIMULATOR

A. Development of PLC Control Logic Simulator Test Bed

1. Development and Testing: Schedule for all testing including at a minimum the testing sequence as specified per Section 40 91 00. Testing schedule shall include submittal of test procedures a minimum of 30 Days prior to commencement of testing. Schedule shall also include all tests dates per Section 40 91 00 and submittal of completed test procedure forms for review and approval by ENGINEER OF RECORD and District. Approved factory testing shall be separated on the schedule into hardware and software.
2. Dates for all subsequent control system project submittal: Include in the scheduled time durations the time required for INSTRUMENTATION SUPPLIER submittal

preparation and submittal review by the District. Include provision for a minimum of two complete District review cycles.

3. Submit hardware and programming details for a standalone PLC control logic simulator as specified in Section 40 91 00 and Section 40 95 10.

4. Submit simulation programming strategy overview as text based functional descriptions or flow chart format. Programming overview shall define and describe specifically:

   a. How the simulation I/O data will be mapped for each individual PLC with specific register space defined for both simulation and real process I/O.

   b. Method for the simulation programming to interact to the identified target PLC.

   c. How the simulation PLC will take control for simulation override of the process PLC for factory testing.

   d. How simulated inputs and outputs will be developed for each logic case (e.g., valve operation, PID control loops, pump start and stop, plan power failure simulation, etc.)

   e. How the control logic simulator will interface to a standard system iFIX workstation and the Temporary HMI Server.

5. Submit programming logic for the simulator using identical programming requirements as used for the real-time process control specified in Section 40 95 10. Programming logic shall include Factory Testing of PLC Control Logic Simulator, Temporary HMI Server, and all networking components.

6. PLC Control Logic Simulator Workshop: A minimum of 6 weeks prior to submittal of the PLC Control Logic Simulator being sent in for review, the INSTRUMENTATION SUPPLIER shall lead and facilitate a 4-hour workshop to review the approach and strategy used for the PLC Control Logic Simulator test bed. The workshop shall address:

   a. How the simulation I/O data will be mapped for each individual PLC with specific register space defined for both simulation and real process I/O.

   b. Method for the simulation programming to interact to the identified target PLC.

   c. How the simulation PLC will take control for simulation override of the process PLC for factory testing.

   d. How simulated inputs and outputs will be developed for each logic case (e.g., valve operation, PID control loops, pump start and stop, plan power failure simulation, etc.).

   e. How the control logic simulator will interface to a standard system iFIX workstation.

   f. Method for factory testing: workshop shall include proposed protocol for witness testing of all panels: use of the PLC Control Logic Simulator for

simulation of program logic; testing of interconnection/networking links between Instrumentation Supplier panels, HMI devices, and third party Instrumentation Supplier network resident devices; and sample loop check signoff forms demonstrating conformance with Witness Testing requirements of Section 40 91 00.

2.07 HMI WORKSTATION CONFIGURATION SOFTWARE

A. General:

1. The INSTRUMENTATION SUPPLIER provided HMI shall be developed per the requirements of the District's SCVWD iFIX HMI Development Standards, and shall match the look, feel, and standards of the existing District SCADA system including graphic screens, reports, security, communication, and programming to the greatest extent possible. Examples of District addressing approach, screen graphics, and reports will be provided to the INSTRUMENTATION SUPPLIER after award of the Contract. The configuration specified in these Contract Documents refers to general features and elements of the graphic, alarming, reporting, and other features of the SCADA system. However, all specific system elements shall conform to the District standards to the greatest extent possible.

2. HMI Software shall be compatible with the operating system supplied with the computers. Provide iFIX by GE Intelligent Platforms, no equal, to match existing District software. iFIX keys and licenses provided under this contract shall be licensed for the latest version of the software available at the time of project completion. The contractor shall develop the HMI application using the current version of the iFIX software that is in use at the Rinconada WTP. The contractor shall maintain the iFIX application version to match the current version in use by the plant throughout the commissioning and testing phases of the project.

3. The INSTRUMENTATION SUPPLIER shall provide all development software necessary to perform the work specified in these Specifications for HMI development at the RWTP. The INSTRUMENTATION SUPPLIER shall provide full development licenses for a minimum of two engineering (thick client) workstations. All other software that may be necessary for a fully configured and operational system including communication configuration and other software shall be provided under this contract. All software licenses and warranties shall be assigned to the District by the INSTRUMENTATION SUPPLIER.

4. Provide full server development package and license for the HMIs as shown on the Drawings. The server shall be furnished with a full development package such that all modifications required can be performed at the HMI workstation. Provide full server development package and license for the HMIs as shown on the Drawings. The INSTRUMENTATION SUPPLIER shall provide iFix Development Licenses with unlimited tags for the Redundant Temporary Servers. The INSTRUMENTATION SUPPLIER shall also provide for all other associated licenses such as Win 911, MBE, OFS, IGS, and OPC. Each server shall also be furnished with a full development package such that all modifications required can be performed at the HMI Server.

5. Provide, configure, and license the HMI system per all requirements specified and shown on the Drawings including; SCADA server redundancy, historical data server redundancy, drivers and software for Modbus TCP and OPC communications on a redundant fiber optic network ring, display terminal servers, thick-client workstations, thin-client work stations, and domain controllers.

6. Provide software package for data base generation; process monitoring and control; collection, analysis, storage, preparation and printing or display of operating information for historical reports; and for plant start-up, normal operating cycles, and shutdown.

7. Perform all scanning of PLC data tables for transferring analog and discrete data to and from the PLC. Scan periods shall be adjustable to ensure that the PC/PLC communications is scanning at the fastest possible time increment, without data degradation. All communications between the PLCs and the operator interface software shall use the Local Area Network (LAN) directly. It is the responsibility of the INSTRUMENTATION SUPPLIER to ensure direct Ethernet 802.3 communications between the PLCs and the Windows operator interface software package provided. Communications between the operator interface and the PLCs through manufacturer's proprietary data highways (serial or otherwise) or utilizing an operating system other than that specified shall not be acceptable.

8. Configure the system to perform all data conversions to engineering units and updates of data files and to perform all integration signal conditioning, linearization, etc.. The package shall compute data from sensor-based and/or manual inputs for mass flows, total pounds from analysis and flow, ratios, percentages, lab results, minimums, maximums, averages, medians, standard deviations, power use, etc., and store for future retrieval and report generation.

9. Perform standard and special calculations required for a water treatment or pumping facility including summation, totalizing, averaging, geometric mean, percent removal, percent efficiency, volume, concentration, detention times, loadings, etc..

10. Perform alarm monitoring of discrete and analog inputs/outputs. The analog inputs shall also be checked for out of range (via high and low limit checks). Alarms shall be capable of being assigned to one of three severity categories with each category producing a distinct sound via the System speaker.

11. Supervise and control all routines necessary to respond to operator requests for control changes, displays, allowable operator modifications, printouts, and any other required operator requests. Operator actions shall be serviced on an interrupt basis, and shall be interwoven with normal operations.

12. Permit manual data entry through any of the terminals. Manual data shall consist of laboratory or process specific inputs and entering or changing elements such as alarm limits, setpoints, or constants. Confirmation shall be required via the respective display and keyboard prior to actual entry into the process memory. Configure security and password protection to prevent unauthorized data entry.

13. Support all required graphic, semi-graphic, and alpha-numeric displays. The software will both format and display screen images of fixed and dynamic data.

14. Support all required logging and reporting. All logs, reports, and print-outs shall be free form, such that the headings and format will be programmed and printed at the time of generation. Any calculations required shall be made at the time of printing. Each page of a report shall have the name of the plant, type of report, time and date the report was prepared and the page number. All logs and summary reports, with the exception of the alarm and equipment status logs, shall be allowed to be manually initiated and canceled.

15. Provide the capability to manually OPEN/CLOSE, START/STOP or initiating auto sequences of selected plant equipment via the operator's screen, control device, and keyboard.

16. Provide a minimum of four levels of security to prevent unauthorized usage or modification of the system. Configure security to match existing District standards. Security standards shall be provided after award.

17. Provide for presentation of current or historical trending values to either the screen or to the laser printer as selected by the operator.

18. Provide for an automatic reset sequence and adjustable time delay for all alarms. All alarmed analog points shall have an operator-adjustable differential/deadband.

19. Provide a support interface for plant equipment maintenance management and scheduling.

20. The operator interface software shall be capable of acting as a DDE server and client allowing data exchanges with other Windows applications.

21. The operator interface software shall be capable of acting as a NetDDE server when used in conjunction with Microsoft Windows products. NetDDE shall allow for sharing of data from the operator workstation with other clients on a LAN.

22. Point configuration, alarm information, and communication data shall be stored in a database format that is open database connectivity (ODBC) compliant to allow management using common database tools.

23. Software shall support up to 45,000 separate point identifiers (tags) with each tag name being up to 30 characters long.

24. Create logical expressions for use in system control using higher level language syntax or scripting.

25. Provide real-time SQL database connectivity.

26. System shall be readily expandable to accommodate future growth of up to a 100% increase in tags, I/O points, and HMIs.

B. Graphic Displays

1. The graphic display package shall be capable of supporting at least 256 colors. Color selection for all displays shall be configurable by the District. The package shall provide vector-based scalable graphic displays with a minimum pixel resolution of 1920 by 1080 to conform to existing District displays.

2. The graphic display pages shall be able to include information from I/O points originating from various PLCs, for the formation of actual and pseudo graphics.

Graphic displays shall have the ability of combining dynamic analog process variables with standard symbols on the same page.

3. Provide quick switches between development and runtime operator displays.

4. Provide a library of common graphic objects and symbols suitable for ready incorporation into operator displays.

5. The graphic display package shall be capable of importing graphics from other drawing packages. Provide import capabilities with AutoCAD ".DWG" files at a minimum. The graphic display package shall be capable of importing graphics from Microsoft Windows clipboard and objects created by other Microsoft Windows applications via OLE 2.0.

6. All graphic pages shall possess the capability of "poke points" to facilitate movement of an arrow in the graphic and allow the operator to choose specific characters or images for launching linked graphic pages via a mouse.

7. Provide menu driven graphic editor with standard geometric symbols such as lines, circles, rectangles, etc. Provide graphic “wizards” and other scripting functions to simplify development.

8. Configure graphic objects to indicate multiple states (i.e. OPEN / INTERMEDIATE / CLOSE / FAIL, OPEN / CLOSE / TRIP / FAIL, START / STOP, HIGH / LOW) and change color correspondingly. Field devices that are tri-state must be represented in three conditions. Change of conditions of field devices shall cause the corresponding graphic symbol to change or blink per District standards to alert the operator viewing the graphic.

9. Provide user defined menus conforming to District standards to select and view predetermined summaries and graphics with simple keystrokes and mouse directions.

C. Trend System

1. Supports plots of at least eight user selectable analog values in an x-y format, with each plot using a unique color. Configure trends to use current or historical information with the ability to trend backward or forward from the initial time reference using a single command. Trend shall present precise numeric values for any point on the trace by moving the mouse on to the graphic trend line. The trend displays shall use shading or color change to emphasize when a particular point crosses a reference value.

2. Configure transparent trends displays so that real-time and historical data can be directly compared; Trend pens shall having different y-axis scales in engineering units. Zoom functions shall be selectable by an operator-adjustable window. Configure export of trend data compatible with standard spreadsheet packages; Configure trends, where required, to simultaneous display historical data, data generated with standard spreadsheet packages, and SQL linked data from relational databases.

3. Configure trends with "ad hoc" trending of any system variable. Variable(s) selected from the SCADA screen shall be displayed and historical trending started. Configure trends to allow other variables to be selectable on the SCADA screen

and added to the ad hoc trend screen or selected through the database. Provide means for saving such as-hoc trends locally and in the network configuration allowing them to be accessed and launched at any SCADA terminal.

D. Database

1. Provide a menu-driven access program which allows the user to enter the database and add, delete or modify any portion of the system to configure changes, including all graphics, group, station and point records, algorithms, report generation and system functions.
2. Provide a structured package such that the HMI database can be created or edited using standard text editors or spreadsheet software packages.
3. Provide means for HMI resident data mapping function blocks to access and control PLC data by bit and register and implement any District standard function blocks used for implementing standard District control or monitoring functions. Any District standard function blocks shall be provided to the INSTRUMENTATION SUPPLIER after award of Contract.

E. Configuration

1. Configure the system to allow the system administrator to have the capability of logging out of the current mode of operation, and with the proper password, enter the configuration mode.
2. The system administrator shall have the capability to modify group, station, and point records including all control, status, analog, pulse, auto control algorithms, limits, pseudo points, off-normal parameters and related datum pursuant to a functional field device or process.
3. The system administrator shall have the capability to modify all graphic displays including operator screen parameters such as orientation of alarm queues, graphics etc.
4. The system administrator shall have the capability to modify all report generation parameters determining logged output.
5. The system administrator shall have the capability to modify password assignment and access/control restrictions for various PLC's and related graphics.
6. The system administrator shall have the capability to modify all alarm attributes and responsibility including assigning of priorities and queues into which alarms will arrive at the operator terminals.

F. Alarm System

1. Conditions in the field designated as alarm conditions shall report to the operator terminal, actuate an audible alarm, and provide a visual blinking image on the associated graphic page.
2. The alarm condition shall be a discrete input output change of state, un-commanded change of state for discrete outputs, analog values above and below limits, high or low analog rate-of-changes as defined in the database, marginal or failed communication link and failure of a hardware device such as screens, printers, input/output module, or other major device.

3. Alarms shall be assigned priority during database configuration, based on relative importance of the alarm condition. The priority will be able to be timed, so that unacknowledged alarms can raise priority if not acknowledged within a specified time period, allowing them to appear at the top of the queue.

4. Each alarm queue shall show the highest priority alarm on the screen. The queue shall be expanded to view up to ten alarms showing the alarming devices' condition in a flashing state, the priority, the time and the alarm arrived at the polling station (hour, minute, second) and the location of the alarm. The operator will have the option of acknowledging the alarm without clearing it, deferring it for reference, or clearing it from the screen.

5. Provide alarms in tabular listings selectable chronologically or by priority, acknowledged, unacknowledged or both. No alarms may be addressed without being able to be viewed.

G. Operator Control

1. Commands related to controlling field devices or system attributes shall conform to District standards.

H. Print Facilities

1. Printing is not required at the site. However, provide means to operate at least one alarm/event printer and one report printer. Alarm/Event printer shall be configurable to redirect event logs to a file.

2. Printouts or files of event logs shall include the station location name, event, date, time, priority of event if applicable, and description.

I. Reports

1. System shall include applications for developing fully customized historical and real-time data reports.

J. Historical Data

1. The new System shall use the existing redundant Historian servers with licenses to support the additional tags required tags plus 50% of the total number of new points and existing points for spare capacity to accommodate future expansion. Instrumentation Supplier shall upgrade the Historian license to accommodate these additional points and processing functionality. Data storage shall be implemented as follows:

   a. Historical Data Collection - All analog inputs, operator process control setpoints, and discrete equipment ON/OFF status shall be collected and stored in the Historian database and incorporated on fixed trend screens of related variables. Historical data collection shall be configured as follows, unless specifically detailed otherwise in the Detailed Loop Specific Control Descriptions. See table below:

Data Capture Parameters	Analog / Digital	Note

Collection Type	Polled	Polled or Unsolicited
Collection Interval	5 seconds	5 second default sampling rate
Collection Offset	1, 2, 3, or 4 seconds	Collection offsets are evenly distributed among all polled tags to avoid polling at the same time
Collector Compression	True	Compression enabled.
Collector Compression Timeout	15 minutes	15 minute heartbeat polling
Collector Deadband Percent Range	0.5% / 0.5 units	Analogs poll on 0.5% change. Digitals poll on change of state.
Interface Absolute Deadbands	False / True	Digitals poll on change of state

2. Historian server software shall be GE Intelligent Platforms Proficy Historian Enterprise edition, no equal, to match existing District standards.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. The CONTRACTOR shall utilize personnel to accomplish, or supervise the physical installation of all elements, components, accessories, or assemblies that it provides. The CONTRACTOR shall employ installers who are skilled and experienced in the installation and connection of all elements, components, accessories, and assemblies it provides.

B. All components of the PLCS including all communication cabling shall be the installation responsibility of the CONTRACTOR unless specifically noted otherwise. The installation of the communication network shall be the complete installation responsibility of the CONTRACTOR including all cables, connectors, transceivers, and any required electrical grounds. Grounding shall be shown on submittal drawings. After installation of the PLCS is completed, the installation shall be inspected jointly by the CONTRACTOR and the Equipment Manufacturer's representatives. Any problems shall be corrected, and when both are satisfied with the installation, a written certification of the installation shall be delivered to the ENGINEER OF RECORD. The certification shall state that all PLC communication and I/O modules, system grounds, communication network, operator interfaces and all other components of the PLCS System have been inspected and are installed in accordance with the manufacturer's guidelines.

3.02 PLC CONTROL LOGIC SIMULATION PANEL PROGRAM DEVELOPMENT

A. Provide PLC Control Logic Simulation Programs to mimic operation of each process area associated with specific area PLCs as shown on the Contract Documents. Provide PLC code developed to meet all District standards as specified in Section 40 91 00, this Section, and matching the System Integrator’s approved programming software design specification as specified above.

B. PLC Control Logic Simulation Programs shall be developed for testing all new and modified existing PLC programs.

C. Process simulations shall generally mimic operation per the general programming and control loop descriptions of Section 40 90 10. Simulation Programs shall include software-based switches and setpoints within the Plant Simulation PLC to allow for testing of normal and abnormal operations, as well as failure modes.

D. Simulation of packaged equipment system operation including the Centrifuge System, etc., are not included in these simulation requirements other than indication of operation is sent and received.

E. Simulated Programs shall be interfaced to the resident program in the Test Bed PLC.

F. Physical/field and simulation I/O shall be mapped to common memory/register areas for processing by the Test Bed PLC logic. Mapping of physical/field or simulation I/O shall be provided by a PLC toggle bit to allow processing of the physical/field I/O or simulation I/O to be activated in the final installed version of the PLC program. Provide interlocks to prohibit inadvertent toggling of final installed version of a PLC program to simulation mode.

G. Plant Simulation PLC shall read the “field” mapped output from the Test Bed PLC and provide simulated “field” mapped inputs to the Test Bed PLC.

H. Provide simulation of individual component operation including:

1. Analog inputs: provide manual entry option for disabling dynamic operation to mimic alarm level; provide means to re-establish dynamic simulation mode with the manually entered analog value for simulating process execution with alarm level process variables as specified
2. Motor start and stop: constant speed
3. Motor start and stop: motor ramp up start/ramp-down stop (reduced voltage or ASD start)
4. Motor variable speed: ASD speed control
5. Open/Close valve or gate: variable travel times matching expected component operating times
6. Modulating valve or gate: variable response times to 4-20 mA position inputs
7. Motor alternation logic (Lead/Lag/Standby, etc.)
8. Process variable response to changes in control variables. For example, if a simulated valve has an upstream pressure transmitter and a downstream flow transmitter, then simulated valve operation would be indicated by valve position feedback (limit switch or % open position), pressure decrease, and flow increase as the valve position changes. Precise variable simulation is not required, a general representation of the process variable action is sufficient.

9. All similar simulation modules shall be consistent and be simulated identically within the PLC simulation software.

10. Provide process specific simulations for all process associated with each standalone PLC system as shown on the Contract Documents. Simulation testing shall allow full testing of all processes resident in the PLC program loaded in the test bed PLC.

11. Provide simulation of normal and abnormal conditions including:

    a. Gravity Thickener

    b. Sludge Mixing Tank

    c. Centrifuge Feed Pump Station

    d. Polymer for Centrifuges

    e. Polymer for Gravity Thickeners

    f. Any equipment related to the transfer of water to the Wash water Recovery Basins

    g. Centrate Wet well Sump Pumps

    h. Solids Discharge Conveyors

    i. Transfer Conveyors

    j. Solid Load Out Conveyors

    k. Remaining equipment left on PLC 710Network failure

    l. Power failure generator restart

    m. Individual component failure

    n. As necessary to demonstrate the testing requirements specified in this Section for the Factory Testing Protocol

    o. Other failure modes where identified in the Instrumentation Supplier's final accepted testing protocol or as identified during the PLC Control Logic Simulation Workshop specified in Section 40 91 00.

I. PLC Logic Simulation HMI And Graphics

1. Test Bed PLC shall interface directly to a Temporary HMI Server. The Temporary HMI Server shall be developed in conjunction with the PLC Control Logic Simulator to allow testing of all newly developed PLC Logic and new HMI elements for this WORK. The Temporary HMI Server shall support graphical presentation of simulated process operations. The Temporary HMI screens shall be the system on which process graphic screens are developed for the specific process per Section 40 90 10 and Section 40 95 10.

    a. The Plant Simulation PLC shall read discrete and analog input variables entered manually from the Temporary HMI Server for initial state variables or for input logic simulation as specified. Provide additional HMI screens as necessary for each simulated process that includes manual entry fields for all field I/O and variables passed from other network resident PLCs as required for the simulation.

b. After final factory testing of the Temporary HMI server and prior to deployment for use as a functioning temporary server, coordinate with OWNER to rack-mount the server in the OWNER's existing network rack.

2. Store the last set of state variables as an HMI "recipe" file to repopulate the HMI simulation entry screen for use on subsequent simulations. As part of setpoint entry, provide means to capture and store setpoints within appropriately named recipe files. Recipes shall be retrievable and downloadable as a means to capture current plant configurations in preparation for short term plant outages and plant operational reconfiguration (e.g., summer vs. winter operation, source water changes, etc.). The INSTRUMENTATION SUPPLIER coordinate with the District operations and SCADA engineering personnel during the PLC Control Logic Simulator Workshop specified in Section 40 91 00 to establish which setpoints are to be included in the setpoint recipe files.

3. Provide an HMI resident graphic ACTIVATE/HOLD/MANUAL switch

a. ACTIVATE: begin dynamic simulation.

b. HOLD: hold a simulated state for inspection.

c. MANUAL: disable dynamic simulation and allow manually changing analog or discrete entries for verification of setpoint alarms or to establish a new initial state for simulation if returned to the ACTIVATE mode.

J. Simulation Network

1. Provide dedicated, isolated PLC and HMI simulation network via the simulation PLC panel managed switch. The simulation network shall emulate the functions of the District's SCADA LAN but shall be kept isolated form the District's real time control SCADA and PLC LANs. Provide dedicated I/P addressing for the simulation LAN. In no case shall the simulation or test bed PLC be connected to the plant SCADA or PLC networks.

3.03 TESTING, AND INSTALLATION

A. The requirements of Section 40 91 00 apply to this Section.

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SECTION 43 20 00

PUMPS, GENERAL

PART 1 - GENERAL

1.01 THE SUMMARY

A. Provide pumps and pumping appurtenances, complete and operable, as indicated in accordance with the Contract Documents.

B. The provisions of this Section shall apply to pumps and pumping equipment throughout the Contract Documents, except where otherwise indicated.

C. Related Sections. See Related Sections for additional requirements applicable to this Section:

1. Section 09 90 00 – Protective Coatings
2. Section 26 05 10 – Electric Motors
3. Section 26 05 15 – Industrial Control Panels
4. Section 26 29 23 – Variable Frequency Drives
5. Section 40 50 06 – Pipe Couplings
6. Section 40 95 13 – Control Panels
7. Section 43 30 52 – Miscellaneous Valves
8. Section 46 01 00 – Equipment General Provisions.

D. Unit Responsibility

1. The pump manufacturer shall be made responsible for furnishing the pumps, motors, and VFDs as one package and for the coordination of design, assembly, testing, and installation of the WORK of each specific pump Section.
2. The CONTRACTOR shall be responsible to the OWNER for compliance with the requirements of each specific pump Section.

E. Single Manufacturer

1. Where 2 or more pump systems of the same type or size are required, provide pumps produced by the same manufacturer.

1.02 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with the requirements of the Standard Provisions.

B. Shop Drawings

1. Submit pump name, identification number, and specification Section number.

2. Performance Information

   a. Submit performance data curves showing head, capacity, horsepower demand, NPSHr3 required, and pump efficiency over the entire operating range of the pumps. Submit efficiency curves of motors and VFDs.

   b. Require the equipment manufacturer to indicate the head, capacity, required horsepower, pump efficiency, and NPSHr corresponding to each flow condition indicated in the respective performance requirement paragraph of each individual pump specification section. Indicate on the pump curve the Allowable Operating Region (AOR), Preferred Operation Region (POR), and minimum submergence required at maximum flow for vertical and submersible pumps.

   c. Submit performance curves at intervals no greater than 100 RPM from the specified minimum speed to maximum speed for each centrifugal pump equipped with a variable speed drive.

3. Operating Range

   a. Require the manufacturer to indicate the limits on the performance curves recommended for stable operation without surge, cavitation, or excessive vibration.

4. Submit assembly and installation drawings, including shaft size, seal, coupling, bearings, anchor bolt plan, part nomenclature, material list, outline dimensions, and shipping weights.

5. Submit data, in accordance with the requirements of Section 26 05 10 – Electric Motors, for the electric motor proposed for each pump.

6. Submit an elevation drawing of the proposed local control panel, showing panel-mounted devices, details of enclosure type, a single-line diagram of power distribution, current draw of the panel, and a list of terminals required to receive inputs or to transmit outputs from the local control panel.

7. Submit a wiring diagram of field connections, with identification of terminations between local control panels, junction terminal boxes, and equipment items.

8. Submit a complete electrical schematic diagram.

C. Operation and Maintenance Documents

1. Submit Operations and Maintenance documents in accordance with the requirements of the Special Provisions Article 14.10. Provide for each type and model of pump provided.

D. Spare Parts List

1. Submit a spare parts list containing the required information indicated in each specific pump Section.

E. Factory Test Data

1. For pumps that shall be factory witness tested, submit factory test plan showing piping diameter sizes and lengths, locations of valves and instruments that will be used during testing as part of shop drawing submittal.

2. For pumps that shall be factory witness tested, submit current calibration certificates of test instruments prior to testing.

3. Submit signed, dated, and certified factory test data for each pump system which requires factory testing.

4. Submit these data before shipment of equipment.

F. Certifications

1. Submit the manufacturer's certification of proper installation.

2. Submit the CONTRACTOR's certification of satisfactory field testing.

PART 2 - PRODUCTS

2.01 GENERAL

A. Compliance with the requirements of the specific pump Sections may necessitate modifications to the manufacturer's standard equipment.

B. Performance Curves

1. Provide centrifugal pumps with a continuously rising pump curve, or with a pump curve that does not cross the system curve within the pump curve’s “dip region.”

2. Unless otherwise indicated, the required shaft horsepower for the entire pump assembly at any point on the performance curve shall not exceed the rated horsepower of the motor or engine or encroach on the service factor.

3. For VFD driven pumps, the rated horsepower of the selected motor shall be 110 percent of the maximum brake horsepower required by the pump.

C. Compatibility

1. Provide entirely compatible components of each pump system provided under the specific pump Sections.

2. In each unit of pumping equipment, incorporate basic mechanisms, couplings, electric motors or engine drives, variable speed controls, necessary mountings, and appurtenances.

D. Balancing

1. Unless otherwise specified the rotating assembly shall be dynamically balanced to ISO 1940 G6.3.

2.02 MATERIALS

A. Provide materials suitable for the intended application.

B. For materials not indicated, provide high-grade, standard commercial quality, free from defects and imperfections that might affect the serviceability of the product for the purpose for which it is intended, and conforming to the following requirements:

1. For drinking water service, use materials with weighted average of lead content of wetted components not to exceed 0.25% to meet the requirement of the Reduction of Lead in Drinking Water Act.

2. Bowls and Casings

a. Provide cast iron pump casings constructed of close-grained gray cast iron, conforming to ASTM A 48 - Gray Iron Castings, Class 30, or equal. Unless otherwise indicated on the specific pump sections, cast iron-fitted pumps shall be epoxy lined and coated for better efficiency.

3. Impellers

a. Where individual pump sections indicate cast iron impellers, such impellers shall be epoxy coated and constructed of close-grained gray cast iron, conforming to ASTM A 48 - Gray Iron Castings, Class 30, or equal.

b. Where individual pump sections indicate stainless steel impellers, such impellers shall be constructed of Type 316 stainless steel.

c. Where individual pump sections indicate bronze impellers, or where the impeller material is not otherwise specified, such impellers shall be constructed of zero-lead aluminum bronze conforming to ASTM B 148 – Standard Specification for Aluminum-Bronze Sand Castings, or zero-lead, zincless nickel aluminum bronze ASTM –B 148-C95800.

4. Provide pump shafts constructed of Type 416 or 316 stainless steel.

5. Provide anti-friction bearings or zero-lead bronze bearings. Bronze bearings shall be Bismuth Tin Bronze ASTM B 584 C89835, or equal.

6. All elastomeric materials such as gaskets, seals, O-rings in contact with water with chloramine and ozone shall be Teflon, Viton-A or other materials compatible with

the fluid service. Test certificate from a material testing laboratory to provide proof of test shall be made available to the ENGINEER OF RECORD if requested.

7. Miscellaneous stainless steel parts shall be of Type 316.

8. Provide anchor bolts, washers, and nuts in standard service (non-corrosive application) of galvanized steel in accordance with the requirements of Section 05 50 00 – Miscellaneous Metalwork.

9. Provide anchor bolts, washers, and nuts in corrosive service of stainless steel in accordance with Section 05 50 00 – Miscellaneous Metalwork.

C. Materials in contact with potable water shall be listed as compliant with NSF Standard 61. Potable water shall be considered to be plant water and all process water pipelines including sludge, thickened sludge, decant, and centrate pipelines as well as drain pipelines that return to the gravity thickeners, washwater recovery facility, or to the existing washwater recovery basins. Test certificate from a material testing laboratory to provide proof of test shall be made available to the CONSTRUCTION MANAGER if requested.

2.03 PUMP COMPONENTS - GENERAL

A. Flanges and Bolts

1. Provide suction and discharge flanges conforming to ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, or ASME B16.5 - Pipe Flanges and Flanged Fittings dimensions. Pressure class shall be suitable for the application or as otherwise recommended by the pump manufacturer.

2. Provide flange bolts in accordance with the requirements of Section 40 05 00 – Piping, General.

3. Flange gaskets shall be in accordance with Section 40 05 00 - Piping, General

B. Lubrication

1. Vertical pump shafts for clean water pumps shall be product water-lubricated, unless otherwise indicated.

2. Provide deep-well pumps with external flushing water- or oil-lubricated bearings and seals, and enclosed line shafts.

3. Pumps for sewage, sludge, and other process fluids shall be grease lubricated or as indicated.

C. Hand holes

1. Provide hand holes on pump casings shaped to follow the contours of the casing in order to avoid any obstructions in the water passage.

D. Drains

1. Provide and connect pipe gland seals, air valves, and cooling water drains to the nearest floor sink or drain, using galvanized steel pipe or copper tube that is properly supported with brackets.

E. Grease Lubrication

1. For vertical propeller and mixed-flow pumps that are not operating continuously such as for flood control application, provide a stainless steel tube attached to the column for grease lubrication of the bottom bearing.

F. Stuffing Boxes

1. Where stuffing boxes are indicated for the pump seal, provide stuffing boxes of the best quality, using the manufacturer's suggested materials best suited for the specific application.

2. For sewage, sludge, drainage, and liquids containing sediments, provide fresh-water-flushed seals, using lantern rings.

3. If fresh water is not available, the seal shall be flushed with product water cleaned by a solids separator as manufactured by **John Crane Co., Lakos (Claude Laval Corp.),** or equal.

4. Conventional Packing Gland Type Seal

a. Unless otherwise indicated, provide packing material of Teflon braiding, containing 50 percent ultrafine graphite impregnation in order to satisfy the requirements listed in the table below.

b. Acceptable ring materials are asbestos-free die-molded packing rings of braided graphite material free of PTFE, **Chesterton 1400R** or equal, for non-potable water service, and braided PTFE material, **Chesterton 1725** or equal, that is listed under NSF Standard 61 for potable water service.

Shaft speeds	up to 2500 fpm
Temperature	up to 500 deg F
pH range	0 - 14

5. Mechanical Seals

a. Provide mechanical seals of the fresh water-flushed-type, unless otherwise indicated in which case use product water cleaned by a solids separator as indicated above. Seal materials in contact with water with chloramine and ozone shall be Teflon or Viton-A or equivalent material compatible with fluid service.

b. Provide split-type mechanical seals as manufactured by the following, or equal:

Sewage, Sludge, or Wastewater Pumps	Double seals	**John Crane Type 3710, Flowserve Type PSS2, Chesterton Type 442**
Abrasives, Grit, or Lime Slurry Pumps	Double seals	Split seals are not recommended.
Chemicals or Corrosive Liquid Pumps	Single seals	Split seals are not recommended because of leakage.
Water Pumps (Hot and cold)	Single seals	**John Crane Type 3710, Flowserve Type PSS II, Chesterton Type 442**

c. Where indicated, circulate a buffer fluid at a minimum 20 psi above discharge pressure, or as required by the manufacturer, in order to maintain reliable seal performance.

d. Equip mechanical seals with non-clogging, flexible–mounted seats with elastomer secondary seals.

e. Provide wetted metal parts constructed of Type 316 stainless steel, Alloy 20, or Hastelloy B or C, whichever has the best corrosion resistance to the pumped fluid.

f. Where double seals are specified, provide double-balanced dual cartridge seals in order to allow for seal integrity in case of flush water pressure reversal.

g. Provide springs in single and double seals, in the non-wetted end of the seal.

h. Deliver fresh water to the seals through appropriate size piping with plug valves, strainers, pressure regulators, electrically operated solenoid valves, and rotameters.

i. Wiring shall comply with the requirements of Division 26 – Electrical, and control shall comply with the requirements of Division 40 – Instrumentation and Control.

2.04 PUMP APPURTENANCES

A. Nameplates

1. Equip each pump with a stainless steel nameplate indicating serial number(s), rated head and flow, impeller size, pump speed, and manufacturer's name and model number.

B. Solenoid Valves

1. Require the pump manufacturer to provide solenoid valves on the water or oil lubrication lines and on cooling water lines.

2. Provide solenoid valve electrical ratings compatible with the motor control voltage.

C. Gauges

1. Except for sample pumps, sump pumps, and hot water circulating pumps, equip pumps with pressure gauges installed at the pump discharge lines.

2. Provide pump suction lines with compound gauges.

3. Located gauges in a representative location, where not subject to shock or vibrations, in order to achieve true and accurate readings.

4. Where subject to shock or vibrations, wall-mount the gauges or attach the gauges to galvanized channel floor stands and connect by means of flexible connectors.

5. Provide pressure and compound gauges in accordance with the requirements of Section 40 91 08 – Pressure Measuring.

2.05 FACTORY TESTING

A. Conduct the following tests on each indicated pump system:

1. Motors

a. Test electric motors in accordance with the requirements of Section 26 05 10 – Electric Motors.

b. Furnish test results to the pump manufacturer prior to the pump test.

2. Variable Frequency Drives

a. Test variable frequency drives in accordance with the requirements of Division 26 – Variable Speed Drives section.

b. Furnish test results to the pump manufacturer prior to the pump test.

3. Certified Factory Non-witnessed Test

a. Perform factory non-witnessed tests on centrifugal pumps with drives up to and including 125 hp in accordance with the ANSI/HI 14.6, Rotodynamic Pumps for Hydraulic Performance Acceptance Test.

b. For pumps with drives smaller than 15 hp, sump pumps, and sample pumps, pumps shall meet hydraulic acceptance criteria Grade "2U" unless otherwise indicated. Such tests shall, at a minimum, consist of the following:

1) Hydrostatic test;

2) Performance test at guaranteed design point or duty point documenting head, flow, bhp, and efficiency results.

3) Unless otherwise indicated, it is not required to test NPSHr in the factory. Instead, manufacturer shall submit the published NPSHr curve in accordance with the requirements of this specification section.

4) Additional tests as indicated in the specific pump specification sections.

c. For pumps with drives 15 hp and larger shall meet hydraulic acceptance criteria Grade "1U" unless otherwise indicated. Such tests shall, at a minimum, consist of the following:

1) Hydrostatic test;

2) Performance Test:

a) Conduct performance testing at maximum speed, obtain a minimum of 5 hydraulic test readings between shutoff head and 25 percent beyond the maximum indicated capacity, and record on data sheets as defined by the Hydraulic Institute Standards;

b) For variable speed driven pumps, test each pump between maximum and minimum speed at intervals no greater than 100 RPM;

c) Submit pump curves showing head, flow, bhp, NPSHr and efficiency results. The manufacturer's certification shall be visible on each submitted curve;

3) Mechanical testing shall be limited to observation during the hydraulic performance test for any abnormal bearing temperature and pump vibration. Any deficiencies shall be corrected by the manufacturer.

4) NPSHr3

a) Perform a net positive suction head required test (NPSHr3), if required by the specific pump Section.

b) Acceptance criteria shall be in accordance with ANSI/HI 14.6

c) If not required by the specific pump Section, submit the published manufacturer-calculated NPSHr3 curve.

5) Additional tests as indicated in the specific pump specification sections.

d. Perform tests using the completely assembled project pump, motor, and VFD system (if equipped with variable speed drive). Calibrated factory motor may be used in lieu of project motor subject to approval of the ENGINEER OF RECORD.

e. Testing of prototype models will not be accepted.

f. Submit certification signed by a senior official of the pump manufacturer that the required pump shaft horsepower did not exceed the rated motor horsepower of 1.0 service rating at any point on the curve.

g. No equipment shall be shipped until the test data have been approved by the ENGINEER OF RECORD.

4. Acceptance

a. In the event of failure of any pump to meet any of the requirements, make necessary modifications, repairs, or replacements in order to conform to the requirements of the Contract Documents, and re-test the pump until found satisfactory.

PART 3 - EXECUTION

3.01 MANUFACTURER'S SERVICES

A. Inspection, Startup, and Field Adjustment

1. Where required by the specific pump Section, furnish a service representative at the Site continuously to supervise and to certify in writing that the equipment and controls have been properly installed, aligned, lubricated, adjusted, and readied for operation. The service representative shall be a direct employee of the manufacturer, not a distributor or equipment supplier, and with comprehensive knowledge of and experience with the equipment. The service representative will supervise the following items:

a. installation of the equipment;

b. inspection, checking, and adjusting the equipment;

c. startup and field testing for proper operation; and

d. Performance of field adjustments to ensure that the equipment installation and operation comply with the indicated requirements.

B. Instruction of OWNER's Personnel

1. Where required by the individual pump Section, furnish an authorized training representative of the manufacturer at the Site for the number of Days indicated in the specific pump Section, to instruct the OWNER's personnel in the operation and maintenance of the equipment, including step-by-step troubleshooting with necessary test equipment. The training representative shall be a direct employee of the manufacturer, not a distributor or equipment supplier, and with comprehensive knowledge of and experience with the equipment.

2. Furnish instruction specific to the model of equipment provided.

3. Qualifications

a. Furnish a representative with at least 2 years' experience in training.

b. Submit a resume for the representative.

4. Schedule the training a minimum of 3 weeks in advance of the first session.

5. Lesson Plan Review

a. Submit the proposed training material and a detailed outline of each lesson for review.

b. Incorporate review comments into the material.

6. The trainees will keep the training materials.

7. The OWNER may videotape the training for later use with the OWNER's personnel.

3.02 INSTALLATION

A. General

1. Install pumping equipment in accordance with the manufacturer's written recommendations.

B. Alignment

1. Field-test the equipment in order to verify proper alignment and freedom from binding, scraping, shaft run out, or other defects.

2. Measure the pump drive shafts just prior to assembly in order to ensure correct alignment without forcing.

3. Ensure that the equipment is secure in position and neat in appearance.

C. Lubricants

1. Provide the necessary oil and grease for initial operation.

3.03 PROTECTIVE COATING

A. Coat materials and equipment in accordance with the requirements of Section 09 96 00 – Protective Coating.

3.04 FIELD TESTS

A. Field-test each pump system after installation simulating all of the operational scenarios as specified in order to demonstrate:

1. satisfactory operation without excessive noise and vibration;
2. no material loss caused by cavitation;
3. no overheating of bearings; and,
4. Meet indicated head, flow, and efficiency at the design point.

B. Conduct the following field testing:

1. Startup, check, and operate the pump system over its entire speed range.
2. If the pump is driven by a variable speed drive, test the pump and motor at 100-RPM increments.
3. If the pump is driven by constant speed, test the pump and motor at the maximum RPM.
4. Unless otherwise indicated, vibration shall be within the amplitude limits recommended by the Hydraulic Institute standards at a minimum of 4 pumping conditions defined by the ENGINEER OF RECORD.
5. Obtain concurrent readings of motor voltage, amperage, pump suction head, and pump discharge head for at least 4 pumping conditions at each pump rotational speed, at 100-RPM increments if equipped with a variable speed drive or at maximum RPM if equipped with a constant speed drive.
6. Check each power lead to the motor for proper current balance.
7. Bearing Temperatures
    a. Determine bearing temperatures by a contact-type thermometer.
    b. Precede this test with a run time sufficient to stabilize bearing temperatures, unless an insufficient liquid volume is available to furnish such a run time.
8. Ensure that electrical and instrumentation tests conform to the requirements of the Section under which that equipment is specified.

C. Witnessing

1. Field testing will be witnessed by the CONSTRUCTION MANAGER.
2. Furnish 3 Days advance notice of field testing.

D. If the pumping system fails to meet the indicated requirements, modify or replace the pump and re-test as indicated above until it satisfies the indicated requirements.

E. Certification

1. After each pumping system has satisfied the requirements, certify in writing that it has been satisfactorily tested and that final adjustments have been performed.

2. Certification shall include the date of the field tests, a listing of persons present during the tests, and the test data.

F. The CONTRACTOR shall be responsible for costs of field tests, including related services of the manufacturer's representative, except for power and water, which the OWNER will bear.

G. If available, the OWNER'S operating personnel will provide assistance in field testing.

END OF SECTION

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SECTION 43 21 29.05

CHEMICAL METERING PUMPS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work included: Furnish and install, complete, metering pumps with variable speed drives, and the associated accessories and appurtenances.

B. System responsibility: In order to assure compatibility, ease of installation, and proper operation, no more than two manufacturers or suppliers shall be responsible for the supply of all equipment specified herein, complete with all accessories and appurtenances including, but not limited to pump, motor and variable speed drive.

C. Related Work Specified Elsewhere:

1. Division 26 – Electrical Requirements for Mechanical System Packages.
2. Special Provisions –Testing and Start-up.
3. Section 03 62 00 – Non- Shrink Grouting.
4. Section 09 96 00 – Protective Coatings.
5. Section 26 05 19 – Wiring and Cabling.
6. Section 26 29 00 – Low Voltage Motor Control.

1.02 EQUIPMENT ID NUMBERS

A. Equipment Identification numbers assigned to equipment and accessories are:

Tag Number	Equipment Name
RPLMPF01	Centrifuge Feed Polymer Metering Pump No.1
RPLMPF02	Centrifuge Feed Polymer Metering Pump No.2
RPLMPF03	Centrifuge Feed Polymer Metering Pump No.3
RPLMPF04	Centrifuge Feed Polymer Metering Pump No.4
RPLMPF05	Thickener Inlet Polymer Metering Pump No.1

1.03 QUALITY ASSURANCE

A. The manufacturer of the pumps and equipment required in this section of the specifications shall have had previous experience in the design, manufacture and installation of similar equipment for a period of not less than 5 years.

1.04 DEFINITIONS

A. Terminology pertaining to pumping unit performance and construction shall conform to the ratings and nomenclature of the Hydraulic Institute Standards.

1.05 SUBMITTALS

A. Provide all required submittals in accordance with the Standard Provisions Section 7, Submittal Management.

B. Submit the following product data and shop drawings prior to release for fabrication:

1. Make, model, weight, and horsepower of each equipment assembly.

2. Complete catalog information, descriptive literature, specifications, and identification of materials of construction.

3. Performance data curves showing head, capacity, horsepower demand, and pump efficiency over the entire operating range of the pump.

4. Detailed structural, mechanical, and electrical drawings showing the equipment dimensions, size, locations of connections, and weights of associated equipment.

5. Power and control wiring diagrams, including terminals and wire numbers.

6. Complete motor nameplate data, as defined by NEMA, motor manufacturer, and including any motor modifications.

7. Factory finish system.

8. Special shipping, storage and protection, and handling instructions.

9. Manufacturer’s printed installation instructions.

10. List of recommended spare parts necessary to maintain the equipment in service for a period of one (1) year with current price information. Specifically identify parts furnish as part of this specification.

C. Submit the following prior to shipping:

1. Certified factory test reports.

2. Final O&M Manuals.

D. Submit the following prior to contract completion:

1. Manufacturer's Certificate of Proper Installation.

2. Certified field test reports.

1.06 OPERATION AND MAINTENANCE (O&M) MANUALS

A. O&M manuals shall include detailed information on the equipment, controllers, and all appurtenances specified herein and required by the system. In addition to the requirements of Standard Provisions Section 7, provide the following:

1. Manufacturer's instructions for storage, installation, preventive maintenance, and lubrication.

2. The equipment manufacturer's warranties.

3. Detailed parts drawing with full parts list include OEM part numbers.

4. Repair data, including mechanical seal replacement.

5. Troubleshooting data.

6. Maintenance Summary Form.

7. Section dividers for field test data and Manufacturer's Certificate of Proper Installation (to be inserted by the District when available).

1.07 SERVICE CONDITIONS

A. Power supply: 240 VAC 3-Phase / 60Hz.

B. Process Fluid (see Section 43 06 40.05 for material properties):

Tag Number	Process	Process Fluid Pumped
RPLMPF01	Centrifuge Feed Polymer Metering Pump No.1	Diluted Solids Conditioning Polymer
RPLMPF02	Centrifuge Feed Polymer Metering Pump No.2	Diluted Solids Conditioning Polymer
RPLMPF03	Centrifuge Feed Polymer Metering Pump No.3	Diluted Solids Conditioning Polymer
RPLMPF04	Centrifuge Feed Polymer Metering Pump No.4	Diluted Solids Conditioning Polymer
RPLMPF05	Thickener Inlet Polymer Metering	Diluted Solids

Tag Number	Process	Process Fluid Pumped
	Pump No.1	Conditioning Polymer

1.08 MANUFACTURER'S FIELD SERVICES

A. Manufacturer's representative shall be present at the site or classroom designated by the CONSTRUCTION MANAGER, for the minimum person-days listed, travel time excluded.

Person-Days	Manufacturer's Service
1	Installation assistance and certification.
2	Field testing and startup (see Special Provisions for additional requirements)
2	Training of District personnel (person-days listed is total training days): • 2 training sessions with no more than 12 persons per session.

PART 2 - PRODUCTS

2.01 WIDE RANGE DIAGPRAGM PUMP, LOW CAPACITY (TYPE 1, FOR REFERENCE ONLY)

A. NOT USED, FOR TYPE 2 REFERENCE ONLY.

B. General: Positive displacement diaphragm type metering pumps with 100:1 turn down ratio without stroke adjustment by means of a stepper type motor.

C. Hydraulically actuated positive displacement, plunger actuated hydraulic diaphragm type metering pumps consisting of two pumping heads, with adjustable speed controllers and DC stepped drive motors. Cam operated mechanical drive. Pump shall have pressure pulsations less than 1 percent of the discharge pressure. Pumping end materials shall be corrosion-resistant to the liquid being pumped and shall withstand the discharge pressures as indicated herein. Below are the acceptable materials of construction:

1. Base (supports): Steel
2. Pump body: Cast iron
3. Pump head: Kynar (PVDF)
4. Ball checks: Ceramic

5. Ball check seats: Kynar (PVDF)

6. Convoluted diaphragms (2 per pump): PTFE

7. Tubing on head: PTFE or Kynar

8. Tubing fittings: Kynar (PTFE)

D. Mechanical drive shall include bevel reduction gear with two cams synchronized to provide pulse-less flow over the entire flow range. The cams drive two hydraulic plungers.

E. All reduction gears shall be steel, cast iron or bronze. Bearings shall be tapered roller or needle type. All gears and bearings and internal working parts shall be oil flooded in weather-resistant gear box.

F. Liquid end shall consist of a convoluted diaphragm driven by an intermediate hydraulic fluid. The intermediate fluid shall be driven by a piston/plunger. The cam mechanism shall produce a smooth positive operation of the piston/plunger.

G. Plunger Diameter shall be selected by manufacturer.

H. Assembled pumps and motors shall be factory mounted on steel supports.

I. Pump shall have a mechanically actuated automatic hydraulic refill system.

J. The steady state flow accuracy shall be +/- 0.5 percent.

K. Pump shall be capable of pumping with 9 psia minimum suction pressure.

L. Drive motors: Refer to Section 26 05 10.

M. Lubrication: Nontoxic food grade quality.

N. Acceptable Products: Milton Roy Centrac S series, or equal as approved by the ENGINEER OF RECORD.

2.02 WIDE RANGE DIAPHRAGM PUMP, HIGH CAPACITY (TYPE 2)

A. Service: dilute solids conditioning polymer.

B. General: Positive displacement diaphragm type metering pumps with 100:1 turn down ratio without stroke adjustment by means of a brushless type D.C. motor.

C. Similar to Type-1 pumps above, except for the following differences:

1. Single pump head (simplex)

2. Shall include helical gear and scotch yoke driven hydraulic piston.

3. Motor shall be brushless DC, TENV.

4. Plunger diameter to be selected by manufacturer.

D. Acceptable Products: Milton Roy Centrac B series, or equal as approved by the ENGINEER OF RECORD.

2.03 PERFORMANCE REQUIREMENTS

A. Maximum stroke speed under any operating condition shall not exceed 100 spm.

B. Maximum working pressure of head: 100 psig minimum.

C. Flow range for each new pump shall be as follows:

Tag Number	Process Fluid Pumped	Pump Type [1,2,3,4]	Required Minimum Flow [gph] at 100 psi	Required Maximum Flow [gph] at 100 psi
RPLMPF01	Dilute Solids Conditioning Polymer	2	150	300
RPLMPF02	Dilute Solids Conditioning Polymer	2	150	300
RPLMPF03	Dilute Solids Conditioning Polymer	2	150	300
RPLMPF04	Dilute Solids Conditioning Polymer	2	150	300
RPLMPF05	Dilute Solids Conditioning Polymer	2	150	300

2.04 PULSATION DAMPENERS AND CALIBRATION COLUMNS

A. Selected by the manufacturer for the capacity and service of the pumps.

2.05 FACTORY FINISHING

A. Factory Coatings shall be in accordance with Section 09 96 00, High-Build Epoxy Coatings.

2.06 SPARE PARTS AND SPECIAL TOOLS

A. Furnish the following securely packaged and labeled with component name and manufacturer's model and part number:

Equipment	Quantities
Hydraulic oil (food grade)	2 quarts for each pump
Any special tools required to service or overhaul the pumps.	1 set for each type

2.07 MOUNTING AND ANCHORAGE

A. Factory mount the complete pumping unit, including motor and pump. Type-2 and Type-3 diaphragm metering pumps shall have a fabricated steel or cast iron support frame or footings integral with the pump body.

B. Anchor bolts: Type 316 stainless steel, diameter to correspond with the mounting holes provided.

2.08 NAMEPLATES

A. Equipment nameplate: stainless steel with 1/4" die-stamped characters securely mounted in a readily visible location with the following information:

1. Model number and serial no.
2. Maximum working pressure
3. Rated flow capacity
4. Size of plunger, piston or tube

2.09 SOURCE QUALITY CONTROL

A. Factory tests and adjustments: Test all control panels and equipment actually furnished.

B. Functional test: Perform manufacturer's standard tests on controllers, pumps and motors.

C. Hydrostatic test: Test pump casing at 150 percent of rated max working pressure. Maintain test pressure for not less than 5 minutes.

D. Furnish test report on results of all factory tests for each pump.

PART 3 - EXECUTION

3.01 INSTALLATION

A. In accordance with manufacturer's written instructions, manufacturer's representative's recommendations. Installation shall be approved by the equipment manufacturer's representative prior to startup.

B. After the pump and driver have been set in position, aligned, and shimmed to the proper elevation, grout the space between the bottom of the baseplate and the concrete foundation with a poured, non-shrinking epoxy grout as specified in Section 03 60 00.

C. Complete lubrication and fill pumps with hydraulic fluid.

D. Connect piping without imposing strain on the equipment.

E. All accessories shall be fully supported with channel struts or other suitable supports.

F. Anchor bolts: Accurately place using equipment templates. Anchors shall be type 316 stainless steel unless otherwise noted.

G. Flush suction and discharge piping with clean water prior to operation.

H. Field Finish: Coatings of all pumps and motors shall be the system and color as designated in Section 09 96 00.

I. Provide equipment identification tags per Section 46 01 00, Equipment General Provisions.

3.02 FIELD TESTING

A. See the Special Provisions for additional requirements.

B. Functional Tests: Conduct on each unit assisted by the manufacturer's representative, as follows:

1. Operate each pump for 30 minutes at 25 percent rated capacity at 50 psig, 30 minutes at 50 percent rated capacity at 50 psig, 30 minutes at 100 percent rated capacity at 50 psig. Verify correct pumping rate using the magnetic flowmeter associated with each pump.

C. Performance Test: See Special Provisions Section 22.

END OF SECTION

SECTION 43 22 76

MAGNETIC DRIVE CENTRIFUGAL PUMPS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The CONTRACTOR shall furnish and install magnetic drive centrifugal chemical transfer pumps, together with all drives, motors, valves, supports, controls, accessories, and appurtenances necessary for transferring chemical solutions from storage tanks to transport tanks, complete and operable, in accordance with the requirements of the Contract Documents.

B. Related Sections. See Related Sections for additional requirements applicable to this Section:

1. Section 09 90 00 – Protective Coatings
2. Section 26 05 10 – Electric Motors
3. Section 26 05 15 – Industrial Control Panels
4. Section 40 50 06 – Pipe Couplings
5. Section 40 95 13 – Control Panels
6. Section 43 20 00 – Pumps, General
7. Section 43 30 52 – Miscellaneous Valves
8. Section 46 01 00 – Equipment General Provisions.

C. The requirements of Section 43 20 00 – Pumps, General apply to this Section.

D. The Supplier shall examine the site conditions, intended application, and operation of the pump system and recommend the pump which will best satisfy the indicated requirements.

1.02 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 43 20 00 – Pumps, General and the Standard Provisions.

PART 2 -- PRODUCTS

2.01 GENERAL

A. The pumps shall be of corrosion-resistant construction with all wetted parts of suitable material for the fluid pumped. Each pump shall be complete with pump base, drive, and electric motor. Size and characteristics of the pumps shall be as specified herein.

2.02 CONSTRUCTION

A. **Type:** The pumps shall be of sealess magnetic drive design. The torque to operate the impeller is transmitted by a magnetic field from a magnet attached to the motor, through a solid body to another magnet attached to the impeller. The pumps shall have an internal cooling circuit to lubricate the bearings, remove frictional heat, and to expel gases. The pumps shall not require seals or drive shafts. The motor shall be TEFC electric motor, suitable for 480-volt, 3-phase, 60 Hz power supply.

B. **Materials:** All wetted parts of the transfer pumps shall be selected by the manufacturer to ensure optimum, corrosion-free, and erosion-free operation for the chemicals involved.

2.03 CONTROL

A. Pumps shall be controlled in accordance with Section 40 91 00 - Process Control and Instrumentation Systems.

2.04 SCHEDULE OF MAGNETIC DRIVE CENTRIFUGAL PUMPS

A. Identification:

1.	Tag Number	-	P-xxx
2.	Quantity	-	**1**
3.	Location	-	Centrifuge Building B Polymer Storage

B. **Operating Conditions:** The WORK of this Section shall be suitable for long term operation under the following conditions:

1.	Duty	-	Continuous
2.	Drive	-	Constant speed
3.	Ambient temperature	-	40-110
4.	Ambient relative humidity (percent)	-	10 to 100
5.	Service Fluid	-	Polymer
6.	Fluid temperature (degrees F)	-	45 -100
7.	Fluid pH range	-	13.5 to 14
8.	Fluid specific gravity	-	1.1

C. **Performance Requirements:**

1.	Design flow capacity (gpm)	-	**100**
2.	Design flow pump head (TDH-ft)	-	**30**
3.	Design Efficiency (%)	-	xx
4.	$NPSH_A$ (ft)	-	xx
5.	Maximum pump speed (rpm)	-	3450
6.	Minimum motor size (hp)	-	3

D. **Pump Dimensions:**

1.	Impeller Size (in)	-	**5.187**
2.	Pump suction size (inches)	-	2 NPT
3.	Pump discharge size (inches)	-	1.5 NPT

2.05 PUMP REQUREMENTS

A. **Construction:** Construction of pump shall conform to the following requirements:

1.	Pump casing	-	Glass fiber reinforced polyproplene
2.	Impeller	-	Polypropylene closed impeller
3.	Pump Bearings	-	PTFE (Rulon)
4.	Shaft (spindle)	-	Ceramic
5.	Seal	-	N/A
6.	Mounting Method	-	Closed coupled
7.	Mouth Ring	-	PTFE (Rulon)
8.	O-Ring Material	-	Viton (FKM) or Teflon
9.	Thrust Ring	-	Ceramic
10.	Drive Magnet	-	Barium Ferrite

2.06 PUMP ACCESSORIES

A. **General:** Each magnetic drive centrifugal pump shall be provided with the following accessories in addition to other valves and connections as shown on the Drawings. Each accessory shall be resistant to the intended chemical. CONTRACTOR shall furnish all other piping, gages, fittings, valves and connections as indicated on the Drawings.

B. **Baseplate:** Each pump shall be provided with a steel baseplate. The baseplate shall be coated to resist spills from the chemical being pumped, as required.

C. **Mounting:** Unless otherwise shown, all magnetic drive centrifugal pumps shall be mounted on concrete pedestals. All pipe connections to and from pumps, piping and in-line accessories must be firmly supported from a floor-mounted, FRP frame, to avoid any stress on the pump or on the piping system. The support frame anchor bolts and fasteners shall be Type 316 stainless steel.

2.07 SPARE PARTS

A. The following spare parts shall be furnished for each pump:

1. One O-ring
2. Two bearings
3. One front thrust washer
4. One rear thrust washer
5. One shaft (impeller spindle)
6. One mouth ring

2.08 MANUFACTURER

A. **Manufacturer's Experience:** The pumping equipment shall be the product of a manufacturer who has designed and manufactured similar equipment and has a record of at least 5 years of successful operation of this type of process. The CONTRACTOR may be required to submit evidence to this effect together with a representative list of installations. The pump manufacturer shall maintain a permanent, local service department and a spare parts department.

B. **Manufacturers,** or equal**:**

1. **Iwaki Walchem**
2. **Finish Thompson, Inc**
3. **Vanton Pumps**

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Pumping equipment shall be installed in accordance with approved procedures submitted with the Shop Drawings and as shown, unless otherwise approved.

B. General installation requirements shall be as specified for "Execution" in Section 43 20 00, "Pumps, General."

END OF SECTION

SECTION 43 23 57

PROGRESSING CAVITY PUMPS

PART 1 -- GENERAL

1.01 THE SUMMARY

A. The CONTRACTOR shall provide progressing cavity pumps and appurtenances, complete and operable, in accordance with the Contract Documents.

B. Related Sections. See Related Sections for additional requirements applicable to this Section:

1. Section 09 90 00 – Protective Coatings
2. Section 26 05 10 – Electric Motors
3. Section 26 05 15 – Industrial Control Panels
4. Section 26 29 23 – Variable Frequency Drives
5. Section 40 50 06 – Pipe Couplings
6. Section 40 95 13 – Control Panels
7. Section 43 20 00 - Pumps, General
8. Section 43 30 52 – Miscellaneous Valves
9. Section 46 01 00 – Equipment General Provisions.

C. The Supplier shall examine the Site conditions, intended application, and operation of the pump system and recommend the pump that will best satisfy the indicated requirements. The Supplier shall confirm that the pumps are suitable for end suction configuration as shown in the Contract Drawings.

1.02 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 43 20 00 – Pumps, General and the Standard Provisions.

PART 2 -- PRODUCTS

2.01 GENERAL DESCRIPTION

A. Identification:

Pump Name	Sludge Transfer Pumps	Centrifuge Feed Pumps
Equipment Number(s)	RSLGXFRP01, RSLGXFRP02	RSLGCTFP01, RSLGCTFP02, RSLGCTFP03, RSLGCTFP04
Quantity	2	4
Location	Area 2 – Sludge Transfer Sump Area	Area 6 – Centrifuge Feed Pump Station

B. Operating Conditions:

Duty	Continuous
Drive	Variable Speed
Ambient environment	Outdoors
Ambient temperature, degrees F	20-100
Ambient relative humidity, percent	0-100
Fluid service	sludge
Percent of Solids	4%
Fluid temperature, degrees F	50
Fluid pH range	6.0 to 10.0
Fluid specific gravity	1.05
Fluid viscosity absolute, centipoises at 60 degrees F	1.1
Project site elevation, ft, m.s.l.	380
Minimum available NPSH, ft absolute	25
Type of suction port	Flanged

C. Performance Requirements:

Pump Name	Sludge Transfer Pumps	Centrifuge Feed Pumps	Centrifuge Feed Pumps
Equipment Number(s)	RSLGTRP01, RSLGTRP02	RCTFP01, RCTFP02	RCTFP03, RCTFP04
Design flow capacity, gpm	300	300	300
Design flow pump head TDH, ft	48	35	40
Minimum required capacity, gpm	100	100	100
Minimum flow TDH, ft	45	40	30
Maximum flow capacity, gpm	400	400	400
Maximum flow pump head TDH, ft	55	50	40
Maximum NPSH required, ft absolute	5	5	5
Maximum pump speed, rpm	300	300	300
Maximum motor speed, rpm	1750	1750	1750
Minimum motor size, hp	30	30	30
Power Supply	480 V, 3 Phase, 60 Hz	480 V, 3 Phase, 60 Hz	480 V, 3 Phase, 60 Hz

D. Pump Dimensions:

Pump Name	Sludge Transfer Pumps	Centrifuge Feed Pumps
Min size of suction flange, in	6	10
Min size of discharge flange, in	8	10
Suction flange rating, ANSI, psi	150	150
Discharge flange rating, ANSI, psi	150	150
Maximum pump length including space required for disassembly, ft	10	10

2.02 PUMP REQUIREMENTS

A. Construction: Construction of progressing cavity pumps shall conform to the following requirements:

Pump body	Cast iron, class 30 with inspection port and with flushing and drain connections in suction hand hole end
Stator	Buna- N with minimum shore durometer hardness of 70
Rotor	Chrome-plated (nominal thickness 0.010-inch) high-carbon tool steel with minimum plating Brinell hardness of 550
Seal	Double mechanical seal, fresh water flushed
Shaft	Solid single piece shaft through bearings and seal; same material as rotor
Shaft Sleeve	Type 316 stainless seal
Bearings	Ball and tapered roller bearings, minimum 60,000 hours L-10 life, grease-lubricated
Joints	Grease-lubricated, crown gear-type universal joints of chrome alloy steel, completely sealed and grease-filled
Connecting rod	Same material as rotor, designed to maintain maximum angularity of 1.5 degrees
Water flush connection	1/2-inch tapping in suction end and (for rotor and seal) in stuffing box, or seal, with solenoid operated water connection.
Pump base	Cast-iron or steel pan with drain, with factory-mounted pump and drive unit
Number of stages	2
Coupling	Heavy-duty flexible spacer coupling
Antirotational device	Differential friction-type antireversal holdback or other acceptable device to prevent flow reversals

B. Drive: Electric motors shall be furnished in accordance with Section 26 05 10 - Electric Motors. Gear motors or gear reducers shall be supplied in accordance with AGMA 6009-A - Standard for Gearmotor, Shaft Mounted, and Screw Conveyor Drives, with a service factor of 1.20.

1. For variable speed operation, pumps shall be furnished with variable frequency drives in accordance with Section 26 29 23 - Variable Frequency Drive Units.

2. For driver configurations utilizing a belt drive, where specified, such belt drives shall have a maximum speed reduction ratio of 4:1.

C. Coating: Interior water passages of cast iron and ductile iron casings shall be coated with 10- to 12-mils DFT vitreous enamel or 10- to 12-mils DFT fusion bonded epoxy per Section 09 96 00 – Protective Coatings. All external surfaces of cast iron and carbon steel materials shall be coated in accordance with Section 09 96 00 – Protective Coatings.

2.03 PUMP CONTROLS

A. Pumps shall be controlled in accordance with Section 40 90 10 - Control Strategies.

2.04 SPARE PARTS

A. Furnish the following spare parts for each pump:

1. One stator

2. One rotor

3. One connecting rod

4. One set connecting rod joint assembly

5. One bearing assembly

6. One mechanical seal

B. Where pumps of identical size and fluid service, the spare parts shall be supplied in the quantities shown for only one of the pumps.

2.05 MANUFACTURERS

A. **Moyno**

B. **Seepex**

C. **Netzsch (NEMO Pump Division)**

PART 3 -- EXECUTION

3.01 SERVICES OF MANUFACTURER

A. Inspection, Startup, and Field Adjustment: The service representative of the manufacturer shall be present continuously at the Site to furnish the services required by Section 43 20 00 – Pumps, General.

B. Instruction of OWNER's Personnel: The training representative of the manufacturer shall be present at the Site for 2 Days to furnish the services required by Section 43 20 00 – Pumps, General.

C. For the purposes of this paragraph, a Day is defined as an 8-hour period at the Site, excluding travel time.

D. The OWNER may require that the inspection, startup, and field adjustment services above be furnished in 3 separate trips.

END OF SECTION

SECTION 43 25 05

SUBMERSIBLE SUMP PUMPS

PART 1 -- GENERAL

1.01 THE SUMMARY

A. The CONTRACTOR shall provide submersible sump pumps and appurtenant WORK, complete and operable, in accordance with the Contract Documents.

B. Related Sections. See Related Sections for additional requirements applicable to this Section:

1. Section 09 90 00 – Protective Coatings
2. Section 26 05 10 – Electric Motors
3. Section 26 05 15 – Industrial Control Panels
4. Section 26 29 23 – Variable Frequency Drives
5. Section 40 50 06 – Pipe Couplings
6. Section 40 95 13 – Control Panels
7. Section 43 20 00 - Pumps, General
8. Section 43 30 52 – Miscellaneous Valves
9. Section 46 01 00 – Equipment General Provisions.

C. The Supplier shall examine the Site conditions, intended application, and operation of the pump system and recommend the pump that will best satisfy the indicated requirements.

1.02 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 43 20 00 – Pumps, General and the Standard Provisions.

PART 2 -- PRODUCTS

2.01 GENERAL DESCRIPTION

A. Identification:

RCENP01	Sludge Transfer Pump Station Sump Pump
RCENP02	Centrifuge Building B Polymer Dosing Area Sump Pump

B. Operating Conditions: The WORK of this Section shall be suitable for long term operation under the following conditions:

Duty	Intermittant
Drive	Constant speed
Ambient environment	Outdoor sump
Fluid service	Sludge
Fluid temperature, degrees F	40 to 70
Fluid pH range	6 to 8
Project site elevation, ft. a.s.l	380
Minimum available NPSH, ft absolute	34
Maximum dia. of spheres to pass, in.	1

C. Performance Requirements:

Equipment Number(s)	RCENP01	RCENP02
Design flow capacity, gpm	30	30
Design flow pump head, TDH ft	40	12
Design flow minimum pump efficiency, percent	40	40
Maximum motor size, hp	2	2
Motor Volts/Phases/Hz	115/1/60	115/1/60

2.02 PUMP REQUIREMENTS

A. Construction: Construction of submersible sump pumps shall conform to the following requirements:

Pump casing	Cast iron
Impeller	Semi-open, non-clog

Bearings	Permanently lubricated ball and sleeve type
Shaft	Stainless steel, series 400
Seal	Mechanical seal
Mounting Method	stainless steel chain and hook
Pump Connection	Flange

B. Drive: Enclosed, submerged, electric motor, suitable for 120 volt, single phase, 60 Hz ac power supply.

C. Coating: Pumps shall be coated in accordance with Section 09 96 00 – Protective Coatings.

2.03 PUMP CONTROLS

A. Pumps shall be controlled in accordance with Section 40 90 10 - Control Strategies.

B. For the Sludge Transfer Pump Station Sump Pump, the pumps shall be equipped with integral float switches for controlling pump start and stop. A separate high level float switch for the sump shall be furnished as part of, and as specified under, Division 40.

C. For the Centrifuge Building B Polymer Dosing Area Sump Pump, the pumps shall be equipped with integral float switches that alarm but do not automatically start/stop the pump. A separate high level float switch for the sump shall be furnished as part of, and as specified under, Division 40.

D. Each pump shall be supplied with a vendor-supplied control panel (VCP) and shall house all required controls, circuit breakers, motor starters, and contacts. The VCP shall have a HAND/OFF/AUTO hand switch to permit local operation of each pump, and indicator lights for RUN status and FAIL status. The VCP shall have dry contacts to provide remote monitoring via OWNER's PLC of all status signals as shown on the Contract Documents, which shall include at a minimum RUN status and FAIL status. The VCP shall satisfy the requirements of Section 26 05 15 – Industrial Control Panels, as applicable to non-hazardous areas.

2.04 MANUFACTURERS, OR EQUAL

A. **ABS Pumps, Inc.**

B. **Aurora Pumps**

C. **Yeomans-Morris-Chicago Pump Company**

D. **Crane-Deming**

E. **Flygt Corporation**

F. **Goulds Pumps Inc.**

G. **Pacific Pumping Company**

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Pumping equipment shall be installed in accordance with the Shop Drawings and as indicated.

B. General installation requirements shall be in accordance with Section 43 20 00 - Pumps, General.

END OF SECTION

SECTION 43 25 06

SUBMERSIBLE SOLIDS-HANDLING PUMPS

PART 1 -- PRODUCTS

1.01 THE SUMMARY

A. The CONTRACTOR shall provide submersible solids-handling pumps and appurtenant WORK, complete and operable, in accordance with the Contract Documents.

B. Related Sections. See Related Sections for additional requirements applicable to this Section:

1. Section 09 90 00 – Protective Coatings
2. Section 26 05 10 – Electric Motors
3. Section 26 05 15 – Industrial Control Panels
4. Section 26 29 23 – Variable Frequency Drives
5. Section 40 50 06 – Pipe Couplings
6. Section 40 95 13 – Control Panels
7. Section 43 20 00 - Pumps, General
8. Section 43 30 52 – Miscellaneous Valves
9. Section 46 01 00 – Equipment General Provisions.

C. The Supplier shall examine the Site conditions, intended application, and operation of the pump system and recommend the pump that will best satisfy the indicated requirements.

1.02 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 43 20 00 – Pumps, General and the Standard Provisions.

PART 2 -- GENERAL

2.01 GENERAL DESCRIPTION

A. Identification:

Name	Centrate Return Pumps
Equipment Number(s)	RCENP03, RCENP04
Quantity	2
Location	Centrate Wet Well B

B. Operating Conditions: The WORK of this Section shall be suitable for long term operation under the following conditions:

Duty	Continuous
Drive	Variable frequency drive
Ambient environment	Outdoors, submerged
Ambient temperature, degrees F	20 to 90
Ambient relative humidity, percent	10 to 100
Fluid service	Centrate, Thickened Sludge
Fluid % Dry Solids	0-4%
Fluid temperature, degrees F	40 to 60
Fluid pH range	6.5 to 7.5
Fluid specific gravity	1.00-1.05
Fluid viscosity (absolute), centipoises at 60 deg. F	1.00-1.03
Project site elevation, ft. a.s.l	370
Minimum available NPSH, ft absolute	34
Maximum size of spheres to pass, in. dia	2

C. Performance Requirements:

Maximum shutoff head, ft	120
Design flow capacity, gpm	800
Design flow pump head TDH, ft	60
Design flow minimum pump efficiency, percent	70
Minimum flow capacity at minimum speed, gpm	400
Minimum flow pump head TDH, ft	20
Maximum Pump speed, rpm	1770
Maximum Motor speed, rpm	1800
Minimum motor size, hp	20
Motor Voltage Requirements	480-volt, 3-phase, 60-Hz, AC

D. Pump Dimensions:

Pump discharge size, inches	6 or 8
Discharge flange rating, psi	125

2.02 PUMP REQUIREMENTS

A. General

1. Each pump shall be capable of continuous operation at full load with a water level of 36-inches above the invert of the wet pit, without cavitation or overheating of the motor.

2. Each pump, with its cable and appurtenances, shall be able to withstand continuous submergence to a minimum depth of 65-feet, whether running or off, without leakage.

3. Each pump shall be able to operate for short periods at zero static suction head without causing any damage to any part of the unit.

B. Construction: Construction of submersible solids-handling pumps shall conform to the following requirements:

Connections	Machined metal-to-metal quick disconnect type, for withdrawal of unit from above without disconnecting pipe. When lowered into place, the pump shall automatically connect and lock into the discharge pipe, allowing for zero leakage at all anticipated pump heads.
Pump Design	Single stage, centrifugal type, close-coupled to sealed or submersible electric motor, for operation in dry or wet pit, without external cooling.
Impeller	Maximum 3-port non-clog type with replaceable wear rings on impeller and in casing, to handle raw unscreened sewage, solids, and fibrous materials.
Bearings	Permanently-lubricated, heavy-duty axial and radial ball or roller bearings top and bottom, with a minimum L-10 life of 50,000 hours, at continuous, maximum load and speed, supported by detailed calculations, to be submitted with the Shop Drawings.
Seals	Dual mechanical tandem, one stationary and one revolving shaft seals with individual springs, tungsten carbide or silicon carbide ring, each not requiring any maintenance, and capable of withstanding 1.5 times pump shutoff head. The seals shall be oil lubricated, with moisture detector probes, alarm, and test circuits.
Oil Chamber	To supply oil for lubrication and cooling of the shaft seals.
Support	Cast duckfoot bend or discharge elbow with machined face, anchored to sump floor.
Cables	Include necessary cables for power connection, moisture detection, and overload protection, sheathed, coded, and suitable for submersible pumps, and of sufficient length for direct connection to the terminal boxes indicated. Cables shall be connected to the pumps and tested at the factory.
Lifting Devices	Type 316 stainless steel guide rails with brackets and stainless steel lifting system (Flygt Grip Eye or equal) of sufficient operating length, or with a stainless steel guide cable system with hooks and tension device, all rated at least 5 times the weight of the pump and motor.

C. Materials

Pump, volute, oil casing, sliding bracket, motor frame	Cast iron, ASTM A-48, Class 35 B
Impeller	Cast iron, statically and dynamically balanced
Pump shaft	Type 420 stainless steel, or 1045 carbon steel with Type 420 stainless steel sleeve
Exposed bolts, nuts, washers	Type 316 stainless steel
Mechanical seals	Independently operating tandem tungsten-carbide or silicon carbide and carbon rings with stainless steel springs
Wear rings	Type 304 or 416 stainless steel and nitrile rubber with steel insert, with a Brinnell hardness of 300 on impeller and 350 on case

2.03 MOTOR

A. **Approval**: The pumping system, including the motor and wiring, shall be approved by a nationally approved testing agency for explosion-proof service. The system shall be rated Class I, Division 1, Group C and D service as determined by the National Electric Code and approved by a nationally recognized testing agency (UL or FM) at the time of opening Bids. The CONTRACTOR shall include in the Bid a copy of the certificate of approval.

B. **Insulation**: The pump motors shall be designed for continuous duty in hazardous locations. The stator and stator leads shall be moisture-resistant, triple varnished and insulated according to Class F, capable of withstanding a temperature rise of up to 155 degrees C. The allowable temperature rise of the motor at full load condition shall not exceed 80 degrees C.

C. **Stator**: The motor stator shall be mounted in an air-filled, watertight casing and shall not be fixed in place by externally-mounted screws which may cause leakage in the motor.

D. **Motor Rating**: Motors shall have service factors of 1.10 or greater. For motors driven by variable frequency drives, motor horsepower shall be the greater of:

1. Non-overloading conditions throughout the pump curve.

2. 1.15 times the horsepower required by the pump at maximum indicated flow.

E. **Junction Box**: The motor shall have a junction box capable of being sealed completely from the stator casing to prevent leakage through the junction box into the stator housing should a motor cable be damaged or have some other means to prevent leakage into the junction box under any condition.

F. **Cable Entry**: The cable entry water seal design shall be such that it precludes specific torque requirements to ensure a watertight and submersible seal. It shall permit no entry of water into any high voltage area even if the cable is severed below the water level.

G. **Cooling System**: Each pump shall be provided with an adequately designed cooling system using a wastewater jacket and thermal radiator integrally cast with the stator casing. Cooling medium channels and ports shall be non-clogging by virtue of their dimensions. Wastewater jackets are not required for motors that are designed to operate continuously at full load with ambient cooling.

H. **Motor Protection**: Integral thermal sensors in the motors, one for each phase, shall be provided to monitor stator temperatures. These sensors shall be used in conjunction with and supplemented by external motor over-current protection located at the control panel.

2.04 PUMP CONTROLS

A. Pumps shall be controlled in accordance with Section 40 90 10 - Control Strategies.

2.05 SPARE PARTS

A. **General:** The pumps shall be backed by supplies of spare parts from stock, and after-sales service from a factory trained and authorized maintenance facility, located within 500 miles from the Site.

B. Parts to be Furnished

1. One set of mechanical shaft seals for each pump.

2. One set of wear rings for each pump.

3. One set of bearings for each pump and motor.

4. Three sets of O-rings and gaskets for each pump.

5. One submersible cable of required length, with termination kit, for each pump.

2.06 FACTORY TESTING AND SHIPMENT

A. In addition to the factory tests in Section 43 20 00, the following procedures shall be included with the factory test prior to shipment:

1. Verification of the pump characteristic curves by testing at 1/4, 1/2, 3/4, and full flow and recording the measured head and motor current for each flow.

2. Verification of cavitation-free service and absence of motor overheating during conditions simulating the actual operating conditions after installation, whether submerged, semi-submerged, or dry.

3. Pump seals shall be designed for complete water tightness at 65-feet submergence for 30 minutes and data on factory testing and quality control shall be submitted with the Shop Drawings.

4. Parts shall be properly lubricated and protected so that no damage or deterioration will occur even during a prolonged delay from the time of shipment until installation is completed and the pumps are ready for operation.

5. Finished ferrous surfaces not painted shall be properly protected to prevent rust and corrosion.

6. The finished surfaces of exposed flanges shall be protected by strong wooden blind flanges.

7. Each pump shall be properly crated to protect against damage during shipment.

2.07 PROTECTIVE COATING

A. Pumps shall be coated in accordance with Section 09 96 00 - Protective Coating.

2.08 MANUFACTURERS, OR EQUAL

A. **Ebara Pumps**

B. **Xylem Flygt**

C. **K.S.B. Pumps**

PART 3 -- EXECUTION

3.01 INSTALLATION

A. In addition to the requirements of Section 43 20 00, the CONTRACTOR shall ensure that anchor bolts are set only after the discharge piping has been properly installed, to ensure exact fit with embedded piping components.

3.02 SERVICES OF MANUFACTURER

A. Inspection, Startup, and Field Adjustment: The service representative of the manufacturer shall be present continuously at the Site to furnish the services required by Section 43 20 00 – Pumps, General.

B. Instruction of OWNER'S Personnel: The training representative of the manufacturer shall be present at the Site for 2 Days to furnish the services required by Section 43 20 00 – Pumps, General.

C. For the purposes of this paragraph, a Day is defined as an 8 hour period at the Site, excluding travel time.

D. The OWNER may require that the inspection, startup, and field adjustment services above be furnished in 2 separate trips.

END OF SECTION

SECTION 43 30 00

VALVES, GENERAL

PART 1 -- GENERAL

1.01 THE SUMMARY

A. Provide valves, actuators, and appurtenances, complete and operable, as indicated in accordance with the Contract Documents.

B. Related Sections. See Related Sections for additional requirements applicable to this Section:

1. Section 09 90 00 – Protective Coatings
2. Section 40 05 00 – Piping, General
3. Section 40 05 02 – Piping Identification
4. Section 40 50 06 – Pipe Couplings
5. Section 40 05 07 – Pipe Supports
6. Section 43 30 12 – Valve and Gate Actuators
7. Section 46 01 00 – Equipment General Provisions.

C. The provisions of this Section shall apply to all valves and valve actuators except where otherwise indicated.

D. Valves and actuators in particular locations may require a combination of units, sensors, limit switches, and controls, as indicated.

E. Support

1. Where a valve is to be supported by means other than the piping to which it is attached, obtain from the valve manufacturer a design for its support and foundation that satisfies the criteria in Section 46 01 00 – Equipment General Provisions.
2. Submit the support design, including drawings and calculations sealed by an engineer, with the Shop Drawings.

F. Unit Responsibility

1. The CONTRACTOR shall assign a single manufacturer to be responsible for the supply, coordination of design, assembly, testing, and furnishing of each valve; however, the CONTRACTOR shall be responsible to the OWNER for compliance with the requirements of each valve Section.

G. Single Manufacturer

1. Where 2 or more valves of the same type and size are required, the valves shall be furnished by the same manufacturer.

1.02 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with the requirements of the Standard Provisions.

B. Furnish the following information on Shop Drawings:

1. valve name, size, Cv factor, pressure rating, identification number (if any), and specification section number:

2. complete information on the valve actuator, hydraulic power units (HPU), pneumatic air supply system including size, manufacturer, model number, limit switches, and mounting:

3. cavitation limits for control valves:

4. assembly drawings showing part nomenclature, materials, dimensions, weights, and relationships of valve handles, hand wheels, position indicators, limit switches, integral control systems, needle valves, and control systems:

5. data in accordance with Section 26 05 10 – Electric Motors, for electric motor-actuated valves:

6. complete wiring diagrams and control system schematics; and,

7. A valve-labeling schedule, listing the valves to be furnished with stainless steel tags, indicating in each case the valve location and the proposed wording for the label.

C. Furnish an O&M manual containing operation, maintenance and other required information for proper care, operation, maintenance and repair of each valve and valve actuator.

D. Furnish a spare parts list, containing the required information for each valve assembly, as indicated.

E. Factory Test Data

1. Where indicated, submit signed, dated, and certified factory test data for each valve requiring certification, before shipping the valve.

2. Furnish a certification of quality and test results for factory-applied coatings.

F. Field Test Data

1. Submit signed, dated, and certified field test data for each valve.

PART 2 -- PRODUCTS

2.01 PRODUCTS

A. General

1. Provide valves and gates of new and current manufacture.

2. Provide valves 6-inch and larger with actuators with position indicators.

3. Unless otherwise indicated, provide valve actuators in accordance with Section 43 30 12 – Valve and Gate Actuators.

B. Protective Coating

1. Coat the exterior surfaces of valves and the wet interior surfaces of ferrous valves of sizes 2-inch and larger in accordance with the requirements of Section 09 96 00 – Protective Coating.

2. The valve manufacturer shall certify in writing that the required coating has been applied and tested in the manufacturing plant prior to shipment, in accordance with the indicated requirements.

3. Do not coat the machined flange faces of valves except where such flanges are not adjoining a mating flange as shown in the Contract Documents. Apply rust inhibitor coating on machined surfaces of the flange prior to shipment.

C. Valve Labeling

1. Except when such requirement is waived by the ENGINEER OF RECORED in writing, provide a label on shut-off valves and control valves except for hose bibbs and chlorine cylinder valves.

2. Furnish a label composed of 1/16-inch plastic or stainless steel, a minimum of 2 inches by 4 inches in size, as indicated in Section 40 05 02 – Piping Identification Systems, and permanently attached to the valve or on the wall adjacent to the valve as directed by the CONSTRUCTION MANAGER.

D. Valve Testing

1. As a minimum, unless otherwise indicated or recommended by the reference standards, test valves 3 inches in diameter and smaller in accordance with the manufacturer's standard procedure.

2. Factory-test valves 4 inches in diameter and larger as follows:

a. Hydrostatic Testing

1) Subject valve bodies to an internal hydrostatic pressure equivalent to twice the water-rated pressure of the valve.

2) Metallic valves rating pressures shall be based at 100 degrees F.

3) Plastic valves rating pressures shall be based at 73 degrees F, or at a higher temperature according to material type.

4) During the hydrostatic test, there shall be no visible leakage through the valve body, end joints, or shaft seals, nor shall parts of the valve be permanently deformed.

5) Allow test duration of at least 10 minutes, in order to allow visual examination for leakage.

b. Seat Testing

1) Test the valves for leaks in the closed position, with the pressure differential across the seat equal to the water rated pressure of the valve.

2) Provide test duration of at least 10 minutes, in order to allow visual examination for leakage.

3) The leakage rate shall be the more stringent of the following:

a) As recommended by the reference standard for that type of valve; or

b) Leakage past the closed valve not to exceed one fluid ounce per hour per inch diameter for metal seated valves, and drop-tight for resilient seated valves.

c. Performance Testing

1) Shop-operate the valves from the fully-closed to the fully-open position, and reverse under no-flow conditions in order to demonstrate that the valve assembly operates properly.

E. Certification

1. Prior to shipment of valves with sizes larger than 12-inches in diameter, submit certified, notarized copies of the hydrostatic factory tests, showing compliance with the applicable standards of AWWA, ANSI, or ASTM.

F. Valve Markings

1. Permanently mark valve bodies in accordance with MSS SP25 - Standard Marking Systems for Valves, Fittings, Flanges, and Unions.

2.02 MATERIALS

A. General

1. Provide materials suitable for the intended application.

2. Provide materials in contact with potable water listed as compliant with NSF Standard 61.

3. Ensure that materials not indicated are of high-grade standard commercial quality, free from defects and imperfections that might affect the serviceability of the product for the purpose for which it is intended.

4. Unless otherwise indicated, provide valve and actuator bodies conforming to the following requirements:

    a. Cast Iron: Close-grained gray cast iron, conforming to ASTM A 48 - Gray Iron Castings, Class 30, or to ASTM A 126 - Gray Iron Castings for Valves, Flanges, and Pipe Fittings

    b. Ductile Iron: ASTM A 536 - Ductile Iron Castings, or to ASTM A 395 - Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures

    c. Steel: ASTM A 216 - Steel Castings, Carbon Suitable for Fusion Welding for High-Temperature Service, or to ASTM A 515 - Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service

    d. Bronze: ASTM B 62 - Composition Bronze or Ounce Metal Castings, and valve stems not subject to dezincification shall conform to ASTM B 584 - Copper Alloy Sand Castings for General Applications. Bronze materials in contact with potable water service shall be free of lead content meeting the Lead Reduction Act.

    e. Stainless Steel: Stainless steel valve and operator bodies and trim shall conform to ASTM A 351 - Steel Castings, Austenitic, for High-Temperature Service, Grade CF8M, or shall be Type 316 stainless steel

    f. PVC: Polyvinyl chloride materials for valve body, flanges, and cover shall conform to Cell Classification 12454

    g. CPVC: Chlorinated Poly Vinyl Chloride materials for valve body, flanges, and cover shall conform to Cell Classification 23447

    h. NSF Standard 61: Materials shall be listed for use in contact with potable water.

    i. Elastomeric materials used for seat, seals and O-rings shall be compatible with temperature, pressures and fluid or gas service.

        1) Elastomeric materials for water with chloramines shall be Teflon or Viton-A.

        2) Elastomeric materials for water with dissolved ozone residual shall be Teflon suitable for ozone service.

        3) Elastomeric materials for oxygen (LOX or GOX) shall be Teflon specially manufactured and packaged suitable for oxygen service.

2.03 VALVE CONSTRUCTION

A. Bodies

1. Provide valve bodies that are cast, molded (in the case of plastic valves), forged, or welded, of the materials indicated, and with smooth interior passages.

2. Provide wall thicknesses uniform and in agreement with the applicable standards for each type of valve, without casting defects, pinholes, and other defects that could weaken the body.

3. Perform welds on welded bodies by certified welders and ground welds smooth.

4. Provide valve ends as indicated, and rated for the maximum temperature and pressure to which the valve will be subjected.

B. Valve End Connections

1. Unless otherwise indicated, valves 2-1/2 inches in diameter and smaller may be provided with threaded end connections.

2. Provide valves 3 inches in diameter and larger with flanged end connections.

3. Flanges, bolts and gaskets shall be as specified in Section 40 05 00 - Piping, General.

C. Bonnets

1. Connect valve bonnets to the body by clamping, screwing, or flanging.

2. Provide bonnets of the same material, temperature, and pressure rating as the body.

3. Make provisions for the stem seal with the necessary glands, packing nuts, and yokes.

D. Stems

1. Provide valve stems of the materials indicated, or, if not indicated, of the best commercially-available material for the specific service, with adjustable stem packing, O-rings, chevron V-type packing, or other suitable seal. Bronze materials in contact with potable water shall be NSF 61 approved and free of lead. Elastomeric materials shall be compatible with fluid service.

E. Stem Guides

1. Provide stem guides spaced with an L/R ratio not to exceed 200:1. Submit calculations for L/R ratios and guide spacing to the ENGINEER OF RECORED for review.

2. Stem guides shall have slotted holes and shall be adjustable in two directions.

3. Construct submerged stem guides from Type 316 stainless steel.

F. Internal Parts

1. Provide internal parts and valve trim as indicated for each individual valve.

2. Where not indicated, construct valve trim from Type 316 stainless steel or other material best-suited for the intended service.

G. Nuts and Bolts

1. Unless otherwise indicated, provide nuts and bolts on valve flanges and supports in accordance with the requirements of Section 05 50 00 – Miscellaneous Metalwork and Section 40 05 00 – Piping, General.

2.04 TORQUE TUBES

A. Submerged or buried valves with a remote gearbox and actuator shall be supplied with a torque tube to transfer torque from the actuator to the valve. Torque tubes shall be directly connected to the valve and the floor stand and gear actuator. Each torque tube and floor stand shall be sized to operate under the maximum service conditions for the valve. Unless otherwise indicated, torque tubes shall be made of schedule 40, steel pipe with epoxy coating suitable for the fluid service. Each submerged valve, torque tube, floor stand and actuator shall be pre-assembled and “matched marked” in the manufacturer’s shop to ensure proper fit when assembled in field.

2.05 Extension Shaft Stem

A. Valves mounted in dry areas with gearbox attached to the valve and with remote actuator shall be supplied with an extension shaft stem with universal joint attached to the gear and actuator. All components shall be sized to operate under the maximum service conditions for the valve. Unless otherwise indicated, shaft stem and universal joints shall be made of carbon steel with epoxy coating suitable for the fluid service. Each valve, shaft stem, floor stand and actuator shall be pre-assembled and “matched marked” in the manufacturer’s shop to ensure proper fit when assembled in field.

2.06 VALVE ACTUATORS

A. Valve actuators shall be as indicated and as specified in Section 43 30 12 – Valve and Gate Actuators

2.07 VALVE ACCESSORIES

A. Provide valves complete with the accessories required to provide a functional system.

2.08 SPARE PARTS

A. Furnish the required spare parts, suitably packaged and labeled with the valve name, location, and identification number.

B. Furnish the name, address, and telephone number of the nearest distributor for the spare parts of each valve.

C. Spare parts are intended for use by the OWNER, after expiration of the correction of defects period.

2.09 MANUFACTURERS

A. Valve manufacturers shall have a successful record of not less than 5 years in the manufacture of the indicated valves.

PART 3 -- EXECUTION

3.01 VALVE INSTALLATION AND TRIAL OPERATION

A. General

1. Install valves, actuating units, stem extensions, valve boxes, and accessories in accordance with the manufacturer's written instructions and as indicated.

2. Adequately brace gates in order to prevent warpage and bending under the intended use.

3. Firmly support valves in order to avoid undue stresses on the pipe.

B. Access

1. Install valves in a manner to provide easy access for actuation, removal, and maintenance, and to avoid interference between valve actuators and structural members, handrails, and other equipment.

C. Valve Accessories

1. Where combinations of valves, sensors, switches, and controls are indicated, properly assemble and install such items such that systems are compatible and operating properly.

2. Clearly note the relationship between interrelated items on Shop Drawing submittals.

D. Trial Operation

1. After installation, schedule trial operation witnessed by the CONSTRUCTION MANAGER and the OWNER representative.

2. All valves shall be cleaned thoroughly of all foreign materials and final adjustments made. The valves shall then be operated through one complete cycle from a fully closed position to a fully open position and back to a fully closed position to verify that the assembly is functional.

3. For control valves that operate in multiple operating scenarios, the CONTRACTOR shall simulate all operational scenarios including the hydraulic power units, pilot control system or pneumatic air supply system to demonstrate compliance to the specifications.

4. A field leakage test meeting the maximum allowable specified requirement shall be conducted.

5. Test certificate shall be signed by the valve manufacturer and the CONTRACTOR and shall be submitted to the CONSTRUCTION MANAGER.

END OF SECTION

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SECTION 43 30 12

VALVE AND GATE ACTUATORS

PART 1 -- GENERAL

1.01 THE SUMMARY

A. Provide valve and gate actuators and appurtenances, complete and operable, as indicated in accordance with the Contract Documents.

B. Related Sections. See Related Sections for additional requirements applicable to this Section:

1. Section 09 90 00 – Protective Coatings
2. Section 40 05 00 – Piping, General
3. Section 40 05 02 – Piping Identification
4. Section 40 50 06 – Pipe Couplings
5. Section 40 05 07 – Pipe Supports
6. Section 43 30 00 – Valves, General
7. Section 46 01 00 – Equipment General Provisions.

C. The provisions of this Section apply to valves and gates except where otherwise indicated in the Contract Documents.

D. Unit Responsibility

1. Make the valve or gate manufacturer responsible for the coordination of design, assembly, testing, and installation of actuators on the valves and gates; however, the CONTRACTOR shall be responsible to the OWNER for compliance of the valves, gates, and actuators with the Contract Documents.

E. Where 2 or more valve or gate actuators of the same type or size are required, the actuators shall be produced by the same manufacturer.

F. The requirements of Section 26 05 15 – Local Control Stations and Miscellaneous Electrical Devices apply to the WORK of this Section.

1.02 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with the requirements of the Standard Provisions and Section 43 30 00 – Valves, General.

B. Submit Shop Drawing information for actuators with the valve and gate submittals as a complete package.

C. Submit calculations showing dynamic seating and unseating torques versus the output torque of the actuator.

PART 2 -- PRODUCTS

2.01 GENERAL

A. Unless otherwise indicated, provide shut-off and throttling valves and externally actuated valves and gates with manual or power actuators.

B. Provide actuators complete and operable with mounting hardware, motors, gears, controls, wiring, solenoids, hand wheels, levers, chains, and extensions, as applicable.

C. Provide actuators with torque ratings equal to or greater than required for valve seating and dynamic torques, whichever is greater, and capable of holding the valve in any intermediate position between fully-open and fully-closed without creeping or fluttering.

D. Actuator torque ratings for butterfly valves shall be determined in accordance with AWWA C504 - Rubber-Seated Butterfly Valves.

E. Identify wires of motor-driven actuators by unique numbers.

F. Manufacturers

1. Where indicated, certain valves and gates may be provided with actuators manufactured by the valve or gate manufacturer.

2. Where actuators are furnished by different manufacturers, coordinate the selection to result in the fewest number of manufacturers possible.

G. Materials

1. Provide actuators of current models, of the best commercial quality materials, and liberally sized for the required torque.

2. Provide materials suitable for the environment in which the valve or gate is to be installed.

H. Actuator Mounting and Position Indicators

1. Securely mount actuators by means of brackets or hardware specially designed and sized for this purpose and of ample strength.

2. Cast the word "OPEN" on each valve or actuator, with an arrow indicating the direction to open in the counter-clockwise direction.

3. Equip gear and power actuators with position indicators.

4. Where possible, locate manual actuators between 48 and 60 inches above the floor or the permanent working platform.

I. Standards

1. Unless otherwise indicated and where applicable, provide actuators in accordance with AWWA C 542 - Electric Motor Actuators for Valves and Slide Gates.

J. Functionality

1. Coordinate electric, pneumatic, and hydraulic actuators with the power requirements of Division 26 – Electrical, and instrumentation equipment as indicated in Section 40 91 00 – Process Control and Instrumentation Systems.

K. Provide fasteners in accordance with the requirements of Section 05 50 00 – Miscellaneous Metalwork.

L. Provide coatings in accordance with the requirements of Section 09 96 00 – Protective Coating.

2.02 MANUAL ACTUATORS

A. General

1. Unless otherwise indicated, provide valves and gates with manual actuators.

2. Provide valves in sizes up to and including 4 inches with direct-acting lever or hand wheel actuators of the manufacturer's best standard design.

3. Provide valves and gates larger than 4-inch with gear-assisted manual actuators, with an operating pull of maximum 60 pounds on the rim of the hand wheel.

4. Provide buried and submerged gear-assisted valves, gates, gear-assisted valves for pressures higher than 250 psig, valves 30 inches in diameter and larger, and where indicated, with worm gear actuators, hermetically-sealed water-tight and grease-packed.

5. Valves 6-inch to 24-inch diameter may be provided with traveling-nut actuators, worm gear actuators, spur or bevel gear actuators, as appropriate for each valve.

B. Buried Valves

1. Unless otherwise indicated, provide buried valves with extension stems to grade, with square nuts or floor stands, position indicators, and cast-iron or steel pipe extensions with valve boxes, covers, and operating keys.

2. Where indicated, provide buried valves in cast-iron, concrete, or similar valve boxes with covers of ample size in order to allow operation of the valve actuators.

3. Permanently label the valve box covers as required by the local Utility Company or the ENGINEER.

4. Provide wrench-nuts in compliance with AWWA C 500 - Metal-Seated Gate Valves for Water Supply Service.

C. Chain Actuator

1. Provide manually-activated valves with the stem located more than 7 feet above the floor or operating level with chain drives consisting of sprocket-rim chain wheels, chain guides, and operating chains supplied by the valve manufacturer.

2. Construct the wheel and guide from ductile iron, cast iron, or steel.

3. Chains

a. Fabricate the chain from hot-dip galvanized steel or stainless steel, and extend to 5 feet, 6 inches above the operating floor level.

b. Provide an extra strong valve stem on chain-actuated valves in order to allow for the extra weight and chain pull.

c. Provide hooks for chain storage where chains interfere with pedestrian traffic.

D. Floor Boxes

1. Provide hot-dipped galvanized cast iron or steel floor boxes and covers to fit the slab thickness, for operating nuts in or below concrete slabs.

2. For operating nuts in the concrete slab, provide a bronze-bushed cover.

E. Tee Wrenches

1. Furnish buried valves with floor boxes with 2 operating keys or one key per 10 valves, whichever is greater.

2. Size the tee wrenches such that the tee handle will be 2 to 4 feet above ground, and to fit the operating nuts.

F. Design and rate buried gear actuators for buried service, provide with a stainless steel input shaft, and double-seal on shaft and top cap.

G. Traveling-Nut Actuator

1. Provide the actuator with a traveling-nut and screw (Scotch yoke), contained in a weatherproof cast iron or steel housing with a spur gear and a minimum 12-inch diameter hand wheel.

2. The screw shall run in 2 end bearings, and provide a self-locking actuator in order to maintain the valve position under any flow condition.

3. Construct the screw and gear from hardened alloy steel or stainless steel, and the construct the nut and bushings from alloy bronze.

4. The bearings and gear shall be grease-lubricated by means of nipples.

5. Design gearing for a 100 percent overload.

2.03 ELECTRIC MOTOR ACTUATORS

A. General

1. Equipment Requirements

a. Where electric motor actuators are indicated, attach an electric motor-actuated valve control unit to the actuating mechanism housing by means of a flanged motor adapter piece.

2. Gearing

a. Provide the motor actuator with the motor, reduction gearing, reversing starter, torque switches, and limit switches in a weather-proof NEMA 4 assembly.

b. Provide a single- or double-reduction unit, consisting of spur or helical gears and worm gearing.

c. Construct the spur or helical gears of hardened alloy steel, and the worm gear of alloy bronze.

d. Accurately cut gearing with hobbing machines.

e. Power gearing shall be grease- or oil-lubricated in a sealed housing.

f. Use ball or roller bearings throughout.

g. Actuator output speed changes shall be mechanically possible by simply removing the motor and changing the exposed or helical gearset ratio without further disassembly of the actuator.

3. Starting Device

a. Except for modulating valves, design the unit such that a hammer blow is imparted to the stem nut when opening a closed valve or closing an open valve.

b. The device shall allow free movement at the stem nut before imparting the hammer blow.

c. The actuator motor shall attain full speed before the stem load is encountered.

4. Switches

a. Electronic-Type Switches

1) Limit switches or valve position shall be sensed by a 15-bit, optical, absolute position encoder.

2) The open and closed positions shall be stored in a permanent, non-volatile memory.

3) The encoder shall measure valve position continuously, including both motor and hand wheel operation, with or without use of battery.

4) Provide an electronic torque sensor.

5) Provide an adjustable torque limit, from 40 to 100 percent of rating in one-percent increments.

6) The motor shall be de-energized if the torque limit is exceeded.

7) Provide a boost function in order to prevent torque-trip during initial valve unseating, and a “jammed valve” protection feature with automatic retry sequence in order to de-energize the motor if no movement occurs.

8) Provide valve actuators with electronic type switches as manufactured by **Limitorque, Rotork** or **Auma Actuators, Inc**.

b. The actuator shall be wired in accordance with the schematic diagram.

c. Connect wiring for external connections to marked terminals.

d. Provide one 1-inch and one 1-1/4 inch conduit connection in the enclosing case.

e. Mount a calibration tag near each switch, correlating the dial setting to the unit output torque.

f. Switches shall not be subject to breakage or slippages due to over-travel.

g. Do not use traveling-nuts, cams, or microswitch tripping mechanisms.

h. Provide limit switches of the heavy-duty, open contact type, with rotary wiping action.

5. Handwheel Operation

a. Provide a permanently attached handwheel for emergency manual operation.

b. The handwheel shall not rotate during electrical operation.

c. The maximum torque required on the handwheel under the most adverse conditions shall not exceed 60 lb-ft, and the maximum force required on the rim of the handwheel shall not exceed 60 lb.

d. Cast or permanently affix an arrow and either the word "OPEN" or "CLOSE" on the handwheel in order to indicate the appropriate direction to turn the handwheel.

e. Provide a clutch lever to put the actuator into handwheel operation.

f. Provide chain activator handwheels for valves with electric motor actuators having stems more than 7 feet above the floor.

g. Provide the clutch lever with a cable secured to the chain in order to allow disengagement for manual operation.

6. Motor

a. Provide a motor of the totally enclosed, non-ventilated, high-starting torque, low-starting current type, for full-voltage starting.

b. The motor shall be suitable for operation on 480 volt, 3 phase, 240 volt, single phase, 120 volt, single phase, or as indicated on electrical drawings, 60 Hz current, with Class F insulation and a motor frame with dimensions in accordance with the latest revised NEMA MG Standards.

c. The observed temperature rise by thermometer shall not exceed 55 degrees C above an ambient temperature of 40 degrees C, when operating continuously for 15 minutes under full-rated load.

d. With a line voltage ranging between 10 percent above to 10 percent below the rated voltage, the motor shall develop full-rated torque continuously for 15 minutes without causing the thermal contact protective devices imbedded in the motor windings to trip or the starter overloads to drop out.

e. Provide bearings of the ball type, and provide thrust bearings where necessary.

f. Provide the bearings with suitable seals in order to confine the lubricant and to prevent the entrance of dirt and dust.

g. Provide watertight motor conduit connections.

h. Motor construction shall incorporate the use of stator and rotor as independent components from the valve operation such that the failure of either item shall not require actuator disassembly or gearing replacement.

i. Provide two Class B thermal contacts or solid-state thermistors embedded within the motor windings in order to protect against over-temperature damage.

j. Provide the motor with a space heater suitable for operation on a 120-volt, single-phase, 60-Hz circuit, unless the entire actuator is of a hermetically sealed, non-breathing design with a separately sealed terminal compartment which prevents moisture intrusion.

k. Provide each electric motor actuator with a local disconnect switch or circuit breaker in order to isolate power from the motor and controller during maintenance activities.

7. Open/Close Operating Speed

    a. Unless otherwise indicated, electric actuators shall provide a full-close-to-full-open or full-open-to-full-close operating time range from 30 to 60 seconds.

8. Elevated Valves

    a. For valves with electric motor actuators where the valve centerline is located at a height greater than 6 feet above the floor, provide a remote actuator control station at a location no higher than 4 feet above the floor.

    b. Provide conduit and wiring between the actuator controls and the valve actuator for these applications.

    c. Wall-mount the actuator controls beneath the valve at a location approved by the ENGINEER OF RECORD.

B. Electric Motor Actuators (AC Reversing Control Type)

1. General

    a. Where indicated, electric motor actuators shall be the AC reversing type complete with local control station with OPEN/CLOSE and LOCAL/AUTO/REMOTE selector switches.

2. Actuator Appurtenances

    a. Provide the actuator for each valve with: OPEN and CLOSE status lights; OPEN, CLOSE, and LOCKOUT/STOP push buttons; and, other indicated devices.

3. Starter

    a. Provide a suitably sized amperage-rated reversing starter with its coils rated for operation on 480-volt, 3-phase, 60-Hz current.

    b. Provide a control power transformer in order to provide a 120-volt source, unless otherwise indicated.

    c. Equip the starter with 3 overload relays of the automatic reset type, and wire the control circuit as indicated.

    d. The integral weatherproof compartment shall contain a suitably sized 120-volt AC, single-phase, 60-Hz space heater in order to prevent moisture condensation on electrical components.

    e. Provide a local power disconnect switch and a close-coupled, padlockable switch with each actuator.

4. Local Control Station

   a. Provide each actuator with a local control station along with the valve actuator assembly.

   b. The station shall include OPEN, CLOSE, and STOP push buttons, and a LOCAL/REMOTE selector switch.

   c. Where indicated on the Instrumentation Drawings, provide a 2-wire control system as indicated above.

   d. The local control station and local power disconnect may be provided as an integral part of the actuator, or as otherwise indicated or required in order to permit operation by a person at floor elevation and within sight of the valve actuator.

5. Electric Motor Actuators (AC Reversing Control Type) Manufacturer, or Equal

   a. **Auma Actuators, Inc**.

   b. **Limitorque Corp**

   c. **Rotork**

C. Electric Motor Actuators (AC Modulating Control Type)

1. General

   a. Where indicated, modulating electric motor actuators shall be of the AC-modulating type, provided complete with a local control station with power disconnect switch or circuit breaker, LOCAL/REMOTE switch, non-latching OPEN/CLOSE pushbuttons, and OPEN/CLOSE status lights

2. Actuator Appurtenances

   a. Provide the actuator for each valve with: a padlockable disconnect switch; OPEN and CLOSED status lights; OPEN, CLOSE, and LOCKOUT/STOP pushbuttons; a LOCAL/REMOTE selector switch; and, other indicated devices.

3. Control Module

   a. Provide a control module of the electronic solid-state AC type, with control outputs for positioning the valve via 4 to 20 ma input signals.

4. Starter

   a. The actuator shall control a solid-state reversing starter designed for minimum susceptibility to power line surges and spikes.

   b. The solid-state starter and control module shall be rated for continuous modulating applications.

c. The power supply shall be 480-volt, 3-phase, 60-Hz.

d. Provide a disconnect switch with each actuator.

5. Construction

a. The control unit shall be microprocessor-based and shall contain an analog/digital converter, separate input-output switches, non-volatile random access memory for storage of calibration parameters, and push-button calibration elements for field setup.

b. Potentiometer adjustments shall contain a PID control function internally.

c. The controller shall contain as a standard feature a loss-of-command signal protection selectable to lock in last or lock in pre-set valve position and a valve position output signal in 4 to 20 ma.

d. As an alternative to the construction requirement, provide a motor capable of modulating at a rate of 600 starts per hour at the 50-percent to 85-percent travel range of the valve.

e. The system shall allow the control of the open, close, or percent open function when the LOCAL/REMOTE switch is in the REMOTE position.

f. Provide each actuator with a frequency shut-down system, which when pre-programmed shall function as directed upon receipt of an ESD signal.

6. Electric Motor Actuators (AC Modulating Control Type) Manufacturer, or Equal

a. **Limitorque**

b. **Rotork**

c. **Auma Actuators, Inc.**

D. 120 V Quarter-Turn and Multi-Turn Electric Valve Operators (6-Inches and Smaller)

1. Provide 120-volt, single-phase, motor-operated valve operators suitable for use with quarter-turn ball valves, multi-turn diaphragm valves, and multi-turn globe valves.

2. Provide operators with the following characteristics and features:

a. reversing capacitor-start motor rated for operation on 120 VAC, 60 Hz, single-phase;

b. output torque as required for valve application and pressure differential;

c. integral motor overload protection, with auto-reset;

d. permanently-lubricated gear train;

e. OPEN/CLOSE Control

1) For OPEN/CLOSE control, provide 4 single-pole, double-throw cam-actuated limit switches (2 OPEN, 2 CLOSED);

2) Use one set of limit switches for both motor control and local indication;

3) Make the other set available for connection to remote monitoring;

4) Provide adjustable limit switch contacts rated for not less than 5 amps at 120 VAC;

f. Local Control Station: OPEN/CLOSE

1) corrosion-resistant, NEMA 4X, for mounting near valve actuator;

2) Provide 2-position selector switch for LOCAL/REMOTE selection and 2 pushbuttons, OPEN and CLOSE;

3) Provide OPEN and CLOSE indicating lights operating at 120 VAC for connection to valve control limit switches;

g. Modulating Control

1) For modulating control, provide an electronic positioner and feedback potentiometer;

2) The positioner shall use a 4 to 20 ma signal to adjust the valve opening;

3) Feedback potentiometer shall be 0 to 1000 ohms;

h. Local Control Station Modulating

1) corrosion resistant, NEMA 4X, for mounting near valve actuator;

2) Provide 2-position selector switch for LOCAL/REMOTE selection, one OPEN and one CLOSE push button, a resistance-to-current converter with 4 to 20 ma output, and a zero to 100 percent electronic valve position indicator; and,

i. Disconnect Switch

1) Provide a local power disconnect switch, NEMA 4X, for disconnecting the 120 VAC power to the valve; and,

2) Install the disconnect in the field within sight of the valve actuator, in accordance with the requirements of NPFA 70.

3. Refer to the Drawings for the control diagram wiring interface.

4. Two-wire control systems are not required for this actuator.

5. 120 V Quarter-Turn and Multi-Turn Electric Valve Operators (6-Inches and Smaller) Manufacturer, or Equal

    a. **Rotork**

    b. **RCS**

    c. **Asahi/America, Quarter Master**

PART 3 --

PART 3 -- EXECUTION

3.01 SERVICES OF MANUFACTURER

A. Field Adjustments

1. The adjustment of actuator controls and limit switches in the field for the required function shall be performed by field representatives of the manufacturers of valves or gates with pneumatic, hydraulic, or electric actuators.

3.02 INSTALLATION

A. Install valve and gate actuators and accessories in accordance with the requirements of Section 43 30 00 – Valves, General.

B. Locate the actuators to be readily accessible for operation and maintenance without obstructing walkways.

C. Do not mount actuators where shock or vibrations will impair their operation, and do not attach the support systems to handrails, process piping, or mechanical equipment.

END OF SECTION

SECTION 43 30 14

BUTTERFLY VALVES

PART 1 -- GENERAL

1.01 THE SUMMARY

A. The CONTRACTOR shall provide butterfly valves and appurtenances, complete and operable, in accordance with the Contract Documents.

B. Related Sections. See Related Sections for additional requirements applicable to this Section:

1. Section 09 90 00 – Protective Coatings
2. Section 40 05 00 – Piping, General
3. Section 40 05 02 – Piping Identification
4. Section 40 50 06 – Pipe Couplings
5. Section 40 05 07 – Pipe Supports
6. Section 43 30 00 – Valves, General
7. Section 43 30 12 – Valve and Gate Actuators
8. Section 46 01 00 – Equipment General Provisions.

1.02 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 43 30 00 – Valves, General and requirements of the Standard Provisions.

B. Shop Drawings

1. Complete Shop Drawings of butterfly valves and actuators.
2. Drawings showing valve port diameter complete with dimensions, part numbers, and materials of construction.
3. Dynamic seating and unseating torque for motor actuated valves.
4. Certified statement of proof-of-design tests from the valve manufacturer. Valve manufacturer shall state that the valves proposed for this project will be manufactured with identical basic type of seat design and materials of construction to the prototype evaluated under the proof of design testing.
5. Manufacturer's certification that the valve complies with applicable provisions of AWWA C504 – Rubber-Seated Butterfly Valves.

1.03 QUALITY ASSURANCE

A. Valves shall be subjected to performance, leakage, and hydrostatic tests in accordance with procedures and acceptance criteria established by AWWA C504.

PART 2 -- PRODUCTS

2.01 RUBBER SEATED BUTTERFLY VALVES 25 TO 150 PSI (AWWA)

A. General: Butterfly valves for steady-state water working pressures and steady-state differential pressure up to 150 psi and for fresh water service having a pH range from 6 to 10 and temperature range from 33 to 125 degrees F shall conform to AWWA C504 and be as indicated. Valves subjected to steady state working pressures and steady state differential pressures from 25 to 150 psi in sizes 3-inches through 24-inches shall be rated for Class 150B with actuator sized for Class 150B. Valves 30 inches through 72-inches shall be of the class indicated. Valves larger than 72-inches shall be of the class indicated, designed in accordance with the intent of AWWA C504. If the operating conditions such as flow, velocity, and differential pressures are not indicated, the valve body and shaft shall be sized for the pressure class rating of the valve.

B. Valves shall be of the body type, pressure class, end joint, and actuator indicated.

C. Construction: Unless otherwise indicated, materials of construction shall be in accordance with AWWA C504, suitable for the service. Seats shall be positively clamped or bonded into the disc or body of the valve, but cartridge-type seats that rely on a high coefficient of friction for retention shall not be acceptable. Seat material shall be guaranteed to last for at least 75 percent of the number of cycles in the AWWA C504 proof-of-design test without premature damage.

Description	Material Standards
Valve bodies	Gray iron, ASTM A 48, Class 40 or Gray iron, ASTM A 126, Class B, or Ductile iron, ASTM A 536, grade 65-45-12 or 70-50-05 Alloy gray iron, ASTM A 436, Type1 or 2, or ASTM A 439, Type D2, with minimum lead content of 0.003 percent
End flanges	Same material as valve bodies
Valve shafts	Stainless steel ASTM A 240 or A 276, Type 316
Valve discs	Same material as valve bodies.
Rubber seats	New natural or synthetic rubber
Seat mating surfaces	Stainless steel, ASTM A 240 or A 276, Type 316
Clamps and retaining rings	Type 316 retaining rings and cap screws.

Valve bearings	Self lubricating materials per AWWA C504
Shaft seals	Resilient non-metallic materials suitable for service
Painting and coating	Refer to Section 09 96 00 – Protective Coating

D. Manual Actuators: Unless otherwise indicated, manually-actuated butterfly valves shall be equipped with a handwheel and 2-inch square actuating nut and position indicator. Screw-type (traveling nut) actuators will not be permitted for valves 30-inches in diameter and larger.

E. Worm Gear Actuators: Submerged and buried valves shall be equipped with worm-gear actuators, lubricated and sealed to prevent entry of dirt or water into the housing.

F. Electric Actuators: Electric actuators shall meet the requirements of AWWA C540. Electric actuators in open and close service shall be rated to produce output torque of at least 1.5 times the required valve maximum seating or maximum dynamic torque, whichever is greater. For valves in modulating service with dynamic torque exceeding the seating torque, the rated output torque of the actuator shall be twice the dynamic torque required by the valve. Actuator rated torque is defined as pullout torque rated at 10 percent below the rated voltage of the motor. The torque switch shall be field set at no greater than 60 percent and 50 percent of the maximum actuator rated torque for open/close service and modulating service, respectively. After plant startup, the manufacturer shall prepare a certification including a torque curve to demonstrate that the torque requirements have been met.

G. Manufacturers, or Equal

1. **DeZURIK Water Controls, Corporation**
2. **Kennedy Valve**
3. **M & H Valve Company**
4. **Mueller Company**
5. **Henry Pratt Company**
6. **Rodney Hunt Company** (24-inches and larger)

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Exposed butterfly valves shall be installed with a means of removing the complete valve assembly without dismantling the valve or operator. Installation shall be in accordance with Section 43 30 00 – Valves, General.

END OF SECTION

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SECTION 43 30 16

CHECK VALVES

PART 1 -- GENERAL

1.01 THE SUMMARY

A. The CONTRACTOR shall provide check valves and appurtenances, complete and operable, in accordance with the Contract Documents.

B. Related Sections. See Related Sections for additional requirements applicable to this Section:

1. Section 09 90 00 – Protective Coatings
2. Section 40 05 00 – Piping, General
3. Section 40 05 02 – Piping Identification
4. Section 40 50 06 – Pipe Couplings
5. Section 40 05 07 – Pipe Supports
6. Section 43 30 00 – Valves, General
7. Section 43 30 12 – Valve and Gate Actuators
8. Section 46 01 00 – Equipment General Provisions.

1.02 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 43 30 00 – Valves, General and requirements of the Standard Provisions.

PART 2 -- PRODUCTS

2.01 SWING CHECK VALVES (3-INCHES AND LARGER)

A. General: Swing check valves for water, sewage, sludge, and general service shall be of the outside lever and spring or weight type, in accordance with AWWA C 508 - Swing-Check Valves for Waterworks Service, 2-in. through 24-in. NPS, unless otherwise indicated, with full-opening passages, designed for a water-working pressure of 150 psi. Units shall have a flanged cover piece to provide access to the disc. Where indicated, swing check valves shall be provided with position indicators.

B. Body: The valve body and cover shall be of cast iron conforming to ASTM A 126 - Gray Iron Castings for Valves, Flanges, and Pipe Fittings, with flanged ends conforming to ASME B 16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800, or be mechanical joint ends, as indicated.

C. Disc: The valve disc shall be of cast iron, ductile iron, or bronze conforming to ASTM B 584 - Copper Alloy Sand Castings for General Applications.

D. Seat and Rings: The valve seat and rings shall be of bronze conforming to ASTM B 584 or B 148 - Aluminum-Bronze Castings or of Buna-N.

E. Hinge Pin: The hinge pin shall be of bronze or stainless steel.

F. Dashpot: Dashpot shall be provided where noted on the valve schedule. A bottom-mounted or side-mounted hydraulic dashpot shall be provided to prevent reverse flow and to alleviate water hammer during the closing cycle of the valve. The dashpot shall have 2 stage closing rates: For the 2 stage closing rate, the first stage shall be adjustable from 100 to 10 percent. The second stage shall be adjustable from 10 to zero percent. Each rate shall be infinitely and independently field adjustable depending on the system requirement. The dashpot shall be a self-contained oil system separate and independent from the pipeline fluid. The oil reservoir for the closing cycle shall be stainless steel, open to the atmosphere with an air breather cap to allow oil level changes in the reservoir and also to prevent contamination of the oil from any outside source. The oil reservoir for the opening cycle shall be stainless steel, be hermetically sealed to contain pressure (air over oil), and shall be equipped with a 3-inch diameter pressure gauge and pneumatic fill valve. There shall be a provision for disconnecting the each dashpot from the valve for servicing, without removal of the valve.

G. Manufacturers, or Equal

1. **APCO (Valve and Primer Corp.)**

2. **Kennedy Valve**

3. **Mueller Company**

4. **Stockham Valves and Fittings**

5. **Golden Anderson**

2.02 SWING CHECK VALVES (2-1/2 INCHES AND SMALLER)

A. General: Swing check valves for steam, water, oil, or gas in sizes 2-1/2 inches and smaller shall be suitable for a steam pressure of 150 psi and a cold water pressure of 300 psi. Units shall have screwed ends unless otherwise indicated, and screwed caps.

B. Body: The valve body and cap shall be of bronze conforming to ASTM B 763 - Copper Alloy Sand Castings for Valve Application, or ASTM B 584 with threaded ends conforming to ASME B1.20.1 - Pipe Threads, General Purpose (inch).

C. Disc: Valves for steam service shall have bronze or brass discs conforming to ASTM B 16 - Free-Cutting Brass Rod, Bar, and Shapes for Use in Screw Machines, and for cold water, oil, and gas service replaceable composition discs.

D. Hinge Pin: The hinge pins shall be of bronze or stainless steel.

E. Manufacturers, or Equal

1. **Crane Company**

2. **Milwaukee Valve Company**

3. **Stockham Valves and Fittings**

4. **Wm. Powell Company**

2.03 INTERNAL SPRING-LOADED CHECK VALVES (GLOBE STYLE)

A. General: Internal spring-loaded check valves for water pumps, compressors, gas, air, and steam shall be of the full-flow internal spring-loaded poppet type. The valves shall be designed for a water-working pressure of not less than 150 psi unless otherwise indicated.

B. Body: The bodies of valves 3-inches and larger shall be of cast iron conforming to ASTM A 126 with 125 lb flanged ends conforming to ASME B 16.1 unless otherwise indicated. Where necessary, there shall be a positive, watertight seal between the removable seat and the valve body. The stem guide shall be integrally cast with the body or screwed into the body.

C. Valves smaller than 3-inches shall have bronze bodies with screwed ends conforming to ASME B 1.201, suitable for a minimum working pressure of 200 psi, and a temperature of 250 degrees F, unless otherwise indicated. The type of bronze shall be suitable for the intended service.

D. Disc and Stem: The disc and stem of all valves in sizes 3-inches and larger shall be of bronze conforming to ASTM B 584 - Copper Alloy Sand Castings for General Applications, or stainless steel. The stem shall have 2 point bearings. The downstream bearing shall have a bronze or other suitable bushing, to provide a smooth operation.

E. Valves smaller than 3-inches shall have discs and retaining rings of Teflon, nylon, or other suitable material, and stems of bronze, brass, or stainless steel, suitable for the intended service.

F. Stem Guide: The stem guide shall be either firmly fixed in the valve body to prevent it from sliding into the adjacent pipe and damaging the pipe lining, or the valve manufacturer shall provide each valve with one matching flange compatible with the adjacent pipe and its lining to prevent damage to the lining. The compatible flange shall be part of the Shop Drawing submittal.

G. Seat: Valves for general service at temperatures up to 250 degrees F shall have bubble-tight shut-off with resilient seats of Buna-N, Teflon, or other suitable material. Valves for steam service and temperatures over 250 degrees F shall have metal-to-metal seating of bronze or stainless steel, as recommended by the manufacturer for the specific service condition. Resilient seats shall be firmly attached to the seating ring by compression molding or other acceptable method.

H. Spring: Valves in sizes 3-inches and larger shall have Type 316 stainless steel springs, and valves smaller than 3-inches shall have stainless steel or beryllium copper springs, as suitable for the service. The spring tension of the valves shall be designed for the individual pressure condition of each valve.

I. Manufacturers, or Equal

1. **APCO (Valve and Primer Corp.)**

2. **CPV (Combination Pump Valve Company)**

3. **Miller Valve Co., Inc.**

4. **VAL-MATIC (Valve and Manufacturing Corporation)**

2.04 PLASTIC BALL CHECK VALVES

A. General: Plastic ball check valves for corrosive fluids, in sizes up to 4-inches, shall be used for vertical up-flow conditions only, unless the valves are provided with spring actions.

B. Construction: The valve bodies and balls shall be of polyvinyl chloride (PVC), chlorinated polyvinyl chloride (CPVC), polyvinylidene fluoride (PVDF), or polypropylene (PP) construction, as best suited for each individual service condition. They shall have unions with socket connections or flanged ends conforming to ASME B16.5 - Pipe Flanges and Flanged Fittings, class 150. Seals shall have Viton O-rings, and valve design shall minimize possibility of the balls sticking or chattering. The valves shall be suitable for a maximum working non-shock pressure of 150 psi at 73 degrees F.

C. Manufacturers, or Equal

1. **ASAHI-AMERICA**

2. **George Fischer, Inc.**

3. **NIBCO Inc. (Chemtrol Division)**

4. **Spears Mfg. Co.** (PVC, CPVC, AND PP only)

PART 3 -- EXECUTION

3.01 GENERAL

A. Valves shall be installed in accordance with provisions of Section 43 30 00 - Valves, General.

END OF SECTION

SECTION 43 30 18

BALL VALVES

PART 1 -- GENERAL

1.01 THE SUMMARY

A. The CONTRACTOR shall provide ball valves and appurtenances, complete and operable, in accordance with the Contract Documents.

B. Related Sections. See Related Sections for additional requirements applicable to this Section:

1. Section 09 90 00 – Protective Coatings
2. Section 40 05 00 – Piping, General
3. Section 40 05 02 – Piping Identification
4. Section 40 50 06 – Pipe Couplings
5. Section 40 05 07 – Pipe Supports
6. Section 43 30 00 – Valves, General
7. Section 43 30 12 – Valve and Gate Actuators
8. Section 46 01 00 – Equipment General Provisions.

1.02 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 43 30 00 - Valves, General and requirements of the Standard Provisions.

PART 2 -- PRODUCTS

2.01 BALL VALVES (6-INCHES AND LARGER)

A. Construction: Unless otherwise indicated, ball valves shall be in accordance with AWWA C507 - Standard for Ball Valves 6-inches through 48-inches (resilient seated), API 6D - Specification for Pipeline Valves (resilient seated), or API 607 - Fire Test for Soft-Seated Valves (resilient seated), with cast iron, ductile iron, or cast steel bodies, flanged ends, suitable for velocities up to 35 fps, temperatures up to 125 degrees F, and design pressures to 150 psi. The balls shall be of cast iron, ductile iron, or cast steel, shaft- or trunnion-mounted, with tight shut-off, single or double seat, and full bore. The valves shall be rubber-, soft- (nylon, teflon, polymer, or similar), or metal-seated, with stainless steel, forged steel, or monel shafts or trunnions, and not less than one thrust bearing. The valves shall see a minimum differential pressure of 100 psi.

B. Actuators: Unless otherwise indicated, ball valves shall have manual actuators with handwheel, position indicator, and 2-inch square operating nut. Operators for buried valves and for power-actuated valves shall be in accordance with provisions of Section 43 30 12 - Valve and Gate Actuators.

C. Manufacturers, or Equal

1. **Apco/Willamette**
2. **GA Industries, Inc.**
3. **Grove Valve and Regulator Company**
4. **Neles-Jamesbury, Inc.**
5. **NIBCO, Inc.**
6. **Henry Pratt Company**

2.02 METAL BALL VALVES (4-INCHES AND SMALLER)

A. General: Unless otherwise indicated, general purpose metal ball valves in sizes up to 4-inches shall have actuators in accordance with Section 43 30 12 - Valve and Gate Actuators.

B. Body: Ball valves up to and including 1-1/2 inches in size shall have bronze or carbon steel 2 or 3 piece bodies with screwed ends for a pressure rating of not less than 600 psi WOG. Valves 2-inches to 4-inches in size shall have bronze or carbon steel 2 or 3 piece bodies with flanged ends for a pressure rating of ANSI 125 psi or 150 psi unless otherwise indicated.

C. Balls: The balls shall be solid chrome-plated brass or bronze, or stainless steel, with standard port (single reduction) or full port openings.

D. Stems: The valve stems shall be of the blow-out proof design, of bronze, stainless steel, or other acceptable construction, with reinforced teflon seal.

E. Seats: The valve seats shall be of teflon or Buna-N, for bi-directional service and easy replacement.

F. Manufacturers, or Equal

1. **Conbraco Industries, Inc. (Apollo)**
2. **ITT Engineered Valves**
3. **Neles-Jamesbury, Inc.**
4. **Watts Regulator**

5. **Worcester Controls**

2.03 PLASTIC BALL VALVES

A. General: Plastic ball valves for corrosive fluids shall be made of polyvinyl chloride (PVC), chlorinated polyvinyl chloride (CPVC), polypropylene (PP), or polyvinylidene fluoride (PVDF), as recommended by the manufacturer for the specific application. Valves shall have manual actuators in accordance with Section 43 30 12 - Valve and Gate Actuators, unless otherwise indicated.

B. Construction: Plastic ball valves shall have union ends or flanged ends to mate with ANSI B 16.5, class 150 flanges for easy removal. The balls shall have full size ports and teflon seats. Body seals, union O-ring seals, and stem seals shall be in accordance with the corrosion resistance requirements of Section 46 30 00 – Chemical Feeding Equipment, General. External (without entering into the wetted area) seat packing adjustment is preferred. Metal reinforced stems to prevent accidental breakage are preferred. Ball valves for sodium hypochlorite solution service shall be drilled through the ball or body per valve manufacturer recommendation to relieve offgas and equalize pressure across the valve. The valves shall be suitable for a maximum working non-shock pressure of 150 psi at 73 degrees F for PVC and CPVC, with decreasing ratings for higher temperatures and other plastics.

C. Manufacturers, or Equal

1. **ASAHI-America**
2. **George Fischer, Inc.**
3. **NIBCO Inc., (Chemtrol)**
4. **Plast-O-Matic Valves, Inc.**
5. **Spears Mfg. Co.**
6. **Watts Regulator**

PART 3 -- EXECUTION

3.01 GENERAL

A. Valves shall be installed in accordance with Section 43 30 00 – Valves, General. Care shall be taken that valves in plastic lines are well supported at each end of the valve.

END OF SECTION

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SECTION 43 30 22

GATE VALVES

PART 1 -- GENERAL

1.01 THE SUMMARY

A. The CONTRACTOR shall provide gate valves and appurtenances, complete and operable, in accordance with the Contract Documents.

B. Related Sections. See Related Sections for additional requirements applicable to this Section:

1. Section 09 90 00 – Protective Coatings
2. Section 40 05 00 – Piping, General
3. Section 40 05 02 – Piping Identification
4. Section 40 50 06 – Pipe Couplings
5. Section 40 05 07 – Pipe Supports
6. Section 43 30 00 – Valves, General
7. Section 43 30 12 – Valve and Gate Actuators
8. Section 46 01 00 – Equipment General Provisions.

1.02 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 43 30 00 – Valves, General and requirements of the Standard Provisions.

PART 2 -- PRODUCTS

2.01 GENERAL

A. Buried valves shall be of the inside screw, non-rising stem type. The valve actuators shall be as indicated, with counter-clockwise opening stems, in accordance with Section 43 30 12 – Valve and Gate Actuators.

B. Gate valves 18-inches and larger shall be provided with a bypass line and isolation valve.

2.02 METAL-SEATED GATE VALVES (3-INCHES AND LARGER)

A. Construction: Metal-seated gate valves for water and sewage service shall conform to AWWA C 500 - Metal-Seated Gate Valves for Water Supply Service. The valve bodies shall be of cast iron conforming to ASTM A 126 - Gray Iron Castings for Valves, Flanges, and Pipe Fittings, or ductile iron conforming either to ASTM A 395 - Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures, or to ASTM A 536 -

Ductile Iron Castings, with flanged, bell and spigot, or mechanical joint-ends as indicated. Body and bonnet wall thickness shall be equal to or greater than the minimum wall thickness as listed in Table 2 of AWWA C500. The design working water pressure shall be 200 psig for valves 12-inches and smaller and 150 psig for larger valves. The valves may be of the double-disc type for tighter shut-off, or of the solid-wedge type, with rising or non-rising stem. For sewage or fluids containing solids, an outside thread shall be used. Valves 14-inches and larger installed in vertical pipes shall be fitted with bronze slides, tracks, rollers, and scrapers to assist the travel of the gate assembly. Gate valves 14-inches and larger shall be furnished with bypass assemblies.

B. Actuators: Unless otherwise indicated, gate valves shall have manual actuators in accordance with Section 43 30 12 – Valve and Gate Actuators.

C. Manufacturers, or Equal

1. **Clow Valve Co.**

2. **Kennedy Valve**

3. **M & H Valve Company**

4. **Milwaukee Valve Company, Inc.**

2.03 KNIFE-GATE VALVES (2- TO 96-INCH)

A. Construction: Knife-gate valves shall be of the flanged or wafer design, with raised face and resilient seats for positive seating. Wetted parts shall be constructed of Type 316 stainless steel, and the gates shall be finish-ground on both sides to prevent packing or seat damage. Valves 2- to 12-inches in size shall be furnished with cast stainless steel bodies; valves 14-inches and larger shall have semi-steel bodies with stainless steel linings. The valve stem shall be of stainless steel with a long life packing. The valves shall be rated for tight shut-off at the following pressures:

1. Valve sizes 4- to 12-inches 150 psi (bi-directional)

2. Valve sizes larger than 12-inches 50 psi

B. Actuators: Knife-gates shall have outside-screw and yoke-rising stems with manual handwheel actuators, unless otherwise indicated, in accordance with Section 43 30 12 – Valve and Gate Actuators.

C. Manufacturers, or Equal

1. **DeZURIK Water Controls Corporation**

2. **Fabri-Valves**

3. **Rovang, Inc.**

2.04 RESILIENT-SEATED GATE VALVES

A. General: Resilient-seated gate valves may be provided in lieu of metal-seated double-disc or solid-disc gate valves, at the discretion of the ENGINEER OF RECORD.

B. For 250-psig applications, consult the valve manufacturer and revise this Section accordingly.

C. Construction: Resilient-seated gate valves shall conform to AWWA C515 - Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service. The valves shall be suitable for a minimum design working water pressure of 150 psig, with flanged, bell and spigot, or mechanical joint ends. The valve body, bonnet, and disc shall be of cast iron or ductile iron and the disc or body shall be rubber-coated. Body and bonnet wall thickness shall be equal to or greater than the minimum wall thickness as listed in Table 1 of AWWA C515. The stem, stem nuts, glands, and bushings shall be bronze, with the stem seal per AWWA C515.

D. Pressure Ratings:

1. AWWA C509 valves that are 3, 4, 6, 8, and 12 inches in size shall be rated for 200 psig minimum design working water pressure, and 16-, 20-, 24-, and 30-inch valves shall be rated for 150 psig minimum design working water pressure.

2. AWWA C515 valves 3- through 36-inch with outside screw-and-yoke (OS&Y) rising stem and 3- through 16-inch for non-rising-stem (NRS), shall be rated for 200 psig minimum design working water pressure.

E. Protective Coating: Valves shall be factory coated in accordance with Section 09 96 00 - Protective Coating. The CONTRACTOR shall submit a test report from a coating inspector that the coating is holiday-free. The CONTRACTOR shall be aware that it may retain the services of a third party coating applicator to achieve the holiday-free requirement.

F. Actuators: Unless otherwise indicated, resilient-seated gate valves shall have manual actuators in accordance with Section 43 30 12 - Valve and Gate Actuators.

G. Manufacturers, or Equal

1. **Mueller Company**

2. **M & H**

3. **Clow**

2.05 GATE VALVES (SMALLER THAN 3-INCHES)

A. Construction: Gate valves smaller than 3-inches, for general purpose use, shall be non-rising stem, heavy-duty type for industrial service, with screwed or soldered ends to match the piping. The bodies shall have union bonnets of bronze conforming to ASTM B 62 - Composition Bronze or Ounce Metal Castings. The stems shall be of bronze conforming to ASTM B 62, or ASTM B 371 - Copper-Zinc-Silicon Alloy Rod. The solid wedges shall be of bronze conforming to ASTM B 62. The valves shall have malleable iron handwheels

unless otherwise indicated, and stem seals shall be of Teflon-impregnated or other acceptable non-asbestos packing. Valves shall have a pressure rating of minimum 125 psi steam and 200 psi coldwater, unless otherwise indicated.

B. Manufacturers, or Equal

1. **Crane Company**
2. **Milwaukee Valve Company**
3. **Wm. Powell Company**
4. **Stockham Valves and Fittings**
5. **Walworth Company**

2.06 HIGH-PRESSURE GATE VALVES (2- TO 12-INCHES)

A. Construction: High-pressure gate valves, except for buried valves, shall have cast iron bodies and flanged bonnets with outside screw & yoke rising stems conforming to ASTM A 126 - Gray Iron Castings for Valves, Flanges, and Pipe Fittings, with 250 psi flanged ends. The valves shall be rated for 250 psig steam and 500 psig cold water working pressure. The solid wedges shall be of bronze or cast iron, bronze-fitted, and the stem shall be of bronze with non-asbestos fiber packing.

B. Actuators: Unless otherwise indicated, high-pressure gate valves shall have cast iron or ductile iron handwheels with 2-inch square operating nuts, in accordance with Section 43 30 12 – Valve and Gate Actuators.

C. Manufacturers, or Equal

1. **Crane Company**
2. **Milwaukee Valve Company**
3. **Wm. Powell Company**
4. **Stockham Valves and Fittings**
5. **Walworth Company**

2.07 PLASTIC GATE VALVES (1-1/2 TO 14-INCHES)

A. Construction: Plastic gate valves shall have PVC bodies with ANSI 150 lb. flanged ends, and polypropylene or CPVC-SBR-lined wedges for tight shut-off. The non-rising stem shall be of PVC or Type 304 stainless steel construction, with O-ring seal. The valves shall have a coldwater pressure rating of 150 psig for sizes 1-1/2 through 8-inches, 110 psig for size 10-inches, and 70 psig for sizes 12- and 14-inches.

B. Actuators: Unless otherwise indicated, PVC gate valves shall have manual handwheel actuators with position indicators, in accordance with Section 43 30 12– Valve and Gate Actuators.

C. Manufacturers, or Equal

1. **ASAHI/America**

2. **Spears Mfg. Co.**

PART 3 -- EXECUTION

3.01 GENERAL

A. Gate valves shall be installed in accordance with the provisions of Section 43 30 00 – Valves, General. Care shall be taken that valves in plastic lines are well supported at each end of the valve.

END OF SECTION

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SECTION 43 30 24

PLUG VALVES

PART 1 -- GENERAL

1.01 THE SUMMARY

A. The CONTRACTOR shall provide plug valves and appurtenances, complete and operable, in accordance with the Contract Documents.

B. Related Sections. See Related Sections for additional requirements applicable to this Section:

1. Section 09 90 00 – Protective Coatings
2. Section 40 05 00 – Piping, General
3. Section 40 05 02 – Piping Identification
4. Section 40 50 06 – Pipe Couplings
5. Section 40 05 07 – Pipe Supports
6. Section 43 30 00 – Valves, General
7. Section 43 30 12 – Valve and Gate Actuators
8. Section 46 01 00 – Equipment General Provisions.

C. Plug valves shall have undergone a proof-of-design test to demonstrate that the valve components operate at the service flow, pressure, temperature, and fluid conditions, free from binding, excessive noise, and premature failures. Proof-of-design test results shall be available to the CONSTRUCTION MANAGER on request. The proof-of-design test shall be conducted in accordance with the applicable provisions of AWWA C517-Resilient-Seated Cast-Iron Eccentric Plug Valves.

1.02 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 43 30 00 - Valves, General and requirements of the Standard Provisions.

PART 2 -- PRODUCTS

2.01 LUBRICATED PLUG VALVES (1/2-inch to 36-inches)

A. Construction: Lubricated plug valves shall be the tapered plug top- or bottom- entry type, with flanged ends for sizes 3-inches and larger, and flanged or screwed ends for smaller valves, as indicated. The body and top plate shall be of cast steel conforming to ASTM A 216 - Steel Castings, Carbon, Suitable for Fusion Welding for High-

Temperature Service, or other acceptable cast or forged steel. The plug shall be of steel or cast iron and the stem shall be of stainless steel or alloy steel, with weather seal and Teflon impregnated packing. Valves up to and including 20-inches size shall have an unobstructed port area of not less than 80 percent of full pipe area, and not less than 70 percent for larger valves. The valve body and plug shall have smoothly-finished water passages free from sharp corners when the plug is in the wide-open position. The valve shall be rated for ANSI class 150 300 or as indicated, between service temperatures of minus 20 to plus 100 deg F.

B. Sealant System: The valves shall be provided with fittings designed to feed a sealant through a check-valve protected passage in the stem, through the side, or through a stainless steel tube for worm-gear actuated or buried valves. There shall be ducts or grooves in the face of the plug to insure the maintenance of a closed, pressurized sealant system between contact surfaces of moving parts. Surfaces of the plug shall be coated with a dry film lubricant, such as polyfluoride or equal, to suit the service, permanently bonded to the metal surfaces. Sealant for LP gas service shall be the manufacturer's recommended type. The plug shall be held toward the seat by factory-adjusted gland assemblies set for proper sealing and operating torque. The gland assemblies shall be adjustable from the valve exterior and shall utilize either spring washers or gland deflection to allow plug unseating when pressurized sealant is injected.

C. Actuators: Unless otherwise indicated, valves 3-inches and smaller shall be lever-actuated; larger valves shall be equipped with manual worm-gear actuators. Valve actuators shall be in accordance with Section 43 30 12 - Valves and Gate Actuators.

D. Lubricating Gun: The CONTRACTOR shall furnish a manual lubricating gun for lubricated plug valves in sizes up to 6-inches, inclusive. For larger valves, the CONTRACTOR shall furnish a pneumatically-operated lubricating gun and a manual lubricating gun. For installations of more than 6 lubricated plug valves, the number of guns shall be doubled. The guns shall be from the same manufacturer as the valves. Guns shall each be equipped with flexible connectors, pressure gauge, safety valve, and be furnished in labeled tool boxes with operating instructions.

E. Manufacturers, or Equal

1. **Nordstrom Audco Valves, Inc.**

2. **Rockwell**

2.02 ECCENTRIC PLUG VALVES (1/2-inch to 72-inches)

A. Construction: Eccentric plug valves shall be of the non-lubricated, eccentric plug design with cast iron bodies conforming to ASTM A 126 - Gray Iron Castings for Valves, Flanges, and Pipe Fittings, with ANSI 125 lb. flanged ends for valves 3-inches and larger, and screwed or flanged ends for smaller sizes. The plugs and shafts shall be of cast iron or ductile iron conforming to ASTM A 536 - Ductile Iron Castings, and the plugs shall be lined with a resilient coating, best suited for the specific service. The body shall be lined with a suitable elastomer, where required for a special service, or it shall be epoxy-lined in accordance with Section 09 96 00 - Protective Coating. The seats shall be of nickel or stainless steel welded to the body. Top and bottom shaft bearings shall

be of permanently lubricated stainless steel or Teflon coated stainless steel. Grit seals of Teflon, Nylatron, or similar suitable material shall be at the top and bottom plug journals. Valves up to and including 20-inches in size shall have an unobstructed port area of not less than 80 percent of full pipe area, and not less than 70 percent for larger valves. Eccentric plug valves shall have a pressure rating of not less than 150 psi WOG, for bubble-tight shut-off in the standard flow direction, and 25 psi WOG in the reverse flow direction. When equipped with worm gear actuator, the pressure rating shall be 150 psi WOG in both directions. The stem seal shall consist of field adjustable packing, replaceable without removal of the actuator, or of self-adjusting U-cup packing.

B. Actuators: Unless otherwise indicated, eccentric plug valves 3-inches and smaller shall have operating levers; larger valves shall have worm-gear actuators. Valve actuators shall be in accordance with Section 43 30 12 - Valves and Gate Actuators.

C. Manufacturers, or Equal

1. **DeZurik Corporation**

2. **Clow Valve Company**

3. **Pratt Valve**

4. **Victaulic**

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Plug valves shall be installed in strict accordance with the manufacturer's published recommendations and the applicable provisions of Section 43 30 00 - Valves, General.

B. Eccentric Plug Valves: Unless otherwise directed, the following rules shall be observed for the installation of eccentric plug valves on sewage, sludge, or other liquid systems containing solids, silt, or fine sand:

1. The valves shall be positioned with the stem in the horizontal direction.

2. In horizontal pipelines, the plug shall swing upwards when opening, to permit flushing out of solids.

3. The orientation of the valve shall prevent the valve body from filling up with solids when closed; however, where the pressure differential through the valve exceeds 25 psi, the higher pressure for valves without worm gear, electric, or air operators shall be through the valve to force the plug against the seat.

4. Valves which may be closed for extended periods (stand-by, bypass, or drain lines) and valves with reversed flow (higher pressure on downstream side, forcing the plug away from its seat), shall be equipped with worm gear operators for the full range of sizes.

5. For special applications or when in doubt, consult with the manufacturer prior to installation.

END OF SECTION

SECTION 43 30 36

FLOW METERING AND CONTROL VALVES

PART 1 -- GENERAL

1.01 THE SUMMARY

A. The CONTRACTOR shall provide an integrated flow metering and rate of flow control valves and appurtenances, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 43 30 00 - Valves, General apply to this Section.

1.02 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 43 30 00- Valves, General and requirements of the Standard Provisions.

PART 2 -- PRODUCTS

2.01 VALVE CHARACTERISTICS

A. The flow metering and control valves shall be capable of accurately measuring and controlling the rate of flow based on an operator input set point regardless of fluctuations in the upstream pressure. The valve shall be a hydraulically operated, adjustable pilot controlled, diaphragm or piston type globe or angle valve as indicated. The pilot controlled, direct-acting diaphragm or piston shall close the valve when the actuating differential pressure increases. The actuating differential pressure shall be controlled by a dual solenoid control to the pilot system utilizing a multi-channel PLC controller. Necessary repairs shall be possible without removing the valve from the pipeline.

2.02 VALVE CONSTRUCTION

A. Valve Body: The valve body shall be of cast iron to ASTM A 48 - Gray Iron Castings, or ASTM A 126 - Gray Iron Castings for Valves, Flanges, and Pipe Fittings, with125 lb flanged ends to ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800, or the body shall be of ductile iron to ASTM A 536 - Ductile Iron Castings, with 150 lb flanged ends to ASME B16.42 - Ductile Iron Pipe Flanges and Flanged Fittings. The valve cover shall be flanged and of the same material as the body.

B. Valve Trim: The valve stems with position indication, springs, body seat rings, and bolts, nuts, and washers shall be of Type 302, 303, or 316 stainless steel. The valve stems shall have top and bottom guides. Rubber parts shall be Buna-N. The diaphragms shall be of nylon-reinforced Buna-N, supported firmly between body and valve cover. The valve pistons and piston liners shall be bronze to ASTM B 62 - Composition Bronze or Ounce Metal Castings.

C. Valve Controls: The valve shall be furnished with a complete, externally mounted control system, including a differential control, adjustable, double-acting pilot valve, speed control needle valves, strainer, and necessary copper or stainless steel connecting tubing and fittings. The controls shall be capable of achieving the flow and speed adjustments indicated.

2.03 MAGNETIC FLOW METER

A. GENERAL

1. The flow meter shall consist of two components: an electromagnetic sensor and a converter. The 1" (25mm) electromagnetic sensor shall installed in an upstream port of a Singer Valve from diameters from 4 in. (100mm) to 36 in. (900mm) in clean water applications.

2. The flow meter shall determine the volumetric flow rate by means of the Continuity Equation where flow rate "Q" equals mean velocity "V" times cross sectional area "A" (Q = V x A). The velocity measurement must be taken at a known location, then, through empirically established equations, the sensed velocity will be converted to a mean velocity.

3. The electromagnetic flowmeter shall have no moving parts or sensors that are prone to damage and inaccuracy due to particulate matter and/or vibration.

4. The electromagnetic flowmeter shall be capable of being powered by from 90 to 265V, 45-66 Hz AC voltage source. It shall have a power draw of 25VA. *(or 10-35V DC voltage source. It shall have a power draw of 21W)*

5. The electromagnetic flowmeter shall have an accuracy of 2% of reading. Accuracy based on full scale is not allowed.

6. Each flowmeter shall be calibrated at the manufacturer's factory with calibrated test equipment traceable to standards such as NIST. Calibration certificates shall be submitted to the CONSTRUCTION MANAGER or CONSTRUCTION MANAGER Representatives prior to delivery of equipment.

7. The electromagnetic flowmeter shall have operating and storage temperature rating from -4° to 140°F (-20°C to +60°C).

8. The flowmeter shall be guaranteed for satisfactory performance and against manufacturing defects for a period of one year.

9. The meter shall be equivalent to the SPI-MV Single Point Insertion Electromagnetic Flow Meter as manufactured by McCrometer, Inc., in Hemet, California, and supplied for use, specifically, with Singer Valve Inc. Main Valves.

B. Converter

1. The flow meter converter shall be microprocessor based with a keypad for instrument set up and LCD displays for totalized flow, flow rate engineering units and velocity.

2. The converter shall power the flow-sensing element and provide a galvanically isolated Dual 4-20mA output. It shall be possible, in the test mode; to easily set the converter outputs to any desired value within the range.

3. The 4-20mA scaling, time constants, pipe size, flow proportional output, engineering units and test mode values shall be easily set via the keypad and display.

4. Four separate fully programmable alarm outputs shall be provided to indicate empty pipe, forward/reverse, polarity (normally open/close), analog over-range, fault conditions, high/low flow rates, % of range, and pulse cut-off.

5. The converter shall periodically perform self-diagnostics and display any resulting error messages.

6. All set up data and totalizer values may be protected by a password.

7. The converter shall have an IP67 rating for protection against temporary immersion in water and ingress of dust (dust tight)

C. Sensor

1. The flow-sensing element shall be of an electromagnetic single point type design and factory calibrated to traceable standards, such as NIST.

2. The sensor shall be made of polyurethane with pure carbon electrodes exposed to flow.

3. To eliminate erroneous readings due to pipe wall effects, the sensor must have its electrodes located at $1/8^{th}$ pipe diameter from the pipe wall and be designed with a curved tip shape, so as not to collect debris while in the operating position. Flat tipped or Doppler sensors shall not be acceptable.

4. The sensor shall have an IP68 rating for protection against the effects of continuous immersion in water.

2.04 PROGRAMABLE CONTROLLER

A. Operating Requirements

1. The programmable controller system shall control the valve dual solenoids to meet the system flow rate from an analog input set point proportional to the desired flow rate.

2. The system shall be programmed with calibration capabilities for each analog input. The calibration shall be independent for each input and shall be enabled when the control panel is in manual mode only or when all control functions are disabled.

3. The system shall be programmed with a failure mode in the event of loss of transmitter signal, remote set-point, or pre-set alarm. It shall have the option to allow the control valve to fail open, fail close, or fail in the last position.

4. The system shall be programmed with an advanced PID algorithm capable of bringing the process to a critically damped response to any given change in set-point. The algorithm shall include a user-configurable duty cycle to control the opening and closing speeds of the valve. It shall also include user-definable hysteresis to prevent the valve from unnecessary cycling for increased process stability and solenoid operating life.

B. Hardware

1. The programmable controller system shall be a complete operating system including a colored touch screen interface, central control processor, appropriate interface and communication modules, input and output modules, and interconnection cabling.

2. The programmable controller system supplied shall be manufactured by Siemens.

3. Solid state relays with a zero-cross function shall be provided for inductive loads such as solenoids. Mechanical relays shall be provided for alarms and indication.

4. To eliminate the effects of electrical interference for inductive AC devices such as relays, solenoids, motor starters, small motors and the like, a line filter and surge suppressor shall be provided and installed. (OPTIONAL) When required, analog input and output isolators shall be provided to protect the analog I/O modules from voltage transients and surges.

5. Circuit breakers and fuses shall be provided and sized accordingly for isolation and protection or as recommended by the manufacturer.

6. All equipment shall be housed in a NEMA 4X fiberglass enclosure, unless noted otherwise.

2.05 FACTORY TESTS AND WARRANTY

A. Valves shall be factory-tested with a hydrostatic test and a functional test, and a test certificate shall be submitted to the CONSTRUCTION MANAGER prior to delivery of the valve. The valve shall be warranted for a period of 3 years from the date of shipment to be free of defects in materials and workmanship.

2.06 OPERATING CONDITIONS

A. The valve shall be designed to operate under the following conditions:

Maximum inlet pressure, psi	90
Minimum inlet pressure, psi	30
Minimum outlet pressure, psi	0
Maximum flow, gpm	500
Minimum flow, gpm	50
Valve size, inches	3
Diameter of pipeline, in	3

2.07 SPARE PARTS

A. The following spare parts shall be furnished in accordance with Section 43 30 00- Valves, General:

1. One complete set of resilient seals and discs

2. One diaphragm (for diaphragm valves, only)

2.08 MANUFACTURERS, OR EQUAL

A. **Singer Valve, Inc.**

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Valves shall be installed in accordance with provisions of Section 43 30 00- Valves, General.

3.02 SERVICES OF MANUFACTURER

A. Inspection, Startup, and Field Adjustment: The service representative of the valve manufacturer shall be present at the Site for 2 Days, to assist the CONTRACTOR in the installation and adjustment of the valve(s).

B. Instruction of OWNER'S Personnel: The training representative of the valve manufacturer shall be present at the Site for 2 Days to instruct the personnel in the operation, adjustment, and maintenance of the valve(s).

C. For the purpose of this paragraph, a Day is defined as an 8 hour period, excluding travel time.

END OF SECTION

SECTION 43 30 46

PRESSURE RELIEF VALVES

PART 1 -- GENERAL

1.01 THE SUMMARY

A. The CONTRACTOR shall provide pressure relief valves and appurtenances, complete and operable, in accordance with the Contract Documents.

B. Related Sections. See Related Sections for additional requirements applicable to this Section:

1. Section 09 90 00 – Protective Coatings
2. Section 40 05 00 – Piping, General
3. Section 40 05 02 – Piping Identification
4. Section 40 50 06 – Pipe Couplings
5. Section 40 05 07 – Pipe Supports
6. Section 43 30 00 – Valves, General
7. Section 43 30 12 – Valve and Gate Actuators
8. Section 46 01 00 – Equipment General Provisions.

1.02 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 43 30 00 - Valves, General and requirements of the Standard Provisions.

1.03 SPECIAL WARRANTY REQUIREMENT

A. The valve shall be warranted for a period of 3 years from the date of shipment to be free of defects in materials and workmanship.

PART 2 -- PRODUCTS

2.01 FLANGED PRESSURE RELIEF VALVES, SIZES 1-1/2 INCHES THROUGH 42-INCHES

A. Valve Characteristics: The pressure relief valve shall open when the inlet pressure exceeds a set maximum level. It shall maintain that pressure and gradually close as the pressure drops below the maximum pressure. The valve shall be a hydraulically-operated, adjustable, pilot controlled diaphragm or piston type globe or angle valve as

indicated. Necessary repairs shall be possible without removing the valve from the pipeline.

B. Valve Body: The valve body shall be of cast iron, ASTM A 48 - Gray Iron Castings, or ASTM A 126 - Gray Iron Castings for Valves, Flanges, and Pipe Fittings, with 125 lb flanged ends to ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800, or the body shall be of ductile iron to ASTM A 536 - Ductile Iron Castings, with 150 lb flanged ends to ASME B16.42 - Ductile Iron Pipe Flanges and Flanged Fittings. The valve cover shall be flanged and be of the same material as the body.

C. Valve Trim: The valve stems, springs, body seat rings, and bolts, nuts, and washers shall be of Type 302, 303, or 316 stainless steel. The valve stems shall have top and bottom guides. Rubber parts shall be Buna-N. The diaphragms shall be of Nylon-reinforced Buna-N, supported firmly between body and valve cover. The valve pistons and piston liners shall be bronze to ASTM B 62 - Composition Bronze or Ounce Metal Castings.

D. Valve Controls: The valve shall be furnished with a complete, externally-mounted control system, including adjustable speed control needle valves, strainer, and necessary copper or stainless steel connecting tubing and fittings. The controls shall be capable of achieving the flow and speed adjustment indicated.

E. Factory Tests: Valves shall be factory tested with a hydrostatic test and a functional test and a test certificate shall be submitted to the CONSTRUCTION MANAGER prior to delivery of the valve.

F. Operating Conditions: The valve shall be designed to operate under the conditions as indicated.

G. Spare Parts: The following spare parts shall be furnished in accordance with Section 43 30 00 – Valves, General:

1. One complete set of resilient seals and discs

2. One diaphragm (for diaphragm valves, only)

H. Manufacturers, or equal

1. **Cla-Val Company**

2. **Golden-Anderson**

3. **OCV Control Valves**

4. **Ross Valve Mfg. Co., Inc.**

5. **Singer Valve, Inc.**

6. **Watts, ACV**

2.02 THREADED PRESSURE RELIEF VALVES, SIZES 1/2- THROUGH 2-1/2 INCHES

A. Valve Characteristics: The pressure relief valve shall open when the inlet water pressure exceeds a set maximum level. It shall maintain that pressure and gradually close as the pressure drops below the maximum pressure. The valve shall be a spring and hydraulically-operated, direct-acting, adjustable diaphragm or piston type globe or angle valve as indicated.

B. Valve Body: The valve body shall be bronze with threaded inlet and outlet to standard NPT and with flanged top, suitable for an inlet pressure of 300 psi. The spring shall be adjustable with an adjusting screw, to regulate the pressure setting.

C. Valve Trim: The valve trim shall be of stainless steel or bronze with stainless steel spring. The rubber seat shall be replaceable.

D. Manufacturers, or equal

1. **Cla-Val Company**

2. **Golden-Anderson**

3. **Ross Valve Mfg. Co., Inc.**

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Valves shall be installed in accordance with provisions of Section 43 30 00 – Valves, General.

3.02 SERVICES OF MANUFACTURER

A. Inspection, Startup, and Field Adjustment: The service representative of the valve manufacturer shall be present at the Site for 1 Day, to assist the CONTRACTOR in the installation and adjustment of the valve(s).

B. For the purpose of this paragraph, a Day is defined as an 8 hour period, excluding travel time.

END OF SECTION

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SECTION 43 30 52

MISCELLANEOUS VALVES

PART 1 -- GENERAL

1.01 THE SUMMARY

A. The CONTRACTOR shall provide miscellaneous valves and appurtenances, complete and operable, in accordance with the Contract Documents.

B. Related Sections. See Related Sections for additional requirements applicable to this Section:

1. Section 09 90 00 – Protective Coatings
2. Section 40 05 00 – Piping, General
3. Section 40 05 02 – Piping Identification
4. Section 40 50 06 – Pipe Couplings
5. Section 40 05 07 – Pipe Supports
6. Section 43 30 00 – Valves, General
7. Section 43 30 12 – Valve and Gate Actuators
8. Section 46 01 00 – Equipment General Provisions.

1.02 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 43 30 00 - Valves, General and requirements of the Standard Provisions.

PART 2 -- PRODUCTS

2.01 AIR-VACUUM AND AIR-RELEASE VALVES

A. Air and Vacuum Valves: Air and vacuum valves shall be capable of venting large quantities of air while pipelines are being filled, and allowing air to re-enter while pipelines are being drained. They shall be of the size indicated, with flanged or screwed ends to match piping. Bodies shall be of high-strength cast iron. The float, seat, and moving parts shall be constructed of Type 316 stainless steel. Seat washers and gaskets shall be of a material insuring water tightness with a minimum of maintenance. Valves shall be designed for minimum 150 psi water-working pressure, unless otherwise indicated.

B. Air-Release Valves: Air-release valves shall vent accumulating air while system is in service under pressure and be of the size indicated. Valves shall meet the same general requirements as indicated for air and vacuum valves except that the vacuum

feature will not be required. Valves shall be designed for a minimum water-working pressure of 150 psi, unless otherwise indicated.

C. Combination Air Valves: Combination air valves shall combine the characteristics of air and vacuum valves and air release valves by exhausting accumulated air in systems under pressure and releasing or re-admitting large quantities of air while a system is being filled or drained, respectively. Valves shall have the same general requirements as indicated for air and vacuum valves.

D. Manufacturers, or Equal

1. **APCO (Valve and Primer Corporation)**

2. **Crispin - Multiplex Manufacturing Company**

3. **GA Industries**

4. **Val-Matic (Valve and Manufacturing Corporation)**

2.02 SOLENOID VALVES

A. Solenoid valves shall be of the size, type, and class indicated and shall be designed for not less than 150 psi water-working pressure. Valves for water, air, or gas service shall have brass or bronze body with screwed ends, stainless steel trim and spring, Teflon or other resilient seals with material best suited for the temperature and fluid handled. Unless otherwise indicated, for chemicals and corrosive fluids, solenoid valves with PVC, CPVC, polypropylene (PP), polyvinylidene fluoride (PVDF), or Teflon materials of construction, suitable for the specific application shall be provided. Enclosures shall be NEMA rated in accordance with the area designations of Section 26 00 00 - Electrical Work, General. Coil ratings shall be for continuous duty. For electrical characteristics see the electrical Drawings or Specifications.

B. Manufacturers, or Equal

1. For general duty

a. Automatic Switch Co. (ASCO), Model RED HAT

b. Skinner Valve (Parker Hannifin Corporation)

c. Magnatrol Valve Corporation

d. **J. D. Gould Co.**

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Valves shall be installed in accordance with the manufacturer's printed recommendations, and with Section 43 30 52 - Miscellaneous Valves.

B. Backflow preventers, as well as air and vacuum release valves, shall have piped outlets to the nearest acceptable drain, firmly-supported, and installed in such a way as to avoid splashing and wetting of floors and obstruction of traffic.

END OF SECTION

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SECTION 43 30 58

FLAP GATES

PART 1 -- GENERAL

1.01 THE SUMMARY

A. The CONTRACTOR shall provide flap gates, complete and operable, in accordance with the Contract Documents.

B. Single Manufacturer

1. The CONTRACTOR shall assign to a single manufacturer responsibility for the furnishing and functional operation of the flap gates, including operators and accessories.

2. The designated single manufacturer, however, need not manufacture more than one part of the units, but shall coordinate the design, assembly, testing, and installation of the units.

C. Related Sections. See Related Sections for additional requirements applicable to this Section:

1. Section 09 90 00 – Protective Coatings

2. Section 40 05 00 – Piping, General

3. Section 43 30 12 – Valve and Gate Actuators

4. Section 46 01 00 – Equipment General Provisions.

1.02 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with the Standard Provisions.

B. Shop Drawings

1. Submit the following:

a. drawings of gates and frames

C. Technical Manuals

1. Submit complete technical manuals, including printed instructions for proper maintenance, lubrication, and complete parts list indicating the various parts by name, number, and exploded view where necessary.

D. Field Procedures

1. Prior to installation of the gates, provide instructions for field procedures for installation, adjustments, inspection, and testing.

PART 2 -- PRODUCTS

2.01 FLAP GATES

A. Design

1. Flap gates and frames shall be of cast iron construction, with fully-adjustable top pivot points and bronze sealing surfaces.

2. Gate frames shall be provided with flat backs for attachment to wall thimbles, unless otherwise indicated.

B. Wall Thimbles

1. Unless otherwise indicated, flap gates shall be mounted against cast iron wall thimbles with Type 316 stainless steel bolts, anchor bolts, nuts, and washers, and sealant or gaskets.

2. The thimbles shall be of the F-pattern type, matching the thickness of the walls in which they are installed.

3. Wall thimbles shall be furnished by the manufacturer of the gates, matching the bolt dimensions of the gates.

C. Sealant Manufacture, or Equal

1. The elastomeric sealant shall be Rubber Caulk Sealer as manufactured by **Products Research Company, Los Angeles.**

D. Grout

1. Gates mounted against concrete walls without wall thimbles shall be installed with one-inch-thick non-shrink grout between the wall and the gate flange.

E. Flap Gate Manufacturer or Equal

1. **Hydro Gate Corp., Model 20C** or **10C** for round openings

2. **Rodney Hunt Company, Series FV-AC**

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Flap gates shall be installed in strict accordance with the requirements of Section 43 30 56 – Hydraulic Gates, General.

END OF SECTION

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SECTION 43 41 45

FIBERGLASS REINFORCED PLASTIC TANKS

PART 1 -- GENERAL

1.01 SUMMARY

A. The Contractor shall supply all labor, materials, equipment, and incidentals required to furnish and install:

1. All fiberglass reinforced plastic tanks, complete and operable in accordance with the Contract Documents

2. All appurtenances as specified herein and as shown on the applicable Contract Documents.

B. Related sections:

General Provisions

Special Provisions

Section 01 33 17 – Structural Design, Support and Anchorage.

Section 09 96 00 – Protective Coating.

Section 33 12 01 – Basic Mechanical Materials and Methods.

Section 40 20 20 – Mechanical Piping.

Section 40 90 00 – Instrumentation and Control for Process Systems

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. American Society for Testing and Materials (ASTM)

1. ASTM C581 – Practice for Determining Chemical Resistance of Thermosetting Resins Used in Glass Fiber Reinforced Structures Intended for Liquid Service.

2. ASTM D638 – Standard Test Method for Tensile Properties of Plastics. to

3. ASTM D3299 – Specification for Filament-Wound Glass-Fiber-Reinforced Thermoset Resin Corrosion-Resistant Tanks.

B. American Water Works Association (AWWA)

1. AWWA D120 – Thermosetting Fiberglass-Reinforced Plastic Tanks.

C. Building Code

1. 2019 California Building Code (CBC)

D. National Bureau of Standards (NBS)

1. NBS PS15-69 – Voluntary Product Standard

E. National Fire Protection Agency (NFPA)

1. NFPA 704 – Identification of the Fire Hazards of Materials

F. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply. When 2 or more of the above regulations are applicable, the more stringent requirement shall be met.

1.03 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 7 of Standard Provisions.

B. Submit the followings prior to fabrication:

1. Catalog cuts: Provide catalog cuts for all off-the-shelf items.

2. Orthographic drawings:

a. Orthographic drawings for the tanks shall be scale drawings showing the relative size, configuration, location, materials of construction, and details of all equipment and materials to be furnished including the tanks, nozzles, baffles, and tank hold down and support systems. Both plan and elevation views shall be provided. All necessary clearances required by Code, or for maintenance and operation shall be clearly indicated. All piping terminal points shall be clearly shown and fully dimensioned. Orthographic drawings for the platforms and ladders shall be scale drawings showing the dimensions, materials of construction and details of construction.

b. All drawings shall be drafted by computer aided drafting method using either Bentley Microstation or AutoCad and shall be in an 11”x17” format. After the drawings have been approved by the District, submit two CDs containing the CAD files of the approved drawings for District use as record drawings.

3. Maximum range of service conditions and specific environmental conditions such as temperature, etc.

4. Tank Loading Drawings/Structural Calculations: Drawings and calculations shall be provided that indicate material properties and all static, dynamic, and seismic loads using material properties as derived from actual tests. Reactions (uplift, shear, gravity loads, etc.) shall be indicated for each of the applicable loading combinations found in the CBC and in Section 01 33 17. Calculations for anchor bolt type, size, location,

shall be indicated for the controlling load condition. Anchor lug design and attachment to shell shall be included in the calculations.

5. Tank Platform Loading Drawings/Structural Calculations: Drawings and calculations shall be provided for the tank platform framing, grating, and anchorage design.

6. Foundation and Anchor Bolt Drawings: Drawings shall be provided that show all data and details required for design of the tanks including locations and dimensions for knockouts and embedded items, and the size, type, location, embedment, and projection of anchor bolts.

7. Shop drawings and design calculations shall be signed and stamped by a Civil or Structural Engineer registered in the State of California.

8. Certificates of corrosion resistance.

9. Installation Instructions: Installation instructions shall be complete, detailed, and sequenced instructions for original installation. Recommended methods for assembly and adjustment including all bolt torques shall be provided along with special precautions and the sequence of work. Rigging and lifting details shall also be included for all factory fabricated assemblies and individual components weighing over 100 pounds.

10. Color sample of the proposed coating.

C. Submit the following prior to delivery:

1. Certified Test Data: Provide certified test data on representative samples of standard materials which demonstrate compliance with the physical properties specified herein.

2. Factory Test Results: Provide a certified copy of all factory test results as noted in Part 3.

3. O&M Manuals: In addition to the requirements in Section 7 of General Provisions, include final tank drawings, installation instructions, factory test reports, and provide a section for Manufacturer's Certificate of Proper Installation and field test reports (to be inserted when available).

D. Submit the following prior to contract completion:

1. Record drawing cad files in accordance with Section 7 of General Provisions.

2. Tank supplier's Certificate of Proper Installation.

3. Certified test report for each factory and field test.

1.04 QUALITY CONTROL

A. The items specified under this Section shall be furnished by manufacturers who are full experienced, reputable, qualified and regularly engaged in the manufacture (for a minimum of 5 years) of the items to be furnished which have been used as required herein. The tank supplier shall show that the responsible production personnel, which include designers, supervisors, and foremen, have each had at least 5 years experience in the design and/or manufacture of tanks of similar size and construction. Tank supplier shall show that he has adequate production machinery, equipment, and facilities to manufacture the tanks.

B. All units of the same type shall be identical and the product of one manufacturer.

C. The tank manufacturer shall have a quality control procedure adequate to ensure that all fabrication complies with these Specifications. Quality control shall include a final inspection by the manufacturer and a written record of this final inspection. The objective of manufacturer's quality control and inspection procedure is to have the tank comply with these Contract Documents at the time of District Representative's first inspection, thus eliminating any need for rework by the manufacturer or a second inspection by the District Representative.

D. Material Compatibility: The manufacturer shall certify that all units and materials are compatible with the chemicals to be stored and that the tanks will comply with the structural design requirements of this Specification.

1.05 QUALITY ASSURANCE

A. The tank supplier shall be responsible for the design of the tank, including wall thickness, methods and locations of support, seismic analysis and stiffener requirements. The design is subject to review and approval by the ENGINEER OF RECORD.

B. The District Representative may inspect both fabrication and coating on an intermittent and up to a full-time basis. The Contractor shall provide cooperation, scheduling information, and complete access to the District Representative during such inspection.

C. The tank supplier shall show that the responsible production personnel, which include designers, supervisors, and foremen, have each had at least 5 years experience in the design and/or manufacture of tanks of similar size and construction.

D. Tank supplier shall show that he has adequate production machinery, equipment, and facilities to manufacture the tanks.

1.06 DELIVERY, STORAGE AND HANDLING

A. The Contractor shall be responsible for shipping, handling, and delivery of the tank and accessories so as to prevent transit and handling damage to the tanks and coatings.

B. Flange faces shall be protected from damage. All openings are to be covered with securely bolted wooden or plastic blank flanges to prevent entrance of dirt, water and debris.

C. Tanks shall be mounted on skids or protective framework so constructed as to provide for easy handling by fork truck or similar device, and shall also be provided with lifting lugs, cleats, etc. to permit handling by crane. Nozzles, manholes, or other fittings shall not be used for lifting.

D. Tanks shall be handled in a manner approved by the coating manufacturer so coatings are not exposed to damaging strain.

E. No components or other pieces shall be shipped loose inside of the tanks.

F. The tank supplier shall provide on-site supervision of all aspects of delivery, handling, and installation.

G. Manufacturers shall provide instructions for unloading, storage and installation of all tank and accessories.

H. The Contractor and District Representative shall coordinate the delivery schedule.

1.07 TANK SUPPLIER'S FIELD SERVICES

A. Manufacturer's representatives for the tanks and liners specified herein shall be present at the jobsite for the minimum person-days listed for the services shown below, travel time excluded:

1. One (1) person-day per tank for installation assistance, inspection, and certification of the installation.

2. One (1) person-day per tank for functional testing.

B. A manufacturer's representative for the storage tanks shall provide certificates of satisfactory installation stating that the tanks have been:

1. Installed in accordance with the manufacturer's recommendations and inspected by a manufacturer's authorized representative, and

2. All applicable safety equipment has been properly installed, and

3. The tanks are ready for start-up.

1.08 WARRANTY

A. The Contractor shall provide a two-year warranty covering all defects in material and workmanship.

PART 2 -- PRODUCTS

2.01 SYSTEM DESCRIPTION

A. All of the tanks specified herein are intended to be custom constructed tanks for the storage of the chemicals specified herein, while meeting the seismic design criteria for this project. All of the tanks shall comply with NSF 61 for surfaces in contact with the service chemicals.

B. Tanks shall be provided for long-term storage of the chemicals specified in **Table 1**.

C. Tank Schedule: Provide Fiberglass Reinforced Plastic Tanks per **Table 1** below.

Table 1 – Fiberglass Reinforced Plastic Tank Schedule

Tank No.	Service	Purpose	Orientation	Dia. x Sidewall Ht (ft.)	Minimum Volume[1] (gal.)	Environment	Environment Temp. (Deg. F)	Reference Contract Drawings
RPLMT03	Polymer	Neat Polymer Storage Tank	Vertical	5'-1" X 7'-3"	1,090	Indoor	55-85	4M-1
RPLMT01	Polymer	Batch Tank No.1	Vertical	10'-2" X 12'-4"	7,300	Indoor	55-85	4M-1
RPLMT02	Polymer	Batch Tank No.2	Vertical	10'-2" X 12'-4"	7,300	Indoor	55-85	4M-1

Note 1: Volume shown is estimated usable volume; nominal volume will be higher to account for dead space at the top and bottom of the tank for overflow and pump nozzles, etc. Contractor shall coordinate exact tank dimensions with the ENGINEER OF RECORD.

Note 2: All appurtenances and instrumentation shall be provided per Contract Drawings.

2.02 GENERAL

A. Like items of equipment specified herein shall be the end products of one tank supplier in order to achieve standardization for appearance, operation, maintenance, spare parts, and tank supplier's service.

B. The use of a tank supplier's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired only.

C. All equipment specified herein shall be factory fabricated and assembled to maximum extent possible requiring a minimum of field assembly. Field installation shall be limited to anchoring the tanks, and making external piping and electrical connections.

D. All tanks and appurtenances shall be suitable for the chemicals stored in them.

E. Materials: Materials that are not indicated to be coated shall be fabricated from materials as indicated. Where materials are not indicated, the CONTRACTOR shall provide corrosion-resistant materials suitable for long-term service.

F. All tanks and appurtenances shall be vertical fiberglass reinforced plastic storage tanks suitable for installation in an indoor area in a chemical environment. See applicable project Drawings.

G. Design:

1. The tanks shall be designed for vertical installation and be cylindrical with flat bottom. The neat polymer storage tank shall have dome or flat top but the batch tanks shall be open to the atmosphere. The tanks shall be made of fiberglass reinforced plastic (FRP) with integral structural steel anchor chairs and pipe/appurtenance supports. Capacities, dimensions and tank penetrations shall be as specified in the Drawings referenced above. The manway and all flanges and other penetrations shall be an integrally molded part of the tank. Design, materials and manufacture shall be in accordance with ASTM D3299.

2. Hydrostatic Pressure: The tanks shall be vented and will store the indicated chemicals at atmospheric pressure. Tank wall thickness shall be designed based on liquid contents with a specific gravity of 1.5. All tanks and appurtenances shall be designed to withstand the hydrostatic pressure resulting from a full tank plus a static head of 4.5 feet of liquid column.

3. Vents shall discharge at least 84-inches above the roof.

4. Personnel access roof load shall be a minimum of 250 pounds exerted as a concentrated load.

H. Construction.

1. Tanks shall not have internal support members.

2. Tanks shall be fabricated such that all edges have a minimum corner radius of 1/8 inch.

3. Polymer tanks shall include a thickened internal sloping bottom to allow full drainage of the tank contents from an elevation above the floor as indicated. The bottom shall slope down at a rate of ¼-inch per foot to the tank drain. The sloping bottom shall be a fully integrated element of the tank and shall comply with the physical and material properties specified in this Section.

4. The top heads shall be designed for an external live load of 250 lb on a 4-inch by 4-inch area. Tops may be dished, flat, or slight rise conical shapes as indicated. Tanks with flat tops shall have a split hinged cover, the fixed part of which shall have a reinforced mixer support pad, as required by the mixer manufacturer.

5. Appurtenances: The tanks shall be equipped with the following items, as specified and required and as shown on the Drawings referenced above:

    a. Nozzles and manways as shown on the Drawings. All manways shall be provided with approved access covers or blind flanges, and confined space labels. Manway openings shall be provided for side access in addition to top access where indicated.

    b. Anchor chairs and bolts for anchoring tank to the concrete pad.

    c. Hardware: All necessary corrosion-resistant hardware for installation of the tanks and accessories shall be supplied. The hardware shall be made of type 316 stainless steel.

    d. Lifting lugs.

    e. Piping and instrumentation supports.

    f. Gaskets: Gaskets shall be provided for all flanged openings. Gaskets shall be minimum 1/8” thick, material to be compatible with the chemical stored.

6. Labels: The tanks shall be identified by bonded lettering and labels indicating the chemical being stored. An NFPA diamond-shaped hazard identification label shall be included on each tank. Lettering shall spell out the tank name, number, and chemical being stored. Identification lettering shall be a minimum of 6 inches high and plainly visible. Labels shall conform to the Fire Code and NFPA 704 for size and color. The NFPA hazardous material labels shall be a minimum of 15 inches by 15 inches. Hazardous material labels shall be as manufactured by Seton Name Plate Company, Style 150 CP, or equal.

7. Nameplate: The vendor shall furnish and mount three (3) feet from the bottom on the outside of the tank a 316 stainless steel nameplate with the following:

    a. Name of manufacturer.

    b. Date of manufacture.

c. District's equipment ID number.

d. Estimated empty weight.

e. Estimated maximum operating weight.

f. Tank capacity (in gallons).

g. Resin number and manufacturer.

h. Type of corrosion resistant liner.

i. Design pressure and temperature.

8. Sight Gauges: Each of the tanks shall be provided with 2" flanges that will allow for mounting of an external level gauge. Magnetic-type sight gauges shall be provided with associated isolation ball valves at the bottom, while top of the gauge will be plumed directly to the top of the tank. Each gauge shall be constructed of materials compatible with the chemical being measured and shall consist of a magnetic float inside of a sealed metal tube with top and bottom process connections and a drain valve at the bottom. An adjacent indicator housing shall incorporate small flags which flip orientation as the float passes by, changing color from white to red thereby indicating liquid level. The magnetic sight gauges shall be Emerson Magtech LG series, Gems-Suresite, or approved equivalent.

   a. For polymer tanks, material of construction shall be Hastelloy C.

I. Tank Platform and Ladder

1. Ladders

   a. Each Batch Tank (RPLMT01 & RPLMT02) shall be furnished with a fixed FRP ladder to provide easy access to the top of the tanks. The ladder rungs shall have a non-slip traction surface and internal stainless steel safety bar. The ladder shall meet or exceed OSHA General Industry Standards, Part 1910.27 for "Fixed Ladders". If the ladder depth is over 15' (as shown on the drawings), install a safety rail with harness and pull up access pole. For ladders less than 15' depth, install a head hazard deflector plate. Ladders shall be compliant with OSHA §1910.27 and 1926.1053. Ladders must be mounted to the tank to allow for tank expansion and contraction due to temperature and loading changes. All top ladder mounts shall be connected to integrally molded attachment lugs that allow for tank movement.

   b. FRP ladders shall conform to material properties as stated herein. FRP properties not stated herein shall conform to 06 80 00 Fiber Glass Reinforced Plastic Fabrications.

2. Platform

a. Batch Tanks (RPLMT01 & RPLMT02) shall be furnished with a single tank roof-mounted platform that spans over both tanks with guardrails and self-closing safety gates.

b. The platform shall be constructed of FRP grating and framing and shall conform to material properties as stated herein. FRP properties not stated herein shall conform to 06 80 00 Fiber Glass Reinforced Plastic Fabrications.

c. Design loads for the platform framing and grating shall conform to ASCE 7, and the following loads:

1) Platform self-weight

2) Mixer weights

3) Live Load: 100psf

4) Seismic lateral loads per seismic design parameters of 01 33 17.

d. Platform framing and grating shall also be designed to meet the following deflection criteria:

1) Less than 1/4-inch or span divided by 180

2) Loads to determine deflections shall be 100 pounds per square foot or 1000 pounds concentrated at midspan, whichever produces the greater effect

e. Platform design calculations and shop drawings shall be stamped by a professional engineer in the State of California.

J. Exterior Coating: Exterior surfaces of the tank shall be coated in accordance with Section 09 96 00.

K. Materials

1. General: All materials used in the tanks and appurtenances shall be resistant to and certified for use with the chemical to be stored.

2. FRP Resin:

a. Resin shall be Hetron 197, Derakane 411, or Atlac 580. Resin shall incorporate a UV stabilizer and shall be certified resistant to the chemical to be stored by the manufacturer.

b. Catalyst and promoter for the inner corrosion resistant liner and interior joints shall be Benzoyl Peroxide -Dimethylaniline (BPODMA), and can be methylethyl ketone peroxide and cobalt naphthenate in the structural wall only. The amount shall be as recommended by the resin manufacturer for use with their resin.

c. No fillers, dyes or pigments shall be employed in the resin. Thixotropic agent may be used for viscosity control in proportions recommended by the resin manufacturer. No thixotropic agent shall be used on interior corrosion resistant surfaces or in interior joint overlays.

3. FRP Reinforcement

a. Glass fiber reinforcement used shall be a commercial grade corrosion resistant borosilicate glass in chopped strand mat, surfacing veil, woven roving, chopper and winder roving.

b. All glass fiber reinforcing shall have a silane type surface finish and binder that is specifically formulated for the resin to be used. This surface finish should allow the maximum possible chemical bonding between the resin and glass.

c. Chemical surfacing veil shall be c-glass surface veil.

d. Nexus surfacing veil shall be Style I020. (No known equal).

e. Chopped strand mat shall be Type E (electrical grade) glass, 1-1/2 oz. per sq. ft., with a fiber length greater than 0.5" and less than 2".

f. Continuous glass roving used in chopper gun for spray-up shall be Type E chopper roving.

g. Woven roving shall be 24 oz. per sq. yd. With a 5 x 4 plain weave, and be Type E glass.

h. Continuous glass roving used for filament winding shall be Type E glass.

i. Unidirectional roving shall be Type E glass.

2.03 TANK SEISMIC RESTRAINT SYSTEM

A. The restraint system shall be an integral part of the tank, be fabricated by the tank supplier and meet the seismic requirements of Section 01 33 17 and Special Provisions Section 13.05.01.

2.04 MANUFACTURER

A. Fiberglass tank manufacturers:

1. Diamond Fiberglass, Victoria, TX

2. Plas-Tanks Industries, Inc., Hamilton, OH

3. Or equal as approved by the ENGINEER OF RECORD.

2.05 SHOP TESTING

A. Hydrostatic Test: Each tank shall be hydrostatically tested for leaks at the factory by filling with water. Each FRP tank shall be checked for leaks after it has been filled for at least 24 hours. The manufacturer shall run this test prior to shipment of the tanks. No leakage will be allowed.

B. FRP Tanks: Perform materials tests on samples taken from each tank. Follow procedures per ASTM D3299, Section 11, for:

1. Chemical resistance.
2. Glass content.
3. Degree of cure (Barcol hardness).
4. Tensile strength.
5. Modulus of elasticity.

C. Certified test results for each tank shall be sent to the District Representative, prior to shipment of the tanks.

D. The tanks may be inspected at the factory by the District Representative.

E. All deficiencies shall be corrected at no additional cost to the District.

PART 3 -- EXECUTION

3.01 GENERAL

A. Installation, handling, and storage of the tanks shall be in strict accordance with the tank supplier's printed instructions. Tanks shall be inspected for proper installation. The tank supplier shall coordinate and supervise all aspects of delivery, handling, and installation.

B. The Contractor shall be responsible for all off-loading, storage, placement and installation of the tanks, as well as connection and integration of the tanks and appurtenances with the chemical pumps and piping.

C. The tanks shall be set on a cushioning pad of several layers of 30 lb roofing felt, or equivalent, to minimize stresses and compensate for concrete slab irregularities in accordance with tank manufacturer recommendations.

D. All connecting of piping, accessories and other hardware, and fastening down of the tanks, shall be performed prior to final testing. Final location of fittings and valves will be made by the District Representative during submittal review.

E. The tank supplier shall inspect the installed tanks and complete a Tank supplier's Certificate of Proper Installation.

3.02 FIELD QUALITY CONTROL

A. Field Tests:

1. Hydrostatic Test: The tanks shall be filled with water and subjected to 4.5 feet of water column pressure after all connections, except for vent/overflow line, have been made. There shall be no leakage, no signs of weeping, and no signs of capillary action over a period of 48 hours.

2. Should any defects become evident during inspection, testing, or within the guarantee period, the Contractor shall repair or replace the defective tank or fitting as approved by the District.

3. The Contractor shall furnish all labor, materials and equipment required for tests.

4. The tank suppliers shall have a quality control procedure adequate to ensure that all fabrication complies with these specifications. Quality control shall include a final inspection by the Contractor and a written record of this final inspection.

5. After testing, the tanks shall be thoroughly cleaned and dried.

END OF SECTION

SECTION 43 52 00

HOISTS AND CRANES, GENERAL

PART 1 -- GENERAL

1.01 THE SUMMARY

A. The CONTRACTOR shall provide the hoisting equipment, ancillary steel, and appurtenances, complete and operable, as indicated in accordance with the Contract Documents.

B. The requirements of this Section apply to all hoists and cranes unless indicated otherwise.

C. Related Sections. See Related Sections for additional requirements applicable to this Section:

1. Section 05 05 19 – Post-Installed Anchors in Concrete

2. Section 05 05 00 – Miscellaneous Metalwork

3. Section 09 90 00 – Protective Coatings

4. Section 46 01 00 – Equipment General Provisions.

1.02 REFERENCE SPECIFICATIONS CODES, AND STANDARDS

A. Commercial Standards

AISC Specifications for the Design, Fabrication, and Erection of Structural Steel for Building

AGMA American Gear Manufacturer's Association

ANSI B30.11 Overhead and Gantry Cranes

ANSI MH 27.1 Underhung Crane and Monorail Systems

ASTM A 36 Carbon Structural Steel

CMAA A division of Material Handling Industry of America

NEMA National Electrical Manufacturer's Association

OSHA 29 CFR 1926.550 – Cranes and derricks

1.03 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with the requirements of the Standard Provisions.

B. Shop Drawings shall include electrical requirements, weights, wheel loads, dimensions, and required clearances.

C. Technical Manuals

1. Include complete operating and maintenance instructions of the hoist and crane systems.

1.04 QUALITY ASSURANCE

A. Inspection and Testing Requirements

1. After installation, the CONTRACTOR shall inspect and test hoists and crane systems in the presence of the manufacturer's service representative, for proper operation and conformance to the indicated requirements.

B. Acceptance Criteria and Tolerances

1. The ENGINEER OF RECORD reserves the right to reject any equipment not conforming to the tolerances, deflections, and lateral stiffness as indicated.

1.05 MANUFACTURER'S SERVICES

A. The CONTRACTOR shall arrange for the hoist or crane manufacturer to furnish the services of a trained, qualified representative for at least one day after the units are installed, for the purpose of inspecting the installation and instructing the OWNER's operating personnel.

1.06 SEISMIC DESIGN

A. Equipment and components shall be designed and constructed in accordance with the seismic criteria in Section 01 33 17 – Structural Design, Support and Anchorage.

PART 2 -- PRODUCTS

2.01 GENERAL

A. Equipment of similar design shall be from a single manufacturer.

B. The capacity of each hoist and trolley shall be permanently marked in a conspicuous manner on the equipment.

C. The wire rope reeving shall be of the 2-part double, cross-mounted or similar appropriate type, to provide a true, vertical lift without drift, unless otherwise indicated.

D. Hooks shall be of the safety type with a latch.

E. Motors shall comply with the requirements of Section 26 05 10 – Electric Motors.

F. The CONTRACTOR shall verify dimensions and clearances in the field prior to installation and shall be responsible for the proper fitting and operation of the equipment.

G. Manufacturers, or Equal

1. **ACCO Babcock, Inc.**

2. **American Monorail**

3. **Cleveland Tramrail**

4. **Thern, Inc.**

2.02 BASIC MATERIALS

A. Materials shall be new and of the best commercial grade.

B. Where materials are not indicated, the CONTRACTOR shall have the manufacturer use the most suitable selection for the given application and environment.

2.03 PLANT FABRICATED ITEMS

A. Fabrication, assembly, and welding shall be performed by factory-trained specialists and certified welders.

2.04 TOOLS AND SPARE PARTS

A. Tools

1. The CONTRACTOR shall furnish one complete set of special wrenches or other special tools necessary for the assembly, adjustment, and dismantling of the equipment.

2. The tools shall be of best quality and furnished in labeled toolboxes of suitable design.

B. Spare Parts

1. Furnish spare parts as required by the hoist or crane Section.

2. The parts shall be properly labeled and identified with the name and number of the equipment to which they belong.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Hoist and crane equipment shall be installed in strict accordance with the manufacturer's printed instructions.

B. Workmanship shall be in accordance with the referenced standards and codes.

C. Care shall be taken that the structural integrity of beams, columns, walls, floors, and roofs will be maintained at all times.

3.02 FIELD TESTING

A. After completion of the WORK, the CONTRACTOR shall test hoist and crane equipment in the presence of the manufacturer's field representative, who shall certify in writing that the equipment meets applicable standards and specifications.

END OF SECTION

SECTION 43 52 02 – JIB CRANE

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall furnish and install a base-mounted, electric jib crane complete and operable, in accordance with the requirements of the Contract Documents. The jib crane shall be equipped for electric lift, travel and rotation, and it shall fit a standard I-beam. Refer to Section 43 52 00 for additional requirements.

B. Related Sections. See Related Sections for additional requirements applicable to this Section:

1. Section 05 05 19 – Post-Installed Anchors in Concrete

2. Section 05 05 00 – Miscellaneous Metalwork

3. Section 09 90 00 – Protective Coatings

4. Section 43 52 00 – Hoists and Cranes, General

5. Section 46 01 00 – Equipment General Provisions.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. The jib crane shall be designed, manufactured and tested in accordance with the pertinent provisions of the following codes and standards. Other equivalent well recognized international standards may be substituted where necessary.

1. AISC Specification, "Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings;"

2. AGMA, "American Gear Manufacturers Association;"

3. ANSI/ASME HST-4 "Performance Standard for Electric Wire Rope Hoists"

4. ASTM A 307, "Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength;"

5. ASTM A 325, "Specification for Structural Bolts, Steel Heat Treated,120/105 ksi minimum Tensile Strength;"

6. ASTM A 490, "Specification for Structural Bolts, Alloy Steel, Heat-Treated, 150 ksi Minimum Tensile Strength;"

7. CMAA Specification No.74, "Specifications for Electric Overhead Traveling Cranes;"

8. NEMA ICS, "Industrial Controls and Systems;"

9. NEMA MG 1, "Motors and Generators;"

10. NFPA 70, "National Electrical Code;"

11. OSHA, "Occupational Safety and Health Administration;"

12. SSPC-PA 1, "Shop, Field, and Maintenance Painting;" and

13. SSPC-SP 6, "Commercial Blast Cleaning."

1.3 ACCEPTABLE MANUFACTURERS

A. The manufacturer for the design and fabrication of the jib crane shall have been in the business of designing and fabricating similar equipment of comparable size for no less than 15 years and shall have at least 5 working installations for not less than 10 years. The supplier shall be subject to the approval of the ENGINEER.

1.4 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 43 52 00 Hoists and Cranes General and requirements of the Standard Provisions.

B. Shop Drawings. Shop Drawings shall show sizes, dimensions, anchorage, clearances, wiring diagrams, and other information necessary for a complete system. Complete catalog cuts shall be provided for all bought-out items. The Shop Drawings to be submitted shall include the following:

1. Complete layout of the equipment supplied with all hook approaches;

2. Make and type of crane and where applicable, trolley;

3. General clearance diagrams which shall show pertinent final dimensions, final weights, bumper reactions, and wheel loads;

4. Assemblies of hoist showing brakes, gear reductions, number of teeth of gears, and drum and sheave dimensions;

5. Arrangement of collectors and trolley power conductors;

6. Make, power rating, speed, and description for each motor, including type of motor insulation;

7. Description and ratings of all brakes;

8. Details of end stops, etc. wherever applicable;

9. Description and details of all controls;

10. Catalog pages describing other components as required;

11. Descriptions of all limit switches;

12. Lists of all crane nameplates and all caution, warning, and control nameplates;

13. Complete schematic, full-line wiring, and connection diagrams covering all equipment and accessories furnished;

14. Electrical data including minimum circuit ampacity and maximum overcurrent protection;

15. Operation and maintenance manuals.

1.5 STRUCTURAL DESIGN

A. **Structural Design Calculations:** The structural design calculations shall consider, as a minimum, the following loads:

1. Seismic Load**:** The seismic loads shall be calculated in accordance with sheet GS-1 design criteria.

PART 2 - PRODUCTS

2.1 GENERAL

A. Drive Trains and Service Factors: Service factors shall be applied in the selection or design of mechanical power transmission components. Components of drive train assemblies between the prime mover and the driven equipment shall be designed and rated to deliver the maximum peak or starting torque (whichever is the greatest), speed, and horsepower. Applicable service factors shall be considered, such as mechanical (type of prime mover), load class, start frequency, ventilation, ambient temperature, and fan factors. Drive train components include couplings, shafts, gears and gear drives, drive chains, sprockets, and V-belt drives. Unless otherwise indicated, the following load classifications shall apply in determining service factors:

Type of Equipment	Service Factor	Load Classification
Cranes or Hoists	1.25	Moderate Shock

B. Protective Coating: Equipment shall be painted or coated in accordance with Section 09 96 00 - Protective Coating, unless otherwise indicated. Non-ferrous metal and corrosion-resisting steel surfaces shall be coated with grease or lubricating oil. Coated surfaces shall be protected from abrasion or other damage during handling, testing, storing, assembly, and shipping.

C. Components: Fasteners, quick release pins, bearings, balls, spools, hooks, and wire rope shall be stainless steel.

D. Protection of Equipment: Machined and coated surfaces shall be protected by rust inhibitor material prior to shipment. Equipment shall be boxed, crated, or otherwise protected from damage and moisture during shipment, handling, and storage. Equipment shall be protected from exposure to corrosive fumes and shall be kept thoroughly dry. Equipment with anti-friction bearings or sleeve bearings shall be protected from being damaged due to jarring motion during shipment. Pumps, motors, drives, electrical equipment, and other equipment having anti-friction or sleeve bearings shall be stored in weathertight storage facilities prior to installation. For extended storage periods, plastic

equipment wrappers should be avoided to prevent accumulation of condensate in gears and bearings. In addition, motor space heaters shall be energized and shafts shall be rotated per manufacturer's recommendation. Equipment delivered to the Site with rust or corroded parts shall be rejected. If equipment develops defects during storage, it shall be disassembled, cleaned, recoated, or otherwise corrected to restore it to original condition.

E. Identification of Equipment Items

1. At the time of shipping, each item of equipment shall have a legible identifying mark corresponding to the equipment number in the Contract Documents for the particular item.

2. After installation, each item of equipment shall be given permanent identification.

F. Shop Fabrication: Shop fabrication shall be performed in accordance with the Contract Documents and the Shop Drawings.

2.2 JIB CRANES

A. Requirements

1. The jib crane, shall have a free standing mast, 1 ton capacity, 14 foot lift, equipped with a motorized boom, and a electrical wire rope hoist with motorized trolley, as shown on the Drawings. The jib crane shall be controlled from a removable pendant pushbutton station and be furnished complete with required safety devices and overload protection. The power supply shall be through a power cable (festooned) with retractable cable reel. The jib crane shall be made with a standard I-beam with stops, mounted on a full three hundred and sixty degree (360°) revolving, self-supporting, floor mounted base securely anchored to the structure, as shown.

B. Site Conditions

Equipment No	**RDWTJCR01**
Atmosphere	Indoors
Operation	Intermittent

C. Boom Assembly

1. Boom. Standard I-beam boom mounted on the free standing mast- supported at top of hopper hoist support structure (bolted to the floor). Boom-Length shall be at 14 ft- radius (farthest point of the hoist pick-up point from mast centerline).

2. Boom Design. Beam deflection shall not exceed one-fiftieth (1/50) of the boom radius under full load. Boom shall have adequate lateral stiffness with a minimum lateral moment of inertia of one-twentieth (1/20) of that of the vertical moment of inertia.

3. Max. Hook radius – 15'-0".

4. Height Under the Boom - 14-0”.

5. Hook Height from the Floor - 12’-0” min.

D. Boom Drive Assembly

1. Description. Jib crane shall have motorized boom for rotation under full rated load. All electrical enclosures shall be rated NEMA 4X or better, suitable for outdoor installation. Totally enclosed, motorized unit shall be capable of rotating the boom 360°. Motorized unit shall be complete with speed reducer, electric motor with brake, reversing starter, adjustable torque switches, etc. for a complete operational unit. Hoist power conductors shall be of the festooned (looped) insulated wire type.

2. Speed of Rotation: one-half to one (1/2-1) rpm.

3. Drive Motor: Single-speed, 460 VAC, 3-phase motor, non-ventilating type.

4. Braking Mechanism: Provide braking mechanism for positioning boom at desired point of rotation. Brake shall be spring set, electrically released with provisions for manual release.

E. Hoist

1. Provide low headroom type electric trolley hoist.

F. Jib Crane Control:

1. Pendant pushbutton station hanging from the crane structure for control of all jib crane motions. Provide mounting bracket on crane to stow pendant when not in use.

2. Provide rotating adjustable, mechanical stops to limit boom rotation.

G. Jib Crane Control

1. Type: Packaged, electric wire rope hoist, under-hung type with motorized trolley.

2. Design: Simple and sturdy design, H3 duty with 30 minutes operational time ratings at 65% mean load factor for infrequent work periods with 200 starts per hour. Hoist shall be suitable for outdoor use.

3. Hoist Operating Speed: Twin speed, one low and one high speed, with high speed between 20-40 feet per minute.

4. Trolley Travel Speed: 30 – 45 feet per minute

5. Minimum Lift: 14 ft.

6. Travel Limits: Two (2) geared limit switches for high and low hook position. Provision shall also be for over travel switches.

7. Wire Rope: Stainless steel, three (3) wraps minimum remaining on drum with hook in the lowest position.

8. Hoist Motor: Two-speed, 460 VAC, 3-phase, TENV, soft start.

H. Controls:

1. Provide one (1) pendant pushbutton station directly connected to the hoist and/or the mast. The pendant shall be provided with a 20-foot cord.

2. The pushbuttons on the pendant shall be clearly marked to indicate its function, and sufficient buttons shall be provided to control operations of hoists and trolley.

3. Jib hoist shall be equipped with an automatic load-limiting device that shall prevent the hoist from applying a pull that would exceed the rated hoist load.

4. All electrical power and control equipment shall be mounted in the mast at readily accessible place. The enclosure rating for all electrical equipment shall be NEMA 4X.

I. Jib Frame: The jib mast and boom shall be constructed of steel. The assembly shall be designed by the manufacture with a flange connection as shown on the drawings.

J. Protective Coatings: Jib mast, beam and components shall be coated using a manufacturer's standard coating systems rated for outdoor installation and service. Do not coat the hardened track. Coating color shall be determined by OWNER. All bolts shall be hot-dip galvanized.

K. Manufacturers, or Equal:

1. Gorbel

2. US Crane and Hoist

3. Handling Systems International

PART 3 - EXECUTION

3.1 FIELD ASSEMBLY AND ERECTION

A. General: All equipment shall be assembled and installed in accordance with the applicable Drawings; written instructions of the manufacturer; and applicable codes, standards, and specifications.

3.2 FIELD TESTING

A. Field Testing: The cranes shall be tested by the CONTRACTOR in the presence of ENGINEER and the OWNER. The CONTRACTOR'S written instructions shall be used as a general guide. The tests shall include, but not be limited to, those specified herein.

B. Preliminary Checks: The equipment shall be examined for proper field assembly and damage during shipment. In particular, it shall be checked for rain or moisture damage

to motors and panels, inadequate painting, accumulations of dirt and rubbish, and oil leaks.

C. No Load Static Tests.

1. All gearing, bearings, couplings, and rotating parts shall be checked for proper oil level or lubrication.

2. The controller for each motion shall be checked to ensure that hook and travel motions agree with marked controller directions.

D. No Load Operation Test.

1. Manual Operation: The crane shall be operated in both the hoisting and lowering direction for the full length of the hook lift.

2. Electric Operation:

a. The crane shall be operated until the limit switch stops travel. Both upper and lower limit switches shall be checked for proper setting (for resulting hook elevation and amount of rope remaining on drum after switch stops travel) and operation.

b. The additional over travel limit switches shall be checked by temporarily bypassing the action of the normal upper limit switch.

c. The hoist shall be checked to determine whether the hook operates within the specified maximum speed ranges. At least two complete raising and lowering operations shall be made for hoist at maximum speed.

d. Proper alignment, quiet operation, and any major tendency toward overheating of motors, bearings, and gear drives shall be checked.

e. Hoist brakes shall be checked to determine whether they are functioning properly.

f. All hook approaches, including the end approaches, shall be checked for conformance to approved shop drawings and the requirements of these Specifications. The limit switches shall allow the specified hook approaches or better.

g. The hoist trolley shall be run in each direction of travel for at least four complete cycles of trolley travel to disclose any tendency toward noisy operation and misalignment at bearings, gearing, or motor. The trolley shall be checked to determine whether the trolley travels at the required speed. The motion of the trolley upon setting the controller to the “off” position shall be checked to determine whether the travel brake correctly stops the trolley.

D. Rated Load Test.

1. Manual Operation: The crane loaded to its rated capacity, shall be operated in both the hoisting and lowering direction for the full length of the hook lift.

2. Electrical Operation:

   a. With the crane loaded to its rated capacity, the tests outlined under no load operation test above shall be repeated except that the additional block operated over travel limit switch operation need not be rechecked.

   b. The operation of the brakes shall be carefully checked. All components shall be checked for overheating. The entire hoist shall be checked for overheating after completing the hoisting and lowering cycle with the test load.

   c. Operating speed on the maximum speed point shall be checked and recorded. The control system shall be checked for proper operation.

   d. The loaded hoist shall be checked to determine whether the hoist control satisfactorily control the handling of the load. The hoist must demonstrate its ability to raise, lower, and hold the rated load in any position.

3. Trolley Travel. The tests outlined above shall be repeated for the trolley travel, with the crane loaded to the rated capacity. The crane swing motion shall be checked for smooth operation and rated speed.

END OF SECTION

SECTION 43 52 04

DAVIT CRANES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The CONTRACTOR shall provide a manual davit crane and pedestal base, complete and operable, in accordance with the Contract Documents.

B. Related Sections. See Related Sections for additional requirements applicable to this Section:

1. Section 05 05 19 – Post-Installed Anchors in Concrete
2. Section 05 05 00 – Miscellaneous Metalwork
3. Section 09 90 00 – Protective Coatings
4. Section 43 52 00 – Hoists and Cranes, General
5. Section 46 01 00 – Equipment General Provisions.

1.02 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 43 52 00 Hoists and Cranes General and requirements of the Standard Provisions.

B. Shop Drawings shall include weights, dimensions, and required clearances.

C. Technical Manuals

1. Include complete operating and maintenance instructions.

PART 2 -- PRODUCTS

2.01 GENERAL

A. Requirements

1. The davit crane shall be a portable hand operated unit with a pedestal mount or base mount as indicated and installed at at the location(s) indicated.

B. Construction: The davit crane shall be designed as follows:

1. Steel construction with stainless steel finish, stainless steel spur gear winch, and stainless teel wire rope. Winch shall be a hand operated type with a brake for load control.

2. Davit crane shall have a telescoping boom that can also be adjusted for height to achieve an operating radius range of 22 inches to 66 inches. Height adjustment shall be by means of a screw jack. Boom shall telescope to 4 lengths.

3. Bases shall be constructed from stainless steel and shall be pedestal or socket mount style as appropriate to their location as shown on the drawings.

4. Base installation anchors shall consist of torque controlled expansion anchors of type 304 stainless steel. Minimum embedment into concrete as recommended by the supplier.

5. Where indicated, provide an extended mast to allow the boom to swing clear the handrail in the lowest position.

C. Capacity and Dimensions

Location	Centrate Wet Well B Pump Station	Sludge Storage Tank Access Bridge	Loadout Structure	Loadout Structure
Min Rated Capacity, lbs	1200	650	650	650
Min Capacity at End of Reach, lbs	650 at 66 inch radius	300 at 66 inch radius	300 at 66 inch radius	300 at 66 inch radius
Wire Rope size, length	1/4 inch	3/16 inch	3/16 inch	3/16 inch
Length of lift below floor, min	27 feet	33 feet	30 feet	15 feet

D. Manufacturers, or Equal:

1. Thern, Commander Series

PART 3 -- EXECUTION

3.01 GENERAL REQUIREMENTS

A. Davit crane and bases shall be installed in strict accordance with the manufacturer's published or written instructions.

B. Anchor the pedestal or socket base to structural steel concrete using bolts or expansion anchors of size and embedment recommended by the crane supplier.

3.02 FIELD TESTING

A. After completion of the WORK, the CONTRACTOR shall test hoist and crane equipment in the presence of the manufacturer's field representative, who shall certify in writing that the equipment meets applicable standards and specifications.

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SECTION 43 62 11

SHAFTLESS SCREW CONVEYORS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The CONTRACTOR shall provide shaftless screw conveyors with all drives, motors, supports, controls and appurtenances for a complete and properly operable system, all in accordance with the requirements of the Contract Documents.

B. The Shaftless Screw Conveyors of this section, shall be manufactured and provided by a single entity that shall assume complete responsibility for the coordination of the individual components. The CONTRACTOR shall furnish these conveyors under one contract with one of the named / listed manufacturer's. One entity shall manufacture the equipment for each section without outsourcing.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. The WORK of the following Divisions or Sections applies to the WORK of this Section. Other Divisions or Sections of the Specification, not referenced below, shall also apply to the extent required for proper performance of the WORK

1. Section 05 12 00 Structural Steel Framing.
2. Section 05 50 00 Miscellaneous Metalwork.
3. Section 09 60 00 Protective Coating.
4. Section 46 01 00 Equipment General Provisions.
5. Division 26, Electrical, as applicable
6. Section 26 05 10 Electric Motors

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Specifications, codes, and standards listed in the GENERAL REQUIREMENTS.

B. American Gear Manufacturers Associations: AGMA Class II Rating.

C. AISC Specifications for Design Fabrication and Erection of Structural Steel for Buildings.

D. Steel Structures Painting Council Surface Preparation Specifications (SSPC-No. SP6-63).

E. American National Standards Institute (ANSI):

1. B3.15: AFBMA Standard, Load Ratings and Fatigue Life for Ball Bearings.

2. B3.16: AFBMA Standard, Load Ratings and Fatigue Life for Ball Bearings.

3. B105.1: Standard Steel Drum Pulleys.

4. 4B20-1: Safety Standard for Conveyors.

F. American Welding Society (AWS) "Structural Welding Code" D1.1 with amendments to date.

G. American Society for Testing and Materials (ASTM) Publications:

H. A36: Specification for Structural Steel.

I. Specifications, codes, and standards listed in the reference Divisions and Sections.

J. Conveyor Equipment Manufacturers Association (CEMA).

K. Anti-Friction Bearing Manufacturers Association (AFBMA).

1.04 CONTRACTOR SUBMITTALS

A. The CONTRACTOR shall submit a single, comprehensive, and complete submittal according to the requirements of Section 40 61 00, Equipment General Provisions and requirements of the Standard Provisions.

B. Spare Parts: CONTRACTOR shall provide one (1) spare auger section and one (1) set of bearings for the new shaftless conveyors. The CONTRACTOR shall also obtain and submit from the manufacturer a list of recommended spare parts. All spare parts provided shall be suitably packaged, identified with the equipment number, and labeled. CONTRACTOR shall also furnish the name, address, and telephone number of the nearest distributor for each piece of equipment.

C. Technical Manuals: The CONTRACTOR shall obtain and submit the complete Manufacturer's operations and maintenance manuals.

D. Special Tools: The CONTRACTOR shall provide all special tools required for installation, operation, and maintenance of the equipment with each unit of equipment.

E. Factory Inspection and Testing: The CONTRACTOR shall submit procedures, schedules, and reports of factory inspection and testing as specified.

F. Field Installation, Testing, and Startup Procedures: For each type of equipment, the CONTRACTOR shall submit instructions for erection, setting, leveling, alignment, inspection, adjustments, inspection, testing, and startup prior to installation of any unit of equipment. Submit test reports for each unit of equipment after completion of testing of that unit.

G. Equipment Warranty: The CONTRACTOR shall provide equipment warranties and guarantees as published in its literature. The minimum spiral-train Warranty shall be three (3) years defined as follows; All weldments and wear (not including wear item – liner) of drive shaft to first coupling plate, spiral to second coupling plate, all spiral welds

and the wear of same.

H. Design Guarantees Summary

1. An 12,000 hour (3 years) system operating warranty excluding normal wear items such as liners, seals and bearings.

2. Spiral Train (drive shaft, coupling drive plates, full spiral, all welding) shall be designed for a minimum of 15,000 operating hours (five (5) years.

3. Mechanical seal of drive shaft shall be designed for 5,000 hours without shaft wear or leakage.

4. Start-up 100 percent loaded, vertical and horizontal.

I. The CONTRACTOR shall submit complete shop drawings as outlined in Section 46 01 00, Equipment General Provisions, including the final transfer chute and screw conveyor equipment configuration drawings, screw size, trough description, parts nomenclature, installation dimensions, weights, loadings transmitted to the foundation or supports, instrumentation, electrical equipment with wiring schematics, and transfer chute design and installation drawings.

J. Design calculations for the screw conveyor, transfer chutes, and supports stamped and signed by a California registered engineer showing stresses resulting from all dead, live, and dynamic loading for normal and seismic conditions as required by UBC Seismic Zone 4.

K. Torque calculations for the screw conveyor, gear reducer and reducer motor and horsepower calculations for the drive motor.

L. Calculations for stress in the auger screw corresponding to the torsional rating as indicated in DESIGN REQUIREMENTS.

M. Drive motor submittals shall be in accordance with Section 26 05 10, Electric Motors. Submittals not in accordance will not be accepted by the ENGINEER OF RECORD for review. Calculations shall be submitted to verify the motor horsepower rating.

N. Certification from the Manufacturer stating that the equipment complies with the Specification, and that the Manufacturer accepts responsibility for coordination of all equipment and services required for proper installation and full operational readiness of the installed equipment.

O. The CONTRACTOR shall submit evidence that the Manufacturer has at least five years experience in the design and manufacture of shaftless screw conveyors and shall submit a reference list of similar applications with contact names and telephone numbers.

P. Contractor shall furnish lubricants of the type and quantity as recommended by the conveyor manufacturer for start –up and one full year of operation.

1.05 QUALITY ASSURANCE

A. Comply with requirements of the Related Work Divisions and Sections and the GENERAL REQUIREMENTS.

B. Shop Inspection: The CONTRACTOR shall arrange for shop inspection of the equipment according to Section 09 of the Standard Provisions.

1. All equipment shall be subject to shop inspection in accordance with Section 09 of Standard Provisions .

2. For all equipment, the CONTRACTOR shall obtain and submit the following to the ENGINEER OF RECORD for approval:

a. The Manufacturer's standard factory test procedure and schedule prior to equipment fabrication or manufacture.

b. The CONTRACTOR shall obtain and submit to the CONSTRUCTION MANAGER for approval the final factory test reports prior to shipping of equipment.

C. Field Performance Test and Reports: All equipment shall be performance tested after installation at the field operating site according to Section 46 01 00, Equipment General Provisions.

1. Testing shall not start until all preliminary checks and calibrations have been completed, the installation has been certified ready for testing by the Manufacturer's representative, and the test forms and procedure have been approved by the CONSTRUCTION MANAGER.

2. All test information shall be recorded on forms provided by the OWNER or approved by the ENGINEER OF RECORD. If forms are not available from the OWNER, the CONTRACTOR shall prepare forms and submit for approval prior to the scheduled start of the test.

3. The CONTRACTOR shall submit the test procedure for approval prior to the scheduled start of the test.

4. The CONTRACTOR shall prepare a field performance test report, including all raw data, and submit the report within 14 calendar days after approved completion of the equipment field test.

D. Screw conveyors shall be fully assembled and given a no-load running test at the Manufacturer's facility. Test results shall be submitted and approved prior to shipment of the screw conveyor. Provide 14 calendar days notice of the factory test.

E. After inspection of the installed equipment the Supplier shall furnish a written report certifying that the equipment has been properly installed and lubricated, is in accurate alignment, is free from any undue stress imposed by connecting piping or anchorage, has been operated under full load conditions and that it operates satisfactorily.

PART 2 -- PRODUCTS

2.01 GENERAL

A. All equipment furnished under this section shall comply with Section 46 01 00, Equipment General Provisions.

B. The shaftless screw conveyors shall be new and of current manufacturer, and shall be designed to transfer screenings or municipal dewatered sewage sludge from the centrifuges to the loadout structure. The shaftless screw conveyors and components shall be designed and constructed in accordance with CEMA Standard 350, and with the following:

Equipment ID Number	**Discharge Conveyors (RDTWCNV08 & 11)**	**Vertical Transfer Conveyors (RDTWCNV09 & 12)**	**Horizontal Transfer Conveyors (RDTWCNV10 & 13)**	**Loadout Conveyors (RDTWCNV05 & 06)**
Service (Material)	Sludge Cake	Sludge Cake	Sludge Cake	Sludge Cake
Temperature (F)	95	95	95	95
Operation	Continuous	Continuous	Continuous	Continuous
Dry Solids Content	20% (MAX)	20% (MAX)	20% (MAX)	20% (MAX)
Design Capacity, (cu. ft/hr)	322	322	322	1,235
Bulk Density Range, (lb/cu ft)	45 – 70	45 – 70	45 - 70	45 - 70
% Allowed Fill Rate	35%	48%	41%	30%
Conveyor Angle or Inclined	10 Degrees	90 Degrees	0 Degrees	0 Degrees
Minimum Trough Size (in)	16 5/8”	16 5/8”	16 5/8”	24 ½”
Minimum Screw Diameter (in)	16 5/8”	16 5/8”	16 5/8”	24 ½”
Max. Screw Speed (RPM)	20	20	20	20
Min. Motor Size (HP)	7.5, 7,5	5, 7.5	7.5, 7.5	20, 20
Power Supply	480v/60Hz/3-phase	480v/60Hz/3-phase	480v/60Hz/3-phase	480v/60Hz/3-phase
Motor/Screw Reverse Rotation	No	No	No	No
Inlet Quantity	1	1	1	4
Outlet Quantity	1	1	1	4

Knife Gates	0	0	0	4
Conveyor heat-traced	No	No	No	No
Approximate Length (As indicated on the drawings)	19', 28'	20', 20'	54', 60'	33', 33'
Transport Direction	Push	Pull	Push	Push

2.02 DESIGN REQUIREMENTS

A. Each conveyor shall be sized to convey the design material handling rate at less than 60 percent of the conveyor's rated capacity or 25 percent trough filling. The flight, shaft, and complete drive components shall be designed for a conveyor capacity of 100 percent trough loading. The torque capacity of the drive unit shall be sufficient to start the conveyor with the trough 100 percent loaded.

B. The Manufacturer shall submit the following calculations:

1. Determination of the torque rating of the screw conveyor auger (defined as the shaft/flighting weld assembly). The maximum allowable stress at any point in the auger shall not exceed 25 percent of the material yield stress (F_y).

2. Demonstration that the auger torque developed by the drive motor at maximum rated horsepower does not exceed 33 percent of the auger torque rating.

3. Demonstration that the maximum torque that the drive system is capable of producing under any operating or overload conditions does not exceed 50 percent of auger torque rating.

4. Demonstration that F_y at any point in the auger is not exceeded when the drive motor is operated at 250 percent of rated horsepower.

5. Design of a shear pin drive connection which shall not fail under any of the above conditions, but will prevent the auger stress from exceeding 90 percent of F_y.

C. Materials: Materials used in the fabrication of the equipment furnished under this Section shall conform to the following:

1. Troughs: 3/16-inch thick minimum 304Stainless Steel

2. Covers: 10 gauge minimum 304 Stainless Steel

3. Chutes: 3/16-inch thick minimum 304 Stainless Steel

4. Drive and End Plate: 1/2-inch minimum 304 Stainless Steel – Bolted connection

5. None-Drive End Plate: 3/8-inch minimum 304 Stainless Steel – Bolted connection

6. Spiral Flights: Cold-Form Carbon 3” x 1” outer and 2.5” x 3/4 “ inner. Micro-Alloy, Brinell 215/240, 80,000/95,000 psi Yield Min/Max

7. Minimum Spiral Diameter 12-inches

8. Support Angle: 3” X 3” X 1/4” Minimum 316 Stainless Steel

9. Wear Liner: 3/8-inch thick UHMW Plastomeric -Xylethon by Durawear Company

10. Bolts, Nuts and Washers: Type 316 Stainless Steel. All threads shall be coated with "Never Seeze" or equal.

11. Cover Fasteners: Type 316 Stainless Steel Screws at 12-inch Spacing

12. Drive Shaft: AISI 1045

13. Protective coatings: All surfaces not stainless steel shall be coated in accordance with Section 099600 Protective Coatings.

14. Drive Coupling Plates (2) as spiral +1/2”, -0” AISI 1045 steel, ¾” min. thickness Diameter same

2.03 SPIRAL FLIGHTING

A. Spiral flighting for the shaftless screw conveyors shall be designed to convey material without a center shaft or hanger bearings. The flighting shall be provided with an inner spiral to increase axial strength and capacity.

B. Spiral flights shall be cold-formed high strength chrome alloy steel with a minimum hardness of 215 Brinnell. The spiral flights shall be designed with adequate stability to prevent distortion and jumping in the trough. A second, inner spiral, concentric with the outside spiral shall also be provided. The torsional rating of the auger flighting shall exceed the torque rating of the drive motor at 150% of its nameplate horsepower. The "spring effect" of the spiral shall not exceed + 1.0 mm per 100 mm of length at maximum load conditions. Total spiral elongation under maximum load 0.10 inch per foot.

C. The spiral flighting shall be formed in sections from one continuous flat bar and shall be concentric to within +2mm. Sectional flighting formed from plate shall not be permitted.

D. Spiral flighting shall have full penetration welds at all splice connections. The flights shall be aligned to assure true alignment when assembled in the field and shall be made in accordance with the supplier's requirements.

E. Field welds at the job site by the Contractor for installation may be necessary when any overall conveyor length presents shipping or handling constraints.

F. A gland packing ring consisting of two aramid fiber packing rings shall seal the drive shaft at its penetration through the end plate, along with a greased labyrinth sealing system.

G. The connection of the spiral to the drive system shall be through a flanged connection plate that is welded to the spiral forming a smooth and continuous transformation from the flange plate to the spiral. The drive shaft shall have a mating flange and shall be bolted to the spiral connection plate. Additionally, a grease lubricated labyrinth seal shall be shaft mounted internally in the conveyor between the back plate and spiral coupling connection.

H. Structural Integrity, The spiral shall be made from hot-rolled micro-alloy steel bar which is cold formed into the final specified diameter, pitch, hardness and strength that eliminates OD spiral thinning or cracking, the cold-forming process. Spirals made from bars cut from hot-rolled plate will not be accepted. Spirals must be formed on a mandrel which uses a device to control the plastic flow of the spiral during forming and maintain a uniform outside and inside diameter thickness with 5% maximum neck-down. The second stage of spiral forming shall consist of cutting the spiral tool ends to assure uniform diameter and shall be concentric to within 1/16 (.0625) inch.

I. The actual spiral manufacturer (not reseller) shall issue a mill certification verifying the material and fabrication process herein specified.

J. Size and Physical Properties: All spiral flighting for the system shall consist of double spirals (outer and Inner) consisting of two (2) only concentric spirals, an outer spiral (3.0” wide maximum x 1.0” thick minimum) and an inner spiral (2.5” width maximum and x 3/4” thick minimum) welded together to form a single contiguous cold formed spiral with a final width of at least 4.33 inches.

K. Spiral Connection: The spiral flighting shall be connected to the drive shaft by welding the spirals to the 3/4-inch (20 mm) minimum circular Drive/Coupling torque transmission plates welded to the spiral as follows:

L. The Drive Coupling plate attached to the drive shaft will use a six (6) pass full penetration weld cleaning after each pass. The drive-coupling plate and drive shaft shall first be machined with 45 degree ¼” matching bevels for welding. The drive-coupling plate shall be bevel machined on both sides.

M. The shaft and coupling plate must be maintained at a 90º angle. Place the coupling plate and shaft into a sturdy jig made for this purpose and tack weld. Proceed with the first pass. The drive coupling plate shaft shall then be put into a lathe and the plate side opposite the shaft shall be machined to ensure a 90º connection.

N. Weld both sides of the shaft with six (6) passes to the coupling plate.

O. Weld the second spiral coupling torque transmission plate to the spiral. The spiral end shall have a 45º. Place the spiral and coupling into a sturdy jig that maintains the spiral level, and the coupling plate at the correct height for welding to the spiral.

P. Grind smooth on and properly reinforced and welded with a curved gusset plate at 180 degrees. The centerline of the spiral shall be perpendicular to the torque plate within +/- 0.015 inch. A separate 3/4-inch (20 mm) minimum torque transmission plate shall be bored with a countersunk and chamfered hole equal to the 1/4 inch less than the shaft

diameter and the drive shaft shall be lathe-turned, keyed and undercut concentrically to a tight fit then welded to the plate with a six pass full penetration weld technique. The shaft shall be perpendicular to the torque plate within +/- 0.015 inch. The torque plates shall be connected with three (3) 3/4-inch No. 8 bolts and no space shall show between the connected plates. Spirals welded directly to a shaft or connected in any other way will not be accepted.

Q. Spiral Welding: Spiral connections shall be welded according to AISC B-U3-GF and be six full-pass full-penetration welds. Flights shall be welded in a jig or the trough to assure true alignment. The OD of the joined spirals shall be completely concentric with no misalignment. Weld jointed spirals shall be straight and not show any misalignment or thump when rotated.

2.04 HOLD DOWN PROVISIONS

A. In order to avoid excessive wear and increased maintenance the conveyors shall be designed without the use of hold down bars. Proprietary additional hold-down guide liners will be accepted that do not interfere with the flow of conveyed product.

2.05 TROUGHS

A. Horizontal and Inclined Troughs shall be U-shaped and be similar to the dimensional standards of CEMA 350 with a double turn down top edge of the trough.

B. A flanged drain outlet shall be provided with each conveyor to facilitate cleaning. The drain outlet shall be piped to a drain as shown on the drawings. Drain flushing connections are to be provided where specified. The Contractor shall furnish all labor and materials to connect the conveyor drains with the plant drain system.

C. Conveyor shall be provided with a stuffing box consisting of two ½ x ½ inch Teflon packing rings for the drive shaft that penetrates the end plate, along with a greased labyrinth sealing system. The stuffing box shall be designed so that the packing can be tighten and replaced without removing the drive assembly

D. Shaftless conveyors shall be equipped with an external flange adapter which will connect to the conveyor end plate and to support the drive assembly. The adapter shall de designed to allow any material passing the stuffing box to escape and not to contact the drive assembly.

E. Each trough shall be equipped with inlet and/or discharge openings as shown on the contract drawings. If required, each inlet and discharge opening shall be flanged suitable for interconnection to other devices. Any interconnecting devices such as chutes and hoppers shall be fabricated from the same grade of material as the troughs and to a gauge to suit the applications requirements.

F. Clamped and hinged covers shall be furnished for any portion of each trough that is not covered by the filling chute. Covers shall be manufactured in maximum four (4) foot length section to allow for easy access and ease of liner replacement. To prevent unsafe access to the conveyors, quick opening covers will not be allowed.

G. Bolted cross support shall be spaced at no more than 4 foot intervals. The top of the conveyor flange and cross support to be provided with adhesive backed neoprene sponge rubber seals Minimum size shall be 3/16-inches thick by 1-inch wide.

2.06 TROUGH COVERS

A. The portion of each trough that is not covered by the inlet chute shall be covered by a minimum 1/8-inch thick steel cover. Covers shall conform to CEMA Standard No.300-023 except the flanges. The flanges shall have a turndown edge of at least 5/8-inch.

B. Covers shall be provided with adhesive backed neoprene sponge rubber seals located on the interior surface which mates with the trough flanges and cross-over members. Minimum size shall be 3/16-inches thick by 1-inch wide.

C. Cover fasteners shall be 316 stainless steel toggles at one foot maximum spacing and shall be provided according to CEMA Enclosure Classification III E. Seams between covers shall be a minimum of 1/4-inches wide for ease of opening.

D. Trough cover shall be flanged bolted of the hinge type. The cover shall be made in approximately 4-foot sections, and be provided with a minimum of two hinges with removable hinge pins on one side, and toggle clamps on the opposite side. Maximum weight of cover sections shall not exceed 50 pounds. Fasteners shall be 316L stainless steel. Clamps shall be spaced to ensure an air tight seal.

2.07 CONVEYOR SUPPORTS

A. Supports from the conveyor trough saddle to the nearest building structure shall be provided by the Manufacturer.

B. The ratio of the unbraced length to least radius of gyration (slenderness ratio) shall not exceed 120 for a compression member and shall not exceed 240 for any tension member (of angles about the Z-Z axis). In addition, all structural members and connections shall be designed so that the unit stresses will not exceed AISC allowable stresses by more than 1/3 when subject to loading of twice the maximum torque of the drive motor.

C. Supports shall be provided within 2 feet of the drive units and at locations no more than 10 feet apart along the conveyor.

D. Support loads shall be based on a completely filled trough, the dead weight of the equipment and two times the maximum drive motor torque.

E. All welds shall be continuous.

F. Support members shall be made from rectangular or square stainless steel tubing with a minimum wall thickness of 1/4-inches. Connections shall be gussetted, preferably with sections cut from the tubing.

G. Bolted support saddles shall be 3/8-inch thick stainless steel and conform to CEMA

Standard No. 300-13 for the hole spacing and feet distance from the trough centerline.

H. All structural steel shall be in accordance with the provisions of Section 051200, Structural Steel.

I. All structural steel members shall be coated in accordance with the provisions of Section 09 96 00, Protective Coatings.

J. All shop welding shall conform to the latest standards of the American Welding Society (AWS). The supports shall be designed to avoid interference with other equipment or equipment supports.

K. All screw conveyors supports shall be provided by the screw conveyor manufacturer and shall be installed by the Contractor in accordance with the manufacturer's instructions. The Contractor shall coordinate field dimensions and equipment installation with the supplier and provide a complete and operable system. The Contractor shall be responsible for all demolition work of existing equipment, supports, structures, etc. as indicated on the drawings, and as required, during the course of screw conveyors installation.

2.08 SCREW CONVEYOR GATES

A. Each horizontal shaftless screw conveyor shall have vertical drop discharges to drop dewatered sludge into another conveyor or a waiting truck in locations shown on the drawings.

B. Each gate shall have a square discharge sized to convey the full capacity of its respective conveyor, shall be electrically actuated, and shall have open and closed limit switches.

C. Each gate shall be leak free and drip proof.

D. Each gate guide shall be equipped with a Type 304 SS removable cover or bonnet to prevent injury during gate operation.

E. Each gate shall have the following construction:

1.	Frame	Type 304 SS
2.	Door	Type 304 SS
3.	Guides	UHMW Black
4.	Wiper	Neoprene 60D
5.	Wiper Retainer	Type 304 SS
6.	Motor	½ HP, 480 volt, 3 phase C-Face, TEFC, 1800 rpm
7.	Miscellaneous Hardware (nuts, bolts, lockwashers, machine screws, clevis pins, cotter pins, etc.)	Stainless Steel

F. **Controls:** Each screw conveyor gate shall be controlled by a Screw Conveyor Gate remote actuator control station provided in addition to the actuator assembly and mounted in the sludge loading area at a location shown on the drawings. Provide conduit and wiring between the actuator controls and the valve actuator for these applications. The local control stations shall provide functions in accordance with the requirements below.

1. The station shall include OPEN, CLOSE, and STOP push buttons, and a LOCAL/REMOTE selector switch.

2. Where indicated on the Instrumentation Drawings, provide a 2-wire control system as indicated above.

3. The control system shall allow communications to the PLC via a PROFIBUS DP network cable in order to monitor and control the valve as indicated above and in Section 409010 – Control Strategies. The Profibus DP network card shall be lightning protected for all outdoor located actuators.

4. The local control station and local power disconnect may be provided as an integral part of the actuator, or as otherwise indicated or required in order to permit operation by a person at floor elevation and within sight of the valve actuator.

5. In addition, provide the following:

   a. A 480 volt, 3 phase circuit breaker disconnect.

   b. 120 volt, 15 amp distribution circuit breakers for all 120 volt loads including control circuits. Provide two spare 15 amp circuit breakers.

   c. All other necessary devices to satisfactorily operate the system.

G. Manufacturers, or Equal

1. **Austin-Mac, Inc.**

2. **JDV Equipment**

2.09 TRANSFER CHUTES, FLEXIBLE BOOTS, AND SUPPORTS

A. General:

1. Refer to Drawings for a general layout of the screw conveyors and transfer chutes. These drawings are illustrative outlines only, and do not in any way relieve the CONTRACTOR of fulfilling the obligations listed in the following paragraphs.

2. The CONTRACTOR shall design, detail, furnish, and install screw conveyor inlet and discharge wet cake transfer chutes.

   a. The inlet chutes will go from the Centrifuge Cake Discharge to Shaftless Screw Conveyor.

   b. The discharge chutes will go from the Shaftless Screw Conveyor to the cake

pump hoppers.

c. CONTRACTOR shall furnish and install a 1-inch thick gasket at the flanged connections between all conveyors, and between conveyors and cake pumps as shown on drawings.

3. The CONTRACTOR shall design, detail, furnish, and install all transfer chutes appurtenances, including stiffeners, mounting brackets, transition sections, flanged flexible boots connection, supports, and structural steel.

4. Materials shall be as follows:

a. Chutes: Shall be 1/4-inch minimum plate, type 316L stainless steel.

b. Flanges and Stiffeners: Shall be 2 inches by 2 inches by 1/4 inch angle minimum, type 316L stainless steel.

c. Mounting Brackets: CONTRACTOR to determine size and thickness, type 316L stainless steel.

d. Supports: All support steel not welded to the chutes shall be according to Division 5, Metals.

e. Preparation and Welding of Stainless Steel: Refer to Section 460100, Equipment General Provisions, for special precautions.

f. Fastening Hardware: All fastening hardware in contact with stainless steel components shall be type 316 stainless steel. Other fastening hardware shall conform to Division 5, Metals.

g. Gaskets: Shall be Buna-N, 3/16 inches thick by 2 inches wide, unless otherwise specified.

h. Protective Coating: Shall conform to Section 09 96 00, Protective Coatings.

B. Inlet And Discharge Chute:

1. The CONTRACTOR shall ensure that the inlet and outlet discharge matches flanges on the equipment, and shall provide any required transition sections.

2. The CONTRACTOR shall provide structural steel supports. Aisles, walkways, and equipment maintenance access shall be maintained according to Section 460100, Equipment General Provisions, and as shown.

3. The CONTRACTOR shall ensure that floor penetrations are sized and aligned properly in accordance with the final equipment configuration.

2.10 DRIVE UNIT

A. Each spiral conveyor shall be driven by a constant-speed integral gear reducer/motor drive unit mounted to an adapter flange mounted to the end plate of the conveyor. The

drive system shall be designed for starting the conveyor fully loaded. Electric motors shall be TEFC, 480 volts, 60 Hz, 3 phase, high efficiency, heavy duty and chemical duty suitable for corrosive environment, NEMA B design with Class F insulation and 1.15 service factor. The design of all drive components shall be such that jamming of any components shall not cause damage to the equipment. The conveyor shall be equipped with a reversing gear motor, where specified, which allows either push or pull conveyance.

B. The adapter flange shall allow the leakage of any material from the conveyor trough to atmosphere rather than into the gear reducer/ motor drive unit. Direct coupling of the gear reducer/motor drive unit to the end flange of the conveyor will not be acceptable.

C. The drive unit shall be rigidly supported so there is no visible "wobble" movement under any operating condition. In the event of a prolonged power failure or emergency system shutdown the drive system shall be designed, at a minimum, to start the conveyor from a dead stop with the trough filled throughout its entire cross sectional area and length with partially dried and hardened dewatered material.

D. All electric motors shall be totally enclosed fan cooled, quiet line, and heavy duty. Drive system components shall be provided such that jamming of any components do not cause damage to the equipment. Electric motors shall conform to Section 260510, Electric Motors.

2.11 DRIVE ADAPTER

A. The drive adapter shall consist of two (2) parallel circular plates connected with four welded angles and machined with parallel faces to within +/- 0.015 inch and bolted to the end plate. The machined drive adapter plate faces shall be parallel to the torque transmission plates to +/- 0.015 inch.

B. The drive unit for the horizontal push screw shall be a PUSH configuration, with A HOLLOW SHAFT MOUNTED gear reducer motor rated a minimum AGMA Class II, single or double reduction or triple reduction. Provide NORD Gear Corporation Unicase, or equal, shaft mounted drive with shrink disc hollow shaft design. (V-belt driven speed reducer or chain driven reducers not permitted.) Shaft shall be AISI 1045, 1050 and welded as in 2.2 herein. The drive and motor assembly shall be capable of supplying 250 percent of the start-up torque required at 100 percent trough loading.

C. Provide reversible motor for the inclined pull conveyor, TEFC 460V, 60-hertz, 3-phase constant speed motors at discharge end of conveyor running at approximately 1800 rpm.

2.12 GEAR REDUCER

A. All gear reducers shall be commercially built, AGMA Class II, single, double, or triple reduction, helical gear units with high capacity roller bearings. Bearings shall be designed for the thrust loads from the fully loaded startup condition and shall have an AFBMA B-10 life of 50,000 hours. The reducer shall be standard air-cooled unit with no auxiliary cooling requirement. The gear reducer shall be sized with a torque service factor of 1.5 times the absorbed power or 1.1 times the motor nameplate, at the driven

shaft speed, whichever is greater.

2.13 WEAR LINERS

A. Liner – The inside trough surfaces of both the screenings compactors and shaftless conveyors shall be lined with a 3/8-inch thick (minimum) layer of ultra high molecular weight polyethylene UHMW-PE manufactured by Durawear corporation under the name Xylethon or equal. The wear liner shall be furnished with two (2) layers, each of a different color, to provide a visible indication when the liner is nearing the end of its useful life. The liner shall be supplied in maximum 4-foot long sections to provide ease of replacement. The liner shall be held in place with stainless steel 3/8" keystock 4" long welded to both sides of the trough at the top of the liner which shall be on the trough vertical flat above the trough curved section.

B. The liner manufacturer shall guarantee a minimum liner replacement of 12,000 (2 years) operating hours before replacement. Liners shall be replaced at no cost to the OWNER in the first two years of operation and prorated in the third year. Test reports shall be furnished to verify density compliance.

C. The portion of the trough not covered by a filling chute shall be covered by 12 gauge Stainless Steel cover with bent over edges in 4-foot sections with stainless steel screw clamps and 1-inch continuous red rubber gaskets along the top flange.

D. The liner material shall have the following physical properties, as a minimum:

Property	Value/Unit	Testing Method
Density	61.2 lbs/ft^3	DIN53479
Molecular Weight	9.2x10^6 g/mol	Margolies
Ball Indentation Hardness	5,946 lbs/in^2	DIN53456
Shore Hardness D	64	DIN53505
Crystalline Melting Range	278º F	
Dynamic Coefficient of friction	0.1-0.12 ratio of tension/load	Plastic to steel

2.14 FLEXIBLE BOOTS

A. Flanged flexible boots shall be provided where shown. The purpose of the flexible boot is to isolate the screw conveyor from the centrifuge vibration. The flexible boot shall be black molded neoprene or Hypalon, 2-ply fabric reinforced with polyester cord, and complete with 316 stainless steel backup flanges and hardware with suitable dimensions to fit between the chute and screw conveyor flange. Transition pieces on chutes shall be provided as required for installation. It shall be the responsibility of the Contractor and screw conveyor supplier to coordinate such requirements.

2.15 Safety Devices

A. Motion Detector: A motion switch with reset to detect under speed or zero speed shall be provided with each conveyor. The unit shall have a time delay to allow the selected machine to accelerate and have sufficient range on the calibration to be able to detect decrease in speed as an alternative to motion failure. The unit shall detect failure in the

forward - directions if required. The motion detector shall be as manufactured by Miltronics or approved equal.

B. Each conveyor shall be equipped with an emergency stop connected to a pull rope attached to each side of each conveyor.

C. Contractor shall install three (3) rows of 3-inch safety striped tape at the bottom of each side of Conveyor blanket over the full length of the conveyor for low head clearance warning. Tape shall be 8-mil thick vinyl tape.

2.16 CONTROLS

A. Controls and panel mounted devices: Refer to Section 409010, Control Strategies, 3.6 for controls description. The Local Control Panel (LCP) shall be provided in accordance with specification 260515, Local Control Stations and Miscellaneous Electrical Devices. Controls shall be provided to interface with the centrifuge control panel. The panel shall be provided with the following components;

1. Panel mounted Hand/Off/Remote (H/O/R) switch
2. Start/Stop Pushbuttons
3. Emergency Stop
4. Motor Run and Fail indicator lights
5. Shaft zero speed alarm indicator light,
6. Cake Pump Trough High Level alarm light
7. Fault Reset pushbutton
8. Screw Conveyor motor starter.

B. The classifier screw motor shall receive a signal from the Centrifuge panel to operate in a drain mode (reverse) or forward to discharge into the cake pump hopper.

2.17 ELECTRICAL EQUIPMENT

A. All electrical equipment shall conform to applicable standard of the National Electrical Manufactures Association (NEMA) and the National Electrical Code (NEC). Both power and control equipment shall be insulated for not less than 600 volts even though operating voltages may be lower.

B. All motors shall be totally enclosed, fan cooled (TEFC), designed in accordance with the detailed motor specifications and suitable for operation with a 480 volt, 3 phase, 60 Hz. Power supply.

C. Each conveyor drive unit shall be equipped with a motion failure alarm unit. The location and mounting details shall be as recommended by the conveyor manufacturer. Motion sensors shall be the non-contacting type using a probe with a pre-amplifier and main

electronic assembly. The main electronic unit shall operate on 120 volt, single phase, 60 Hz power supply, and shall be housed in a NEMA 4 enclosure. A 0 to 60-second time delay shall be provided for startup of the conveyor.

D. Each conveyor motor starter shall incorporate a solid state electronic motor overload/trip relay. The overload relay shall be self powered and shall trip in 2 seconds or less under phase loss conditions when applied to a fully loaded motor. The relay shall include a visual trip indicator and shall be equipped with a test button that operates the normally closed contact.

E. In addition to overload protection, the electronic relay shall also trip upon sensing either a ground fault, nominally at 50% of FLA setting or when sensing a jam, when the motor current exceeds 400% of the FLA setting. Jam protection shall be disabled for 30 seconds during startup. Relay shall be Allen Bradley model SMP-2 or equal.

2.18 ELECTRICAL CONTROLS

A. Electrical controls and panels shall be as shown on the drawings and specified in Section 40 90 10.

2.19 MANUFACTURERS, OR EQUAL:

A. Shaftless screw conveyor:

1. Keystone Conveyor Corporation
2. Biosec Enviro Inc.;
3. Spirac Inc;
4. Jim Myers and Sons
5. Custom Conveyors Corp.;
6. Or Equal

B. Gear Reducer:

1. Dodge Gear;
2. Falk Gear;
3. Nord Gear;
4. Sew Eurodrive;
5. Or Equal

PART 3 -- EXECUTION

3.01 INSTALLATION

A. The shaftless screw conveyor shall be installed in strict accordance with the ENGINEER OF RECORD approved Manufacturer's printed installation recommendations, and with the requirements of the Contract Documents.

B. Manufacturer’s Field Services: Furnish the services of a qualified representative of the equipment manufacturer to provide instruction on the proper installation of the equipment, inspect the completed installation, make any necessary adjustments, and participate in the startup of the equipment and place the equipment in trouble-free operation. Furnish a minimum of one trip, 24 hours of start-up and instruction.

3.02 OPERATOR TRAINING AND FIELD TESTING

A. The CONTRACTOR shall furnish the services of a qualified representative of the screw conveyor manufacturer who shall provide training for the OWNER’s personnel in the proper operation and maintenance of the screw conveyor equipment. This training shall be followed by field testing during which the OWNER’s personnel will operate the equipment under the supervision of the manufacturer’s representative who shall direct the OWNER’s personnel in operational adjustments, but who shall not touch the equipment or personally make any modifications or adjustments thereto during the field testing period.

B. Operator training shall commence following receipt by the OWNER of all specified copies of the complete and accepted shafted screw conveyor operation and maintenance manuals and upon completion of the services described below in section D.

C. Operation and maintenance training shall be in accordance of Section 017900.

D. The screw conveyor shall be field tested after installation and operator training to demonstrate satisfactory operation without causing excessive noise, vibration, and overheating of the motor bearings.

E. Field-testing shall be performed by an experienced field representative for each major item of equipment. This representative shall submit a written procedure to the CONSTRUCTION MANAGER for prior approval, shall conduct testing, and shall supervise as a minimum, the following tasks:

1. Start up, inspect, and operate the equipment over the entire speed and load range

2. Determine bearing temperatures with a contact-type thermometer. A running time under load of at least 20 minutes shall be maintained for this test.

3. The representative shall certify in writing that the equipment have been properly installed, aligned, lubricated, adjusted, and is fully operable; and that the controls have been properly set up and tested.

4. Performance testing shall include all normal start, normal stop and emergency

cycles, as well as a running test. All safety devices shall be checked for satisfactory operation. All required adjustments shall be made to the equipment prior to the start of performance testing.

5. The performance test on the screw conveyor system shall demonstrate that the system and accessories match or exceed the process requirements as specified herein. The performance test shall be for a minimum of 2 consecutive 8-hour days to demonstrate that each unit can meet the required operating performance under continuous operating conditions.

6. The performance tests shall be coordinated with centrifuge operations to assure a sludge cake supply during testing.

7. Testing shall continue until the performance test has been completely run, and the results of the test demonstrate that the equipment meets or exceeds all performance and process criteria.

8. The Manufacturer's Representative shall prepare a daily log of each day's activities and observations, and shall submit three (3) copies of each report. On completion of satisfactory testing, the Manufacturer shall submit also submit a test report which shall include date of the final acceptance test, a listing of all persons witnessing the test, and the equipment test performance and other data gathered in the acceptance test.

9. The expense of all test personnel, activities, instruments, and materials shall be paid by the CONTRACTOR, and shall result in no additional cost to the OWNER. The OWNER shall provide water and power for testing of the equipment.

3.03 FAILURE TO MEET PERFORMANCE REQUIREMENTS

A. Should the screw conveyor equipment fail to meet the performance requirements specified above, the CONSTRUCTION MANAGER may require that the screw conveyor equipment be replaced with equipment that will meet the performance standards and all start-up and testing procedures specified herein be repeated.

B. The CONTRACTOR, at his discretion, may attempt to demonstrate that the specified performance criteria are unattainable with the screw conveyor equipment specified. Should this be demonstrated to the CONSTRUCTION MANAGER's satisfaction, the criteria will be revised to reflect the best performance attainable with the specified equipment and performance of the equipment actually furnished will be evaluated in comparison to the revised performance criteria.

3.04 CLEANUP AND DISPOSAL

A. After completion of the installation and testing, the WORK shall be cleaned and readied for the OWNER.

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SECTION 46 01 00

EQUIPMENT GENERAL PROVISIONS

PART 1 -- GENERAL

1.01 THE SUMMARY

A. The CONTRACTOR shall provide equipment and appurtenant WORK, complete and operable, in accordance with the Contract Documents.

B. The provisions of this Section shall apply to equipment throughout the Contract except where otherwise indicated.

C. All component and support systems of the equipment shall be designed and manufactured to withstand all forces such as internal or external, static, wind, dynamic and seismic loads (wind and seismic in accordance with Section 01 33 17 – Structural Design, Support and Anchorage) in order for the equipment to last throughout its expected life without premature failure. If the project is located in a seismically active zone as specified in Section 01 33 17 – Structural Design, Support and Anchorage, the manufacturer shall submit a certification signed and stamped by a registered engineer stating that the equipment was designed and manufactured to withstand all the loads specified in this paragraph. Submit a copy of that analysis for review by the ENGINEER OF RECORD.

D. Equipment Arrangement: Unless specifically indicated otherwise, the arrangement of equipment indicated is based upon information available from manufacturers at the time of design and is not intended to show exact dimensions particular to a specific manufacturer. Some aspects of the Drawings are diagrammatic and some features of the illustrated equipment arrangement may require revision by the CONTRACTOR to meet the actual equipment requirements proposed by the CONTRACTOR. Structural supports, foundations, piping and valve connections, and electrical and instrumentation connections indicated may have to be altered by the CONTRACTOR to accommodate the equipment provided. No additional payment will be made to the CONTRACTOR for such revisions and alterations. Substantiating calculations and drawings shall be submitted prior to beginning the fabrication of equipment.

1. Section 01 33 17 – Structural Design, Support and Anchorage
2. Section 03 60 00 - Grouting
3. Section 05 05 19 – Post-Installed Anchors in Concrete
4. Section 05 50 00 - Miscellaneous Metalwork
5. Section 09 90 00 – Protective Coatings
6. Section 26 05 10 – Electric Motors
7. Section 26 05 15 – Industrial Control Panels

8. Section 26 29 23 – Variable Frequency Drives
9. Section 40 05 00 – Piping, General
10. Section 40 05 07 - Pipe Supports
11. Section 43 20 00 - Pumps, General

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Equipment shall be in accordance with the following standards, as applicable and as indicated in each equipment specification:

1. American Society for Testing and Materials (ASTM).
2. American National Standards Institute (ANSI).
3. American Society of Mechanical Engineers (ASME).
4. American Water Works Association (AWWA).
5. American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE).
6. American Welding Society (AWS).
7. National Fire Protection Association (NFPA).
8. Federal Specifications (FS).
9. National Electrical Manufacturers Association (NEMA).
10. Manufacturer's published recommendations and specifications.
11. Occupational Safety and Health Administration (OSHA).
12. Hydraulic Institute (HI)
13. General Industry Safety Orders (GISO).

B. The following standards are referenced in this Section:

ASME B16.1	Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800
ASME B16.5	Pipe Flanges and Flanged Fittings, Steel, Nickel Alloy and other Special Alloys
ASME B46.1	Surface Texture

ANSI S12.6	Method for the Measurement of the Real-Ear Attenuation of Hearing Protectors
ASME B1.20.1	General Purpose Pipe Threads (Inch)
ASME B31.1	Power Piping
ASME B31.3	Process Piping
AWWA C206	Field Welding of Steel Water Pipe
AWWA C207	Steel Pipe Flanges for Waterworks Service - Sizes 4 In. Through 144 In. (100 mm through 3,600 mm)
AWWA D100	Welded Steel Tanks for Water Storage
ASTM A 48	Gray Iron Castings
ASTM A 108	Steel Bars, Carbon, Cold-Finished, Standard Quality

1.03 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with the Standard Provisions.

B. **Shop Drawings**: Furnish complete drawings and technical information for equipment, piping, valves, and controls. Where indicated or required by the ENGINEER OF RECORD, Shop Drawings shall include clear, concise calculations showing equipment anchorage forces and the capacities of the anchorage elements proposed by the CONTRACTOR.

C. **Spare Parts List**: The CONTRACTOR shall obtain from the manufacturer and submit as part of Shop Drawings a list of suggested spare parts for each piece of equipment. CONTRACTOR shall also furnish the name, address, and telephone number of the nearest distributor for each piece of equipment.

1.04 QUALITY ASSURANCE

A. Costs: Responsibility shall be the CONTRACTOR'S for performing and paying the costs of inspection, startup, testing, adjustment, and instruction services performed by factory representatives. The OWNER will pay for costs of power and water. If available, the OWNER'S operating personnel will provide assistance in the field testing.

B. Inspection: The CONTRACTOR shall inform the local authorities, such as building and plumbing inspectors, fire marshal, OSHA inspectors, and others, to witness required tests for piping, plumbing, fire protection systems, pressure vessels, safety systems, cranes, and related items to obtain required permits and certificates, and shall pay inspection fees.

C. Quality and Tolerances: Tolerances and clearances shall be as shown on the Shop Drawings and shall be closely adhered to.

1. Machine WORK shall be of high-grade workmanship and finish, with due consideration to the special nature or function of the parts. Members without machined or milled ends and which are to be framed to other steel parts of the structure may have a variation in the detailed length of not greater than 1/16-inch for members 30-feet or less in length, and not greater than 1/8-inch for members over 30-feet in length.

2. Castings shall be homogeneous and free from non-metallic inclusions and defects. Surfaces of castings which are not machined shall be cleaned to remove foundry irregularities. Casting defects not exceeding 12.5 percent of the total thickness and where defects will not affect the strength and serviceability of the casting may be repaired by approved welding procedures. The CONSTRUCTION MANAGER shall be notified of larger defects. No repair welding of such defects shall be carried out without the CONSTRUCTION MANAGER'S written approval. If the removal of metal for repair reduces the stress resisting cross-section of the casting by more than 25 percent or to such an extent that the computed stress in the remaining metal exceeds the allowable stress by more than 25 percent, then the casting may be rejected. Costs of casting new material shall be the CONTRACTOR'S responsibility as part of the WORK.

3. Materials shall meet the physical and mechanical properties in accordance with the reference standards.

D. Machine Finish: The type of finish shall be the most suitable for the application as recommended by the equipment manufacturer in micro-inches in accordance with ANSI B46.1. In the absence of manufacturer's recommendations, the following surface finishes shall be used:

1. Surface roughness not greater than 63 micro-inches shall be required for surfaces in sliding contact.

2. Surface roughness not greater than 250 micro-inches shall be required for surfaces in contact where a tight joint is not required.

3. Rough finish not greater than 500 micro-inches shall be required for other machined surfaces.

4. Contact surfaces of shafts and stems which pass through stuffing boxes and contact surfaces of bearings shall be finished to not greater than 32 micro-inches.

E. Manufacturer's Experience: Equipment manufacturer shall have a record of proven experience of at least 5 years of successful, troublefree operation in similar applications and size equal or larger than the equipment in this Contract. Where indicated in each individual equipment specifications, the CONTRACTOR shall submit this experience record to the CONSTRUCTION MANAGER for approval.

PART 2 -- PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Noise Level: When the equipment is in operation, no single piece of equipment shall exceed the OSHA noise level requirement of 105 dBA for one hour exposure per day.

B. High Noise Level Location: The CONTRACTOR shall provide one personal hearing protection station at each location defined as follows:

1. Outdoor Location: Any single equipment item or any group of equipment items that produce noise exceeding OSHA noise level requirements for a 2 hour exposure. Where such equipment is separated by a distance of more than 20-feet, measured between edges of footings, the area for each group of equipment shall be provided with a separate hearing protection station.

2. Indoor Location

a. Any single equipment item or any group of equipment items located within a single room not normally occupied, that produces noise exceeding OSHA noise level requirements for a 2 hour exposure.

b. Any single equipment item or any group of equipment items located within a single room normally occupied by workers that produces noise exceeding OSHA noise level requirements for an 8 hour exposure.

C. Personal Hearing Protection: The CONTRACTOR shall furnish 3 pairs of high attenuation hearing protectors in the original unopened packaging. The ear protectors shall be capable of meeting the requirements of ANSI S12.6 and shall produce a noise level reduction of 25 dBA at a frequency of 500 Hz. The hearing protectors shall have fluid filled ear cushions and an adjustable, padded headband. The protectors shall be stored in a weatherproof, labeled, steel cabinet, provided at an approved location near the noise producing equipment.

D. Drive Trains and Service Factors: Service factors shall be applied in the selection or design of mechanical power transmission components. Components of drive train assemblies between the prime mover and the driven equipment shall be designed and rated to deliver the maximum peak or starting torque (whichever is the greatest), speed, and horsepower. Applicable service factors shall be considered, such as mechanical (type of prime mover), load class, start frequency, ventilation, ambient temperature, and fan factors. Drive train components include couplings, shafts, gears and gear drives, drive chains, sprockets, and V-belt drives. Unless otherwise indicated, the following load classifications shall apply in determining service factors:

Type of Equipment	Service Factor	Load Classification
Centrifugal Fans	1.0	Uniform
Pumps centrifugal or rotary	1.0	Uniform

reciprocating progressing cavity	1.8 1.0	Moderate Shock Uniform
Mixers constant density variable density rapid mixer sludge mixer	 1.0 1.25 1.25 2.5	 Uniform Moderate Shock Moderate Shock Moderate Shock
Cranes or Hoists	1.25	Moderate Shock

E. Mechanical Service Factors

	Mechanical Service Factors	
	Electric Motor	**Internal Combustion Engine**
Uniform	1.25	1.50
Moderate Shock	1.50	1.75
Heavy Shock	2.00	2.25

F. For thermal rating adjustments such as start frequency, ambient temperature, and hourly duty cycle factor, ventilation factor, and fan factor, refer to gear manufacturer sizing information.

G. For service factors of electric motors, see Section 26 05 10 - Electric Motors.

H. Where load classifications are not indicated, the equipment manufacturer's recommendations for service factors shall be utilized.

I. Welding: Unless otherwise indicated, welding shall conform to the following:

1. Latest revision of AWWA D100.

2. Latest revision of AWWA C206.

3. Composite fabricated steel assemblies that are to be erected or installed inside a hydraulic structure, including any fixed or movable structural components of mechanical equipment, shall have continuous seal welds to prevent corrosion of hard-to-coat metallic surfaces.

4. Welding shall be by the metal-arc method or gas-shielded arc method as described in the American Welding Society's "Welding Handbook" as supplemented by other pertinent standards of the AWS. Qualification of welders shall be in accordance with the AWS Standards.

5. In assembly and during welding, the component parts shall be adequately clamped, supported, and restrained to minimize distortion and for control of dimensions. Weld reinforcement shall be as specified by the AWS code. Upon completion of welding, weld splatter, flux, slag, and burrs left by attachments shall be removed. Welds shall be repaired to produce a workmanlike appearance with uniform weld contours and dimensions. Sharp corners of material that are to be painted or coated shall be ground to a minimum of 1/32-inch on the flat.

J. Protective Coating: Equipment shall be painted or coated in accordance with Section 09 96 00 - Protective Coating, unless otherwise indicated. Non-ferrous metal and corrosion-resisting steel surfaces shall be coated with grease or lubricating oil. Coated surfaces shall be protected from abrasion or other damage during handling, testing, storing, assembly, and shipping.

K. Potable Water Contact: Materials immersed in or exposed to potable water shall be made of materials or coated compliant with NSF Standard 61. Potable water shall be considered to be plant water and all process water pipelines including sludge, thickened sludge, decant, and centrate pipelines as well as drain pipelines that return to the gravity thickeners, washwater recovery facility, or to the existing washwater recovery basins. Bronze alloy materials in contact with potable water shall be constructed of zero-lead materials or materials whose lead content do not exceed the weighted average criteria as required by the Lead Reduction Act. Equipment manufacturer shall submit to the CONSTRUCTION MANAGER a certification of compliance with the requirement of NSF Standard 61 and the Lead Reduction Act.

L. Protection of Equipment: Machined and coated surfaces shall be protected by rust inhibitor material prior to shipment. Equipment shall be boxed, crated, or otherwise protected from damage and moisture during shipment, handling, and storage. Equipment shall be protected from exposure to corrosive fumes and shall be kept thoroughly dry. Equipment with anti-friction bearings or sleeve bearings shall be protected from being damaged due to jarring motion during shipment. Pumps, motors, drives, electrical equipment, and other equipment having anti-friction or sleeve bearings shall be stored in weathertight storage facilities prior to installation. For extended storage periods, plastic equipment wrappers should be avoided to prevent accumulation of condensate in gears and bearings. In addition, motor space heaters shall be energized and shafts shall be rotated per manufacturer's recommendation. Equipment delivered to the Site with rust or corroded parts shall be rejected. If equipment develops defects during storage, it shall be disassembled, cleaned, recoated, or otherwise corrected to restore it to original condition.

M. Identification of Equipment Items

1. At the time of shipping, each item of equipment shall have a legible identifying mark corresponding to the equipment number in the Contract Documents for the particular item.

2. After installation, each item of equipment shall be given permanent identification.

   a. Pumps, compressors, and blowers of 150 horsepower or less shall receive acrylic plastic nametags.

b. Pumps, compressors, and blowers larger than 150 horsepower shall receive stainless steel plate nametags.

N. Vibration Isolators: Air compressors, blowers, engines, inline fans shall be provided with restrained spring-type vibration isolators or pads per manufacturer's written recommendations. Vibration isolations shall be provided with seismic restraint.

O. Equipment Maximum Allowable Vibration Level: Unless otherwise indicated, maximum allowable vibration level shall be in accordance with the acceptance criteria recommended by the reference Standard for that particular type of equipment

P. Shop Fabrication: Shop fabrication shall be performed in accordance with the Contract Documents and the Shop Drawings.

Q. Controls: Equipment and system controls shall be in accordance with Division 40 - Instrumentation.

2.02 EQUIPMENT SUPPORTS AND FOUNDATIONS

A. Equipment Supports: Equipment components and supports, anchors, and seismic restrainers shall be adequately designed for static, dynamic, wind, and seismic loads. The design horizontal seismic force shall be the greatest of the following design criteria:

1. Design Criteria noted in Section 01 33 17 – Structural Design, Support and Anchorage.

B. Submit design calculations for equipment supports, anchors, and seismic restrainers signed and sealed by an engineer registered in the State of California. Calculations shall account for forces and distribution of forces on supporting structures resulting from normal operation, normal operation plus seismic loadings, and normal operation plus wind loadings in accordance with Section 01 33 17 – Structural Design, Support and Anchorage.

1. Wall-mounted equipment weighing more than 250 pounds or which is within 18-inches above the floor shall be provided with fabricated steel supports. Pedestals shall be of welded steel. If the supported equipment is a panel or cabinet or is enclosed with removable sides, the pedestal shall match the supported equipment in appearance and dimensions.

2. Seismic requirements: Freestanding and wall-hung equipment shall be anchored in place by methods that satisfy Section 01 33 17 – SeismStructural Design, Support and Anchorage. Calculations shall be performed and signed and stamped for equipment weighing more that 400 pounds. Calculations shall analyze lateral and overturning forces and shall include a factor of safety against overturning equal to 1.5. Calculations shall include the distribution of forces imposed on the supporting structure and anchors, verifying that each anchor can develop the required resistance forces.

3. Wind requirements: Exterior freestanding equipment shall be anchored in place by methods that satisfy Section 01 33 17 – Structural Design, Support and Anchorage. Calculations shall be performed and signed and stamped, analyzing lateral and

overturning forces and shall include a factor of safety against overturning equal to 1.5. Calculations shall include the distribution of forces imposed on the supporting structure and anchors, verifying that each anchor can develop the required resistance forces.

4. Anchors: Anchor bolts shall be in accordance with Section 05 50 00 - Miscellaneous Metalwork. CONTRACTOR shall determine the size, type, capacity, location, and other placement requirements of anchorage elements. Anchoring methods and leveling criteria in the manufacturer's literature shall be followed. Submit methods and criteria with the Shop Drawings.

5. Equipment Foundations: Unless otherwise indicated, mechanical equipment, tanks, control cabinets, enclosures, and related equipment shall be mounted on minimum 3.5-inch high concrete bases. Unless otherwise indicated on the Drawings, pumps, blowers, compressors and engine driven equipment shall be provided with a concrete foundation with a total weight equal to at least five times the weight of the equipment. Concrete foundations shall be isolated from the building floor in order to prevent transfer of vibration from the equipment to the building structure. The CONTRACTOR through the equipment manufacturer shall verify the size and weight of equipment foundation to insure compatibility with equipment.

6. Equipment Grout: Mechanical equipment installed on top of concrete foundations or bases shall be provided with non-shrink concrete or epoxy grout as indicated and as specified in Section 03 60 00 - Grouting. Grout shall be applied between the base plate and the concrete foundation or base in accordance with the grout manufacturer’s recommendation. Grout shall be free of void space.

2.03 COUPLINGS

A. Mechanical couplings shall be provided between the driver and the driven equipment. Flexible couplings shall be provided between the driver and the driven equipment to accommodate slight angular misalignment, parallel misalignment, end float, and to cushion shock loads. Unless otherwise indicated or recommended by the equipment manufacturer, coupling type shall be furnished with the respective equipment as follows:

Equipment Type	Coupling Type
Horizontal and end suction pumps	Gear or flexible spring
Vertical nonclog pumps, close coupled	Flexible disc pack

B. Each coupling size shall be determined based on the rated horsepower of the motor, speed of the shaft, and the load classification service factor. The CONTRACTOR shall have the equipment manufacturer select or recommend the size and type of coupling required to suit each specific application.

C. Differential Settlement: Where differential settlement between the driver and the driven equipment may occur, 2 sets of universal type couplings shall be provided.

D. Taper-Lock or equal bushings may be used to provide for easy installation and removal of shafts of various diameters.

2.04 SHAFTING

A. General: Equipment manufacturer shall be responsible for designing and manufacturing shafting to carry all loads applied to the shaft. Shafting shall be continuous between bearings and shall be sized to transmit the power required. Keyways shall be accurately cut in line. Shafting shall not be turned down at the ends to accommodate bearings or sprockets whose bore is less than the diameter of the shaft. Shafts shall rotate in the end bearings and shall be turned and polished, straight, and true.

B. Design Criteria: Shafts shall be designed to carry the steady state and transient loads suitable for unlimited number of load applications.

C. Materials: Shafting materials shall be compatible with the type of service and load transmitted. Environmental elements such as corrosive gases, moisture, and fluids shall be taken into consideration. Materials shall be as indicated unless furnished as part of an equipment assembly.

1. Low carbon cold-rolled steel shafting shall conform to ASTM A 108, Grade 1018.

2. Medium carbon cold-rolled shafting shall conform to ASTM A 108, Grade 1045.

3. Other grades of carbon steel alloys shall be suitable for service and load.

4. Corrosion-resistant shafting shall be stainless steel or Monel, whichever is most suitable for the intended service.

D. Differential Settlement: Where differential settlement between the driver and the driven equipment may occur, a shaft of sufficient length with 2 sets of universal type couplings shall be provided.

2.05 GEARS AND GEAR DRIVES

A. Unless otherwise indicated, gears shall be of the spur, helical, or spiral-bevel type, designed and manufactured in accordance with AGMA Standards, with a service factor suitable for load class, mechanical service and thermal rating adjustment, a minimum L-10 bearing life of 60,000 hours, and a minimum efficiency of 94 percent. Peak torque, starting torque, and shaft overhung load shall be checked when selecting the gear reducer. Worm gears shall not be used unless specifically approved by the ENGINEER OF RECORD.

B. Gear speed reducers or increasers shall be of the enclosed type, oil- or grease-lubricated and fully sealed, with a breather to allow air to escape but keep dust and dirt out. The casing shall be of cast iron, ductile iron, or heavy-duty steel construction with lifting lugs and an inspection cover for each gear train. An oil level sight glass and an oil flow indicator shall be provided, located for easy reading.

C. Gears and gear drives that are part of an equipment assembly shall be shipped fully assembled for field installation.

D. Material selections shall be selected by the manufacturer, provided the above AGMA values are met. Input and output shafts shall be adequately designed for the service and load requirements. Gears shall be computer-matched for minimum tolerance variation. The output shaft shall have 2 positive seals to prevent oil leakage.

E. Oil level and drain locations shall be easily accessible. Oil coolers or heat exchangers with required appurtenances shall be provided when necessary.

F. Where gear drive input or output shafts from one manufacturer connect to couplings or sprockets from a different manufacturer, the CONTRACTOR shall have the gear drive manufacturer furnish a matching key taped to the shaft for shipment.

2.06 DRIVE CHAINS

A. Power drive chains shall be commercial type roller chains meeting ASME Standards.

B. A chain take-up or tightener shall be provided in every chain drive arrangement to provide easy adjustment.

C. A minimum of one connecting or coupler link shall be provided in each length of roller chain.

D. Chain and attachments shall be of the manufacturer's best standard material and be suitable for the process fluid.

2.07 SPROCKETS

A. General: Sprockets shall be used in conjunction with chain drives and chain-type material handling equipment.

B. Materials: Unless otherwise indicated, materials shall be as follows:

1. Sprockets with 25 teeth or less, normally used as a driver, shall be made of medium carbon steel in the 0.40 to 0.45 percent carbon range.

2. Type A and B sprockets with 26 teeth or more, normally used as driven sprockets, shall be made of minimum 0.20 percent carbon steel.

3. Large diameter sprockets with Type C hub shall be made of cast iron conforming to ASTM A 48, Class 30.

C. Sprockets shall be accurately machined to ASME Standards. Sprockets shall have deep hardness penetration in tooth sections.

D. Finish bored sprockets shall be furnished complete with keyseat and set screws.

E. To facilitate installation and disassembly, sprockets shall be of the split type or shall be furnished with Taper-Lock bushings as required.

F. Idler sprockets shall be provided with brass or Babbitt bushings, complete with oil hole and axial or circumferential grooving with stainless steel tubing and grease fitting extended to an accessible location. Steel collars with set screws may be provided in both sides of the hub.

2.08 V-BELT DRIVES

A. V-belts and sheaves shall be of the best commercial grade and shall conform to ASME, MPTA, and RMA Standards.

B. Unless otherwise indicated, sheaves shall be machined from the finest quality gray cast iron.

C. Sheaves shall be statically balanced. In some applications where vibration is a problem, sheaves shall be dynamically balanced. Sheaves operating at belt speeds exceeding 6,500 fpm may be required to be of special materials and construction.

D. To facilitate installation and disassembly, sheaves shall be provided complete with Taper-Lock or QD bushings as required.

E. Finish bored sheaves shall be complete with keyseat and set screws.

F. Sliding motor bases shall be provided to adjust the tension of V-belts.

2.09 DRIVE GUARDS

A. Power transmission trains, prime movers, machines, shaft extensions, and moving machine parts shall be guarded to conform to the Division of Industrial Safety General Industrial Safety Orders latest edition. The guards shall be constructed of minimum 10-gauge expanded, flattened steel with smooth edges and corners, galvanized after fabrication, and securely fastened. Where required for lubrication or maintenance, guards shall have hinged and latched access doors.

2.10 BEARINGS

A. General: Bearings shall conform to the standards of the American Bearing Manufacturers Association, Inc. (ABMA).

B. To assure satisfactory bearing application, fitting practice, mounting, lubrication, sealing, static rating, housing strength, and lubrication shall be considered in bearing selection.

C. Re-lubricatable type bearings shall be equipped with hydraulic grease fitting in an accessible location and shall have sufficient grease capacity in the bearing chamber.

D. Lubricated-for-life bearings shall be factory-lubricated with the manufacturer's recommended grease to insure maximum bearing life and best performance.

E. Anti-Friction Type Bearing Life: Except where otherwise indicated, bearings shall have a minimum L-10 life expectancy of 5 years or 20,000 hours, whichever occurs first. Where so indicated, bearings shall have a minimum rated L-10 life expectancy corresponding to the type of service, as follows:

Type of Service	Design Life, years	L-10 Design Life, hours
	(whichever comes first)	
8-hour shift	10	20,000
16-hour shift	10	40,000
Continuous	10	60,000

F. Bearing housings shall be of cast iron or steel and bearing mounting arrangement shall be as indicated or as recommended in the published standards of the manufacturer. Split-type housings may be used to facilitate installation, inspection, and disassembly.

G. Sleeve Type Bearings: Sleeve-type bearings shall have a cast iron or ductile iron housing and Babbitt or bronze liner. Bearing housing shall be bolted and doweled to the lower casing half. These housings shall be provided with cast iron caps bolted in place and the bearing end caps shall be bored to receive the bearing shells. Sleeve bearings shall be designed on the basis of the maximum allowable load permitted by the bearing manufacturer. If the sleeve bearing is connected to an equipment shaft with a coupling, the coupling transmitted thrust will be assumed to be the maximum motor or equipment thrust. Lubricant, lubrication system, and cooling system shall be as recommended by the bearing manufacturer. In accordance with the Lead Reduction Act, sleeve bearings containing lead material exposed to drinking water shall not be acceptable.

H. Plate Thrust Bearings: Thrust bearings shall be the Kingsbury Type, designed and manufactured to maintain the shaft in the fixed axial position without undue heating or the necessity of adjustment or attention. Bearings shall be oil lubricated to suit the manufacturer's standard method of lubrication for the specific bearing. If bearing cooling is required, manufacturer shall provide heat exchangers, incluging necessary intrumentation and controls, piping, filters, and valves.

2.11 PIPING CONNECTIONS

A. Pipe Hangers, Supports, and Guides: Pipe connections to equipment shall be supported, anchored, and guided to avoid stresses and loads on equipment flanges and equipment. Supports and hangers shall be in accordance with Section 40 05 07 - Pipe Supports.

B. Flanges and Pipe Threads: Flanges on equipment and appurtenances shall conform to ASME B16.1, Class 125, or B16.5, Class 150, unless otherwise indicated. Pipe threads shall be in accordance with ASME B1.20.1 and Section 40 05 00 - Piping, General.

C. Flexible Connectors: Flexible connectors shall be installed in piping connections to engines, blowers, compressors, and other vibrating equipment and in piping systems in accordance with the requirements of Section 40 05 00 – Piping, General. Flexible connectors shall be harnessed or otherwise anchored to prevent separation of the pipe where required by the installation.

D. Insulating Connections: Insulating bushings, unions, couplings, or flanges, as appropriate, shall be used in accordance with the requirements of the specifications.

2.12 GASKETS AND PACKINGS

A. Gaskets and packings shall be in accordance with the requirements of the specifications. Gaskets and packings in contact with drinking water shall be NSF 61 approved. Elastomeric materials in contact with water with chloramines, or water with ozone residual shall be made of Teflon or Viton-A, or equal.

B. Packing around valve stems and reciprocating shafts shall be of compressible material, compatible with the fluid being used. Chevron-type "V" packing shall be Garlock No. 432, John Crane Everseal, or equal.

C. Packing around rotating shafts (other than valve stems) shall be "O" rings, stuffing boxes, or mechanical seals, as recommended by the manufacturer and approved by the ENGINEER OF RECORD, in accordance with Section 43 20 00 - Pumps, General.

2.13 NAMEPLATES

A. Equipment nameplates of stainless steel shall be engraved or stamped and fastened to the equipment in an accessible location with No. 4 or larger oval head stainless steel screws or drive pins. Nameplates shall contain the manufacturer's name, model, serial number, size, characteristics, and appropriate data describing the machine performance ratings.

2.14 TOOLS AND SPARE PARTS

A. Tools: The CONTRACTOR shall furnish one complete set of special wrenches and other special tools necessary for the assembly, adjustment, and dismantling of the equipment. Tools shall be of best quality hardened steel forgings with bright finish. Wrench heads shall have work faces dressed to fit nuts. Tools shall be suitable for professional work and manufactured by Snap On, Crescent, Stanley, or equal. The set of tools shall be neatly mounted in a labeled toolbox of suitable design provided with a hinged cover.

B. Spare parts shall be furnished as indicated in the individual equipment sections. Spare parts shall be suitably packaged in a metal box and labeled with equipment numbers by means of stainless steel or solid plastic nametags attached to the box.

2.15 EQUIPMENT LUBRICANTS

A. The CONTRACTOR shall provide lubricants for equipment during shipping, storage, and prior to testing, in accordance with the manufacturer’s recommendations. Lubricants that could come in contact with potable water shall be food grade lubricants. After successful initial testing, final testing, and satisfactory completion startup testing, the CONTRACTOR shall conduct one complete lubricant change on equipment. In addition, the CONTRACTOR shall be responsible for the proper disposal of used lubricants. The OWNER will then be responsible for subsequent lubricant changes

PART 3 -- EXECUTION

3.01 SERVICES OF MANUFACTURER

A. Installation Supervision, Inspection, Startup, and Field Adjustment: An authorized, experienced, and competent service representative of the manufacturer shall visit the Site. The service representative shall be a direct employee of the manufacturer, not a distributor or equipment supplier. The service representative will supervise the following items:

1. Supervision of the installation of the equipment

2. Inspection, checking, and adjusting the equipment and approving its installation

3. Startup and field testing for proper operation, efficiency, and capacity

4. Performing field adjustments during the test period to ensure that the equipment installation and operation comply with requirements

5. Certify in writing that the equipment and controls have been properly installed, aligned, lubricated, adjusted, and readied for operation.

6. Unless otherwise indicated, factory representative shall be present at the job site for the following number of days:

   a. Half a day per equipment for smaller than 500 horsepower.

   b. One day per equipment for 500 horsepower and larger.

B. Owner Staff Training

1. Owner staff training shall be in accordance with the individual Section, this Section, and the Special Provisions. The training representative shall be a direct employee of the manufacturer, not a distributor or equipment supplier, and with comprehensive knowledge of and experience with the equipment.

2. Unless otherwise indicated, a minimum of one day of training shall be provided for each type of equipment.

3.02 INSTALLATION

A. General: Equipment shall be installed in accordance with the manufacturer's written recommendations.

B. Alignment: Equipment shall be field tested to verify proper alignment.

3.03 PACKAGED EQUIPMENT

A. When any system is furnished as pre-packaged equipment, the CONTRACTOR shall coordinate space and structural requirements, clearances, utility connections, signals, and outputs with Subcontractors to avoid later change orders.

B. If the packaged system has any additional features (as safety interlocks, etc.) other than required by the Contract Documents, the CONTRACTOR shall coordinate such features with the CONSTRUCTION MANAGER and provide material and labor necessary for a complete installation as required by the manufacturer.

3.04 FIELD ASSEMBLY

A. Studs, cap screws, bolt and nuts used in field assembly shall be coated with Never Seize compound or equal.

3.05 WELDING

A. Welds shall be cleaned of weld-slag, splatter, etc. to provide a smooth surface.

3.06 FIELD TESTS

A. Where indicated by the individual equipment sections, equipment shall be field tested after installation to demonstrate satisfactory operation without excessive noise, vibration, or overheating of bearings or motor.

B. The following field testing shall be conducted:

1. Start equipment, check, and operate the equipment over its entire operating range. Vibration level shall be within the amplitude limits as indicated or as recommended by the reference applicable standards.

2. Obtain concurrent readings of motor voltage, amperage, capacity, vibration, and bearing temperatures.

3. Operate equipment indicated in Section 01 75 00 – Equipment Testing and Plant Startup.

C. The CONSTRUCTION MANAGER shall witness field-testing. The CONTRACTOR shall notify the CONSTRUCTION MANAGER of the test schedule 3 Days in advance.

D. In the event that any equipment fails to meet the test requirements, the equipment shall be modified and retested until it satisfies the requirement.

END OF SECTION

SECTION 46 32 60

POLYMER BLENDING SYSTEM

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The CONTRACTOR shall furnish and install a polymer blending system complete with all drives, motors, valves, piping, supports, pumps, mixing chambers, tanks, mixers, controls, and accessories necessary for a complete and operable system, in accordance with the requirements of the Contract Documents.

B. The requirements of Section 46 01 00 – Equipment General Provisions, apply to this Section.

C. Manufacturer's Experience: All polymer blending units shall be furnished only by manufacturers with at least 5 years experience in the manufacture of similar equipment.

1.02 CONTRACTOR SUBMITTALS

A. Submittals shall be in accordance with Section 7 of Standard Provisions and with Section 46 01 00 – Equipment General Provisions.

B. The following items shall be submitted.

1. Complete details of all polymer blending units, including pump output data, materials of construction, and dimensional information.

2. The CONTRACTOR shall furnish technical manuals for the units.

3. Equipment certifications, tools, written field procedures and calibration graphs shall be provided.

1.03 WARRANTY

A. Polymer feed system shall be warranted for a period of 12 months from the date of start-up by authorized technician.

1.04 SPARE PARTS

A. A set of mixing chamber o-rings for each size

B. Mechanical seal

PART 2 -- PRODUCTS

2.01 GENERAL

A. The polymer blending units shall be integrated equipment packages to automatically meter, dilute, mix, and activate liquid/emulsion polymer and water.

B. Concentrated polymer and water shall be blended in a multi-zone mixing chamber with a tempered mixing intensity. Each unit shall include progressing -type polymer transfer pumps capable of dosing all polymers with apparent viscosities up to 3,000 centipoise to the mixing chamber.

C. SYSTEM COMPONENTS: The polymer blending systems shall consist of the following items:

	Dewatering Polymer
Neat Polymer Feed Pump	RPLMTP01 RPLMTP02
Mixing Chambers	RPLMMX01 RPLMMX02
Blending Unit Control Panel	RPLMCP01 RPLMCP02

D. Polymer Blending Unit: Each polymer blending unit shall consist of a:

1. Components:

   a. dilution water supply piping and controls;

   b. motorized multi-zone mixing chamber;

   c. progressing cavity-type polymer transfer pump;

   d. interconnecting, piping, controls, and all necessary accessories to provide a complete unit. All motors and controls shall be interconnected to require a single 480 volt, 60 Hz, three phase connection to the unit. Motors shall comply with Section 26 05 10 - Electric Motors.

2. Multi-Zone Mixing Chamber

   a. Polymer and water shall be mixed in a chamber designed to create sufficient mixing energy.

b. This design shall include a motor-drive impeller that will create high fluid sheer.

c. Solution shall undergo a tapered mixing intensity slope.

d. Polymer activation efficiency shall be consistent over the dilution water range.

3. Dilution Water Control

a. Unit shall have an electric motor ball valve for on/off control of total dilution water flow.

b. Flow indicators and flow control valves shall be provided for each dilution water stream.

c. Unit shall have a low pressure switch on the dilution water line or electronic flowmeters with end user adjustable low flow setpoint on the controller.

4. Pump

a. Unit shall have a neat polymer metering pump. Pump shall be positive displacement, progressing cavity type.

b. Thermal flow switch shall be provided on pump discharge or integral to the pump stator.

5. Controls

a. Each unit shall be equipped with all necessary controls, interwired in a NEMA 4X panel, to provide the following minimum functions:

1) Main power on/off switch with light.

2) Hand-Off-Remote switch and dry contact to allow either remote or local control of the unit. Start of the system, either locally or remotely, shall turn on the transfer pump and open the water supply solenoid *or motor ball* valve.

a) In the remote switch position, the unit shall accept a run signal.

b) Unit is manually controlled in the on position.

3) Unit shall accept a 4-20 mA analog signal to pace the polymer metering pump.

4) Unit shall detect loss of water flow, sensing that water flow has been interrupted for any reason, will place the polymer pump and mix chamber on standby and will restart it automatically when flow is restored.

5) Microcontroller shall pace polymer metering pump based on operator programmed data or *based on a 4-20 mA analog input signal.*

a) Operator shall be able to determine mode of operation at touchpad, internal or external.

b) Internal mode shall allow for automatic polymer pump pacing based on programmed setpoint.

c) Operator shall be able to enter a make up concentration setpoint.

d) Controller will compute a ratio of polymer to water from primary dilution water flow rate signal generated by flow element.

e) Controller will generate signal to pace pump accordingly.

f) As primary dilution water flow changes, setpoint concentration will be automatically maintained by controller.

g) External mode shall allow for automatic polymer pump pacing based on a 4-20 mA analog input signal.

6. An integral timer shall monitor loss of flow and energize contact indicating alarm after 15 seconds of continuous loss. Controller shall indicate loss of water alarm with LED.

7. Controller LED display shall indicate:

   a. Primary water flow

   b. Secondary water flow

   c. Polymer flow

   d. Make up solution concentration in mixing chamber

   e. Discharge solution concentration including post dilution

8. Power Supply

   a. Each unit shall have a 480-volt, 3-phase, 60-Hz power supply, and thermal overload protection with manual reset.

9. Pump Accessories

   a. All polymer blending units shall be equipped with the following accessories:

      1) Calibration cylinder: A suitable sized calibration cylinder shall be supplied for the neat polymer feed pump. Cylinder shall be mounted to frame with PVC isolation ball valves. Cylinder shall be calibrated in mL and be constructed of clear PVC with slop on cap and ½ inch NPT vent connection.

10. Manufacturers:

    a. USGI Polyblend

b. Prominent ProMix

c. Velodyne Veloblend

d. Enpro Paradyne

PART 3 -- EXECUTION

3.01 SERVICES OF MANUFACTURER

A. Inspection, Startup, and Field Adjustment: The service representative of the Manufacturer shall be present at the site for two work days over two separate trips, to furnish services for inspection of the installation and start-up.

B. Instruction of OWNER'S Personnel: The training representative of the Manufacturer shall be present at the site for one work day to train the OWNER'S personnel in operations and maintenance procedures.

C. For the purpose of this paragraph, a work day is defined as an eight hour period at the site, excluding travel time.

END OF SECTION

Equipment Data Sheet

EQUIPMENT NUMBER	RPLMMX01
Equipment Type:	Polymer Blending Unit

General Information

EQUIPMENT NAME	DEWATERING POLYMER BLENDING SYSTEM 1
LOCATION	CENTRIFUGE BUILDING B

Performance Requirements

Dilution Water Flow Range, gph	600 - 12,000
SYSTEM OPERATING PRESSURE, PSI	40

Dimensions

Dilution Water Inlet	3"
Neat Polymer Inlet	1"
Discharge Connection	3"

System Construction

Structural Frame	304 SS
Plumbing	PVC
Mixing Chamber	PVC

Equipment Data Sheet

EQUIPMENT NUMBER	RPLMMX02
Equipment Type:	Polymer Blending Unit

General Information

EQUIPMENT NAME	DEWATERING POLYMER BLENDING SYSTEM 2
LOCATION	CENTRIFUGE BUILDING B

Performance Requirements

Dilution Water Flow Range, gph	600 - 12,000
SYSTEM OPERATING PRESSURE, PSI	40

Dimensions

Dilution Water Inlet	3"
Neat Polymer Inlet	1"
Discharge Connection	3"

System Construction

Structural Frame	304 SS
Plumbing	PVC
Mixing Chamber	PVC

Equipment Data Sheet

EQUIPMENT NUMBER	RPLMTP01
Equipment Type:	Progressive Cavity Pump

General Information

EQUIPMENT NAME	POLYMER TRANSFER PUMP 1
DRAWING NUMBER	I-10
LOCATION	CENTRIFUGE BUILDING B

Performance Requirements

DESIGN FLOW CAPACITY, GPH	12-120

Operating Conditions

FLUID SERVICE	EMULSION POLYMER

Construction

Stator	Elastomer best suited for the application
Rotor	316 SS
Seal	Mechanical seal

Equipment Data Sheet

EQUIPMENT NUMBER	RPLMTP02
Equipment Type:	Progressive Cavity Pump

General Information

EQUIPMENT NAME	POLYMER TRANSFER PUMP 2
DRAWING NUMBER	I-10
LOCATION	CENTRIFUGE BUILDING B

Performance Requirements

DESIGN FLOW CAPACITY, GPH	12-120

Operating Conditions

FLUID SERVICE	EMULSION POLYMER

Construction

Stator	Elastomer best suited for the application
Rotor	316 SS
Seal	Mechanical seal

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SECTION 46 41 00

MIXERS, GENERAL

PART 1 -- GENERAL

1.01 THE SUMMARY

A. The CONTRACTOR shall provide mixers and appurtenances, complete and operable, in accordance with the Contract Documents.

B. Related Sections. See Related Sections for additional requirements applicable to this Section:

1. Section 09 90 00 – Protective Coatings
2. Section 26 05 10 – Electric Motors
3. Section 26 05 15 – Industrial Control Panels
4. Section 26 29 23 – Variable Frequency Drives
5. Section 40 95 13 – Control Panels
6. Section 46 01 00 – Equipment General Provisions.

C. This Section applies to all mixers in the Contract Documents, unless indicated otherwise.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

NFPA 70	National Electric Code
ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800
ANSI B16.5	Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and Other Special Alloys
ASME B31.1	Power Piping
ASME B73.1	Specifications for Horizontal End Suction Centrifugal Pumps for Chemical Process
IEEE 112	Test Procedure for Polyphase Induction Motors and Generators
IEEE 115	Test Procedure for Synchronous Machines
ASTM A 48	Gray Iron Castings
ASTM A 470	Vacuum-Treated Carbon and Alloy Forgings for Turbine Rotors and Shafts

ASTM A 536 Ductile Iron Castings

ASTM B 62 Composition Bronze or Ounce Metal Castings

Latest Edition Hydraulic Institute Standards for Centrifugal, Rotary, and Reciprocating Pumps

1.03 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with the Standard Provisions.

B. Shop Drawings

1. Equipment name, identification number and specification number.

2. Performance data.

3. The CONTRACTOR shall require the manufacturer to indicate the limits recommended for stable operation between which the mixers may be operated without surge, cavitation, or vibration. The stable operating range shall be as wide as possible based on actual hydraulic and mechanical tests.

4. Equipment detailed description and specification.

5. Electrical data including control and wiring diagrams.

6. Assembly and installation drawings including shaft size, seal, coupling, anchor bolt plan, part nomenclature, material list, outline dimensions and shipping weights.

7. Drive and motor data in accordance with Section 26 05 10 - Electric Motors.

C. Certification: The CONTRACTOR shall obtain written certification from the manufacturer, addressed to the OWNER, stating that the equipment will efficiently and thoroughly perform the required functions and that the manufacturer accepts joint responsibility with the CONTRACTOR for coordination of all equipment, including motors, drives, controls, and services required for proper installation and operation of the completely assembled and installed units. The CONTRACTOR shall submit certificates to the CONSTRUCTION MANAGER.

D. O & M Manuals: Prior to start-up, furnish complete operations and maintenance manuals in accordance with the Standard Provisions. Printed instructions relating to proper maintenance, including lubrication, and parts lists indicating the various parts by name, number, and diagram where necessary, shall be furnished in duplicate with each unit or set of identical units. Instructions for field procedures for erection, adjustments, inspection, and testing shall be provided prior to installation of the equipment.

1.04 MANUFACTURER'S SERVICE REPRESENTATIVE

A. Erection and Startup Assistance: Service and instruction assistance by the manufacturer's engineering representative for each piece of equipment 10 hp and larger shall be furnished by the CONTRACTOR during the following periods:

1. One day during erection.

2. One day during startup.

B. Instruction of OWNER's Personnel: The CONTRACTOR shall furnish the services of a factory service representative to instruct the OWNER'S personnel in the operation and maintenance of the equipment. This service shall consist of a one day's visit to the plant for each type of similar equipment.

1.05 GUARANTEES, WARRANTIES

A. After completion, the CONTRACTOR shall furnish to the OWNER the manufacturer's written guarantees, that the equipment will meet the published data and these Specifications. The CONTRACTOR shall also furnish the manufacturer's warranties as published in its literature and as specified.

1.06 SEISMIC DESIGN REQUIREMENTS

A. Design shall conform to the seismic requirements as specified in Sections 01 33 17 – Structural Design, Support and Anchorage and 46 01 00 - Equipment General Provisions.

PART 2 -- PRODUCTS

2.01 GENERAL

A. Equipment provided under this Section shall be new, current models of reputable manufacturers specializing in such products; and having had previous experience in such manufacture. Upon request of the ENGINEER OF RECORD, the manufacturer shall furnish the names of not less than 5 successful installations of its equipment of comparable nature to that in this Section.

B. Where 2 or more units of the same type and/or size of equipment are required, such units shall all be produced by the same manufacturer.

2.02 MATERIALS

A. Materials shall be suitable for the intended application; material not specifically called for shall be high-grade, standard commercial quality, free from all defects and imperfections that might affect the serviceability of the product for the purpose for which it is intended. Unless otherwise indicated, materials shall conform to the following requirements:

1. Cast iron casings shall be of close-grained gray cast iron, conforming to ASTM A 48, or equal.

2. Bronze impellers shall conform to ASTM B 62.

3. Stainless steel shafts shall be of Type 300 or 400 Series, as best suited for the purpose. Miscellaneous stainless steel parts shall be of Type 316 except in septic environment.

4. All anchor bolts, nuts and washers shall be in accordance with Section 05 50 00 - Miscellaneous Metalwork.

2.03 APPURTENANCES

A. Nameplates: Each piece of equipment shall be equipped with a stainless steel nameplate indicating rated performance, size, speed, and manufacturer's name and model number.

B. Solenoid Valves: The equipment manufacturer shall provide any solenoid valves on water or oil lubrication lines and on all cooling water lines. Solenoid valve electrical rating shall be compatible with the motor control voltage and shall be provided complete with all necessary conduit and wiring installation from control panel to solenoid.

C. Pressure Gauges: All pumps shall be equipped with pressure gauges installed at pump suction and discharge lines. Pressure gages shall be located in a representative location, where not subject to shock or vibrations, in order to achieve true and accurate readings. Pressure gauges shall be furnished in conformance with Section 40 91 08 - Pressure Measuring.

D. Variable Speed Drives: Variable speed drives, speed control equipment, and accessories shall be provided in accordance with Section 26 29 23 - Variable Frequency Drive Units.

E. Motors: Motors shall be heavy duty and shall comply with Section 26 05 10.

F. Flanges: Equipment flanges shall conform to ANSI B16.1 or B16.5 dimensions.

G. Lubrication: Equipment shafts, bearings, gears, and other moving parts shall be grease, oil, or product lubricated. All lubricating points shall be filled with the recommended lubricants.

H. Equipment: Gland seals, air valves, and cooling water drains, and drains from variable speed drive equipment shall be piped to the nearest floor sink or drain, with galvanized steel pipe or copper tube, properly supported with brackets.

I. Equipment Seals: Seals on equipment shafts shall be the manufacturer's suggested best quality mechanical seals or stuffing boxes, as best suited for each individual application. Where necessary, such seals shall be oil lubricated or water-flushed.

2.04 TOOLS AND SPARE PARTS

A. Tools: Special tools necessary for maintenance and repair of the equipment and one pressure grease gun for each type of grease required for pumps, mixers, flocculators, and motors shall be furnished as a part of the work hereunder; such tools shall be suitably stored in metal tool boxes, and identified with the equipment number by means of stainless steel or solid plastic name tags attached to the box.

B. Spare Parts: Furnish the following, in addition to the requirements of the individual mixer and flocculator sections. Package the spare parts in a labeled box as required above for tools.

1. Seals, packing, gaskets, wear rings
2. Other parts subject to wear
3. Parts specific to mixers
    a. 1 impeller
    b. 1 gearbox
    c. 1 set of printed circuit control boards, if applicable.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. General: Equipment shall be installed in accordance with the Shop Drawings and as indicated.

B. Alignment: Equipment shall be field tested to verify proper alignment, operation as indicated, and freedom from binding, scraping, overheating, vibration, shaft runout, or other defects. Drive shafts shall be measured just prior to assembly to ensure correct alignment without forcing. Equipment shall be secure in position and neat in appearance.

C. Lubricants: Installation shall include the necessary oil and grease for initial filling and one year's operation.

3.02 ACCEPTANCE

A. In the event of failure of any equipment to meet any of the above requirements or efficiencies, the CONTRACTOR shall make all necessary modifications, repairs, or replacements to conform to the requirements of the Contract Documents and the equipment shall be re-tested until found satisfactory.

END OF SECTION

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SECTION 46 41 16

HYPERBOLOID-TYPE MIXERS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The CONTRACTOR shall provide hyperboloid-type mixers including motor, gear drive, mounting base, drive shaft, hyperboloid-shaped body, and other appurtenances, complete and operable, in accordance with the Contract Documents.

B. Mixers shall be of the non-clogging, vertical shaft, hyperboloid-body type.

C. The mixer and its appurtenances shall be specifically designed for continuous duty operation in a submerged application in a sludge storage tank. The mixers shall not overload the motors at any point within the operating limits recommended by the mixer manufacturer.

D. The mixer shall be designed with no submerged bearings and with a dry installed motor. The entire weight of the mixers shall be supported at the mounting plate.

E. The WORK includes coordination of design, assembly, testing, and installation.

F. Related Sections. See Related Sections for additional requirements applicable to this Section:

1. Section 09 90 00 – Protective Coatings
2. Section 26 05 10 – Electric Motors
3. Section 26 05 15 – Industrial Control Panels
4. Section 26 29 23 – Variable Frequency Drives
5. Section 40 95 13 – Control Panels
6. Section 46 01 00 – Equipment General Provisions.

1.02 SPECIFICATIONS AND STANDARDS

ASTM A 312	Seamless and Welded Austenitic Stainless Steel Pipe
ANSI A 58.1	Minimum Design Loads for Buildings and Other Structures
ASTM A 283	Low and Intermediate Tensile Strength Carbon Steel Plates

1.03 SUBMITTALS

A. Provide submittals in accordance with the requirements of Section 46 01 00 Equipment General Provisions and the Standard Provisions.

B. Shop Drawings: Furnish complete drawings and technical information for equipment including:

   a. General arrangement plans;

   b. Dimensional drawings;

   c. Structural requirements include support base and anchor bolt requirements;

   d. Operating weight and loads;

   e. Erection and installation instructions;

   f. Electrical load calculations, rated power, rated input power, shaft power curve and its relationship to percent solids;

   g. Bearing life calculations;

C. CFD Modeling: Provide computational fluid dynamic (CFD) model outputs to confirm the location and performance of the mixers in the tanks. The performance shall be modelled with all mixers in operation and with one mixer out of service. The model shall be prepared using the geometry and water levels in the tank as indicated in the drawings. Coordinate with the OWNER to confirm any information needed to set up the model or inform the model outputs prior to submitting the first model results.

D. Factory Test Results: Provide report verifying shop tests as indicated in this Section.

E. Operations and Maintenance Manual: Provide an O&M Manual complying with the requirements of Special Provisions Article 14.10.

F. Spare Parts List

1.04 SERVICES OF MANUFACTURER

A. Manufacturers' services for training OWNER'S personnel, equipment system testing and startup shall comply with the requirements of Section 46 01 00 Equipment General Provisions.

B. **Inspection, Startup, and Field Adjustment:** An authorized service representative of the manufacturer shall visit the Site to furnish the indicated services.

C. **Instruction of OWNER'S Personnel:** The authorized representative shall furnish the indicated services for not less than 2 days.

1.05 QUALITY ASSURANCE

A. All equipment in this Section shall be furnished by a single supplier. Equipment shall be fabricated, assembled, erected and placed in proper operating condition in full conformity with the Drawings, Specifications, instructions and recommendations of the equipment manufacturer.

B. Qualifications of Manufacturer: The manufacturers shall be experienced in the design and construction of equipment for this purpose and shall have furnished such equipment with successful performance for a period of not less than five (5) years.

PART 2 -- PRODUCTS

2.01 IDENTIFCATION:

Location	Equipment Number
Sludge Mixing/ Storage Tank No. 1	RSLGMXT1MX01
	RSLGMXT1MX02
	RSLGMXT1MX03
	RSLGMXT1MX04
Sludge Mixing/ Storage Tank No. 2	RSLGMXT2MX01
	RSLGMXT2MX02
	RSLGMXT2MX03
	RSLGMXT2MX04

2.02 Performance Requirements

A. The mixers shall be capable of completely mixing each sludge tank as required to meet the performance requirements below. Each test will be conducted in the presence of the ENGINEER OF RECORD and the Owner. The performance requirements presented below define the minimum mixing capacity of each mixer. If additional mixing capacity is required to meet the performance test requirements, the Contractor shall provide the necessary equipment at no additional cost to the Owner.

B. Mixers shall be designed to meet the following conditions:

No. of mixers per tank	4
Mixer configuration	Hyperboloid
Liquid being mixed	Thickened Water Treatment Solids
Percent solids	0.1 to 6.0 percent
Maximum mixer body speed	40 RPM

Motor Type:	Squirrel Cage, Induction type
Nominal Motor Speed:	Coordinate with Mixer RPM Requirements
Motor Efficiency:	NEMA MG1 Premium Efficiency
Design:	Design B
Duty:	Continuous, designed for a minimum of ten starts per hour.
Insulation Class:	F
Maximum Motor Horsepower:	15 Hp
Voltage:	460V, 3 Ph., 60 Hz.
Motor Type:	TEFC
Drive Type:	Gear Drive
Service Factor:	1.15

2.03 MATERIALS

A. General

a. Each mixer assembly shall consist of a dry installed heavy-duty speed reducer with hollow shaft, electric motor, baseplate, SS shaft, and hyperboloid-type mixer body.

b. The bottom of the hyperbolic mixing body should be installed above the basin floor at a height recommended by the manufacturer for optimal performance.

c. Mixers shall be capable of handling biological thickened water treatment residuals with a solids concentration from 0.1 to 6.0 percent solids and shall be designed to prevent settlement in the tanks.

d. The mixer should be designed as a vertical shaft mixer, with a dry installed motor. During operation the mixer should not generate any upward forces on the bridge construction.

e. Mixer components in contact with the liquid shall be of Type 316 stainless steel with smooth surfaces devoid of blow holes and other irregularities. All exposed nuts, bolts, fasteners, and hardware shall be of Type 316 stainless steel with “Never Seize” coating.

B. Gear Drive

a. Each mixer shall include a gear drive assembly to maintain the maximum mixer speed as indicated the performance requirements.

b. The gear drive assembly shall have a cast-iron housing with high-quality corrosion protection coating, robust weather protective hood, and provide for thermal protection of the motor.

c. The calculated lifetime L10 of the bearings shall exceed 100,000 hours.

d. Provide drive motors meeting the requirements of Section 26 05 10 Electric Motors and shall be a squirrel cage induction motors, 460 V, 3 phase, 60 Hz, 1,800 RPM, Class F insulation.

e. The motors shall be equipped with a weather protection hood shall be equipped with integral thermal overload protection.

f. The hollow shaft shall be covered and sealed with a hollow shaft cap.

C. Mounting Base

a. The mounting base of each mixer shall consist of a gear base plate mounted permanently to the bridge/supports by bolted connection and shall include rubber shock absorbing buffers.

D. Shaft**:**

a. The drive shaft of the mixer shall be made from SS 316.

b. At the lower end there, shall be a flange connection to the mixer body itself.

c. All bolted connections shall utilize 316 stainless steel hardware.

E. Hyperboloid Mixer body:

a. Each hyperboloid mixer body shall be manufactured of FRP and be a streamlined stress-free body without any mounted or fitted parts.

b. Transport ribs which accelerate the flow shall be integrated in the mixer body.

c. The mixer body shall be coated with a special gel coat to provide a polished surface.

2.04 CONTROLS

A. The CONTRACTOR shall provide a complete control system housed in an individual cabinet with mounting brackets or pedestal, and all the necessary components meeting the requirements of Division 40 to provide the functions for each mixer as shown on the contract drawings and specifications.

2.05 TOOLS AND SPARE PARTS

A. **Spare Parts:** The WORK includes the following spare parts for each mixer:

a. One shaft holder

b. One set motor shaft bearings.

c. One set seals, gaskets, and O-rings

d. One set of rubber buffers.

e. One set special tools (if required).

2.06 MANUFACTURERS OR APPROVED EQUAL

A. INVENT Environmental Technologies

B. Entec International

C. DBS Manufacturing

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Mixers shall be installed in strict accordance with manufacturer's recommendations and the installation shall be certified by the manufacturer as proper before testing.

3.02 FACTORY TESTING

A. The manufacturer shall perform the following inspections and tests on each unit before shipment:

a. Mixer body diameter, motor rating, and electrical connections shall be checked for compliance with contract requirements.

b. Certified copies of all test procedures and results shall be provided to the Owner prior to shipment

3.03 FIELD TESTING

A. Mixers shall be witness tested in the field after installation. The witness test shall be part of startup checks in advance of commissioning activities per requirements of the Special Provisions. Field testing shall include:

a. Verify that propeller, motor rating, and electrical connections comply with this Section.

b. Run mixer dry to verify proper rotation and alignment.

c. Run mixer Hyperboloid at least one minutes under at least 10 feet of water to check for balance, unusual noise, and overheating. Correct for any objectional vibration in accordance with manufacturer’s recommendations.

d. An indicator test shall be performed to verify the proper pumping capacity and efficiency of mixing.

e. Test motor for no-load current at rated voltage, high potential, amperage draw, and locked rotor current.

f. verify mixer functions using the control station(s)

B. A functional wet test shall be conducted at plant startup. Verify operation without excessive noise, vibration, cavitation, or overheating. Document motor voltage and current draw.

C. The OWNER reserves the rights to perform a “Quality Inspection” factory or site visit for all pieces of equipment being furbished for this project. The MANUFACTURER shall make available staff and resources for this visit. The cost for this visit shall be paid by the OWNER.

END OF SECTION

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SECTION 46 41 30

VERTICAL SHAFT MIXERS

PART 1 -- GENERAL

1.01 THE SUMMARY

A. The CONTRACTOR shall provide vertical-shaft flocculating assemblies and appurtenant equipment, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 46 01 00 - Equipment General Provisions, apply to this Section.

C. The requirements of Section 46 41 00 - Mixers, General, apply to this Section.

1.02 CONTRACTOR SUBMITTALS

A. Submittals shall be in accordance with Section 46 41 00 - Mixers, General.

B. Calculations: The CONTRACTOR shall submit the manufacturer's calculations, certified by a professional engineer, for the gear rating and bearing life of the unit.

PART 2 -- PRODUCTS

2.01 GENERAL

A. Design: Mixers shall be high efficiency, low shear, axial-flow type impeller units of the same design and manufacturer. Parts shall be designed and proportioned for ample strength, stability, and stiffness for the intended purpose. Ample space and access shall be provided for inspection, repairs, lubrication, and adjustment. Each mixer and drive assembly shall be designed for 24 hour a day continuous service and shall be built in accordance with the current AGMA Standards. The assemblies shall be suitable for out-of-doors service and shall be of weatherproof construction.

B. Motors: Motors shall be of the heavy-duty (high-efficiency) TEFC type, in accordance with Section 26 05 10 - Electric Motors.

C. Anchorage: The CONTRACTOR shall provide equipment manufacturer-recommended stainless steel anchor bolts, nuts, and washers, but the manufacturer shall furnish templates necessary for setting the equipment. Placement of the anchor bolts shall be performed by the CONTRACTOR from certified dimension prints supplied by the equipment manufacturer. Anchor bolts shall be in accordance with Section 05 50 00 - Miscellaneous Metalwork.

D. Factory Test: Each mixer unit shall be subjected to a full size scale factory test by the manufacturer of the units, in the exact field dimensions.

2.02 MIXER UNITS

A. General: Each mixer unit shall consist of an impeller mounted on a vertical shaft, suspended from a pedestal, and shall include a speed reducing drive unit with shaft bearings, coupling, electric motor, a mounting flange and a CONTRACTOR-furnished cover plate, and a base. No underwater bearings will be permitted.

1. The units shall be designed to transmit to the water the indicated velocity gradient "G" based on the minimum water temperature indicated below, to provide an adequate pumping capacity, and to produce eddies which are essential to the flocculation process, at a minimum shear.

B. Criteria: The mixers shall meet the following design criteria:

Identification number	RPLMTMX01 & RPLMTMX02
Total number of units	2 (one per tank)
Tank Diameter, ft	10’-2”
Approximate liquid depth, ft	12’-4”
Top of slab to bottom of tank, ft	386.00
Minimum solution temperature, deg. F	55
Output speed (rpm)	39
Direction of flow	Downflow
Minimum motor horsepower per unit (HP)	5
Motor Speed (rpm)	1750

C. Drive: Mixers shall be driven by a Variable Frequency Drive (VFD), coupled to the gear reducer. VFD shall bein accordance with Section 26 29 23 - Variable Frequency Drive Units. If applicable, the motors should be rated for inverter duty, in accordance with NEMA MG1, part 30 and 31, with a separate stainless steel nameplate affixed to the motor.

1. The drive unit motor or VFD shall include an external on-off switch and an internal contact for remote indication of operation.

2. Each drive assembly shall be of ample capacity to supply the required power and torque output at speed settings within the speed range. Motor and gear reducer shall be equipped with lifting lugs.

D. Gear Reducer: Each gear reducer shall be of the vertical offset shaft arrangement type, ruggedly encased in a cast iron or fabricated steel heavy duty housing designed for the conditions it will encounter. Gears shall be helical or spiral bevel type or a combination of both. Worm gear arrangements will not be acceptable. The reducer shall be designed and manufactured in accordance with the AGMA Standard and shall have a service factor of 1.5 based upon the full motor nameplate horsepower at maximum operating speed. Bearings shall be grease- or oil-lubricated with a minimum L-10 life of 100,000 hours, sufficiently sized to stabilize the impeller assembly under operating conditions throughout the range.

E. Setting: Each drive assembly shall be furnished with a CONTRACTOR-supplied and manufacturer-approved steel base for mounting to the supporting structure and with a cover plate to support the unit. The cover plate shall be drilled and cut to match the mixer base, and it shall have anchor bolts set into the concrete slab.

F. Lubrication: Lubrication of each speed reducer shall be by means of an efficient oil splash mechanism. The drive shall be provided with a dipstick to observe oil level. Each drive must have an effective drywell feature to eliminate oil leakage down the output shaft. Output shaft bearings may be grease lubricated, including a high quality lip seal to retain grease. Oil fill and drain lines and grease fittings shall be in easily accessible locations, at a minimum of 10-inches above the mixer mounting surface.

G. Impeller and Shaft: Mounted at the end of each mixer shaft shall be a stainless steel impeller bolted to a cast hub. Submerged nuts, bolts, and washers shall be Type 316 stainless steel. The hub shall be of sufficiently large diameter, and impellers shall be designed to assure maximum efficiency by preventing central backflow. The impeller assembly shall be securely keyed to the shaft. Shaft stresses shall be limited to 9,000 psi and impeller stresses to 12,000 psi.

H. Impeller Adjustment: The impeller shaft shall be of Type 316 stainless steel. The impeller shall be connected to the shaft with a hook key for security. An extended keyway shall be provided to allow for vertical adjustment of each impeller in 3-inch increments 12-inches from its recommended position.

I. Shaft Coupling: The lower mixer shaft shall be connected to the upper, or drive output shaft, by means of a rigid flanged coupling, of either the welded or interference fit hub type. Mating coupling faces shall have a rabbeted male and female pivoted connection for accurate concentricity, and shall not require match marks for alignment. The coupling shall be designed to minimize shaft run-out, and it shall be located near the tank deck level.

J. Structural Strength and Stability: Structural members and connections shall be designed to withstand, within normal working stresses and deflections, loads imposed on them by rotation of the assembly at maximum design speeds submerged and dry, as well as loads which may be superimposed during or subsequent to erection while the basins are empty. The shaft shall be designed for a maximum stress not to exceed 11,000 psi while under maximum operating loads. The shaft shall be of the overhung design, and the use of bottom steady bearings shall not be permitted. The shaft impeller design shall be such that the operating speed shall not exceed 70 percent of the first lateral critical speed. Lower shaft straightness, rigid coupling squareness, and output shaft accuracy shall give

a maximum runout at the lower end of the shaft of 1/8-inch for every 10-feet of overhang, as measured when turning over by hand.

2.03 MANUFACTURERS, OR EQUAL

A. **Chemineer, Inc. (Robbins and Meyers)**

B. **Lightnin**

C. **Philadelphia Mixer Corporation**

D. **Equal**

PART 3 -- EXECUTION

3.01 INSTALLATION

A. General installation requirements shall be in accordance with Sections 46 01 00 – Equipment General Provisions and 46 41 00 - Mixers, General.

B. Placement of the anchor bolts shall be determined by the CONTRACTOR from certified dimension prints supplied by the equipment manufacturer.

END OF SECTION

SECTION 46 43 22

CIRCULAR, SLUDGE THICKENER RAKE ARMS

PART 1 -- GENERAL

1.01 THE SUMMARY

A. The CONTRACTOR shall provide circular center-feed clarifier rake arms, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 46 01 00 - Equipment General Provisions, apply to this Section.

C. The requirements of Section 46 43 00 - Clarifiers/Sedimentation Tanks, General apply to this Section.

D. Single Manufacturer: A single manufacturer shall be responsible for a complete and integrated package including the following:

1. Truss support arms
2. All fasteners
3. Spare parts and assemblies
4. Any other components required for a complete, operable unit.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

AISC	Code of Standard Practice for Steel Bridges and Buildings
AISC	Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings
ASTM A 36	Structural Steel
ASTM A 48	Gray Iron Castings
ASTM A 536	Ductile Iron Castings
ASTM A 370	Standard Test Methods and Definitions for Mechanical Testing of Steel Products
AWS D1.1	Structural Welding Code

1.03 CONTRACTOR SUBMITTALS

A. In addition to the Shop Drawing requirements in Section 46 43 00 - Clarifiers/Sedimentation Tanks, General, furnish the following:

B. Product Data

1. Manufacturer's literature, illustrations, specifications, and engineering data.

C. Shop Drawings

1. Drawings shall show critical project-specific field dimensions and elevations drawn accurately to scale.

2. Drawings showing sludge collector mechanism with dimensions, member thickness, welds, and connection details.

3. Setting drawings, templates, and directions for the installation of anchor bolts and other anchorages.

4. List of recommended additional spare parts beyond the items listed in the Specifications, describing parts recommended for operating period of one year with recommended quantities and unit prices.

5. Complete field weld information including location, type, size, length, and explanation of special conditions.

6. Certifications

a. Manufacturer's material verifications and hardness.

b. Manufacturer's installation instructions

7. Manufacturer's field reports: Include the following:

a. Field test results

b. Manufacturer's certification that equipment was installed in accordance with the manufacturer's instructions, inspected by the manufacturer, serviced with the proper initial lubricants, equipped with applicable safety equipment, and installed with proper electrical and mechanical connections.

D. Technical Manual in accordance with Section 01 33 00 - Contractor Submittals.

E. Warranties

1.04 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Manufacturer which has been regularly engaged in manufacture of sludge collectors for a minimum of 15 years, that have been successfully utilized in domestic water treatment and wastewater treatment applications for a

minimum of 15 years. The complete center drive assembly shall be a regularly manufactured in-house product of the clarifier manufacturer.

B. Welder Qualifications: Qualified and certified in accordance with AWS D1.1.

1.05 SPECIAL CORRECTION OF DEFECTS PROVISIONS

A. CONTRACTOR shall furnish manufacturer's warranty for 5 years on the mechanism structure.

PART 2 -- PRODUCTS

2.01 GENERAL DESIGN

A. Thickener Description.

B. Design Criteria, each thickener

Service		Sludge Thickener
Collector Type		Plow Rake
Influent maximum		1,000
Overflow	minimum	0
	average	200
	maximum	1,000
Tank Diameter, ft		50
Side Water Depth, ft		20
Freeboard, in		24
Bottom slope, in/ft		2.75

2.02 RAKE COLLECTION ARMS

A. The mechanism shall include 2 sludge removal arms of steel truss construction, with steel plow type raking blades and adjustable stainless steel squeegees secured to the blades by Type 304 stainless steel bolts and nuts. The blades shall be properly spaced to insure complete raking of the bottom twice per revolution. The blades shall plow the heavy sludge to the center sludge hopper and shall be minimum 6-inches deep. The members shall be of adequate size to be capable of raking any normal sludge deposit encountered without distorting the truss arms or the center cage. If rectangular box construction is used, there shall exist bracing in each bay where the truss members

meet. If members are placed back to back, there shall be a space between them of at least 1/2-inch to allow for cleaning and painting or provide a continuous weld around the entire connection.

2.03 PROTECTIVE COATING

A. Coating shall be in accordance with Section 09 96 00 – Protective Coating.

2.04 Spare Parts AND SPECIAL TOOLS

A. The CONTRACTOR shall furnish the following spare parts to the Site or at a location designated by the OWNER. The spare parts shall be delivered in a crate protected for long term storage.

1. One set of squeegees.

2. One set of neoprene gaskets for skimmers.

3. One set each of oil seals for the worm shaft and pinion shaft.

B. Special Tools

1. Furnish in the same manner as spare parts.

2. Include tools that are required to assemble, disassemble, repair, and maintain equipment, and that have been specifically made for use on clarifier equipment.

3. Include with each tool set the necessary hooks and rods for handling equipment parts that are not permanently attached.

4. Mark or tag special tools with equipment identification numbers.

5. Include a list of special tools with the maintenance and operation data in the technical manual.

6. Furnish each set of tools, eyebolts, hooks, and rods in boxes with hinged covers, with provision for wall mounting

2.05 CATHODIC PROTECTION

A. Provide sacrificial anode cathodic protection systems for the interior submerged surfaces of steel in each gravity thickener that have continuity with the rake arms.

B. All materials in contact with the water or sludge to be classified in accordance with ANSI/NSF 61 – Drinking Water System Components.

C. Submittals to conform to the requirements of this specification.

D. Design Drawings and Computations: Prepare all computations and drawings by or under the direct supervision of a Corrosion Engineer who is a Professional Engineer, registered in the United States with a minimum of ten years' experience in cathodic protection design for steel water system components. Design the system to provide

effective corrosion control in accordance with the criterion for protection which is a steel-to-water potential, IR drop free, within a range of -0.850 volts to -1.050 volts relative to copper-copper sulfate reference electrode. Measure this potential free of the effect of voltage gradients (IR drops).

The Corrosion Engineer to base system capacity on:

1. Total wetted surface area of steel in the thickener that has continuity with the rake arms to the high water level (HWL).

2. High quality interior coating.

3. Protection of bare steel surfaces due to coating deterioration of up to 20% of the total submerged surface area.

4. Chemical analysis of thickener contents including resistivity.

5. Minimum anode system life of twenty (20) years.

E. Provide certificate, signed and sealed by Professional Engineer stating that computations and Drawings are in conformance with these design criteria.

F. Catalog Cuts: Submit manufacturer's catalog cuts for the system which demonstrates classification in accordance with ANSI/NSF 61 - Drinking Water System Components.

G. Operating and Maintenance Manual: Submit five (5) operating, monitoring and maintenance manuals for the cathodic protection system. Include operating instructions, maintenance data, product data and test procedures in the manuals.

H. Drawings: Maintain as-built Drawings of the corrosion system during installation and construction. Revise drawings to show exact locations of all wiring, connections and terminal boxes. Properly identify all items of equipment and material. Submit the original as-built Drawings to the Owner representative.

2.06 MANUFACTURERS, OR EQUAL

A. **Kusters**

B. **Westech**

C. **Ovivo**

PART 3 -- EXECUTION

3.01 DELIVERY, STORAGE, AND HANDLING

A. Prior to shipping, the equipment shall be inspected to assure that equipment is complete and in compliance with the following requirements:

1. Match mark mating parts for ease of field assembly.

2. Lubricate moving parts as practical before shipment. When necessary to disassemble components for shipping, coat exposed machined surfaces with suitable rust-preventive compound before shipping.

3. Shop photograph fabricated steel items, clearly showing piece marks.

4. Mount and securely bolt equipment to pallets.

5. Crate equipment (when required for additional protection). Securely attach one packing list to each pallet or container.

6. Securely block or otherwise support components that may be subject to damage from vibration or jarring during shipment.

7. At the Site, store materials to permit easy access for inspection and identification. Keep steel members off the ground, using pallets, platforms, or other supports.

3.02 INSTALLATION

A. Clarifier equipment shall be installed in accordance with Section 46 43 00 Clarifiers/Sedimentation Tanks, General.

3.03 FIELD TESTS

A. The clarifier mechanism and the alarm system shall be torque-tested to 100 percent of the indicated running torque. Each arm shall be tested in the presence of the CONSTRUCTION MANAGER and manufacturer by applying the load evenly to both arms before the mechanism is accepted and placed into operation.

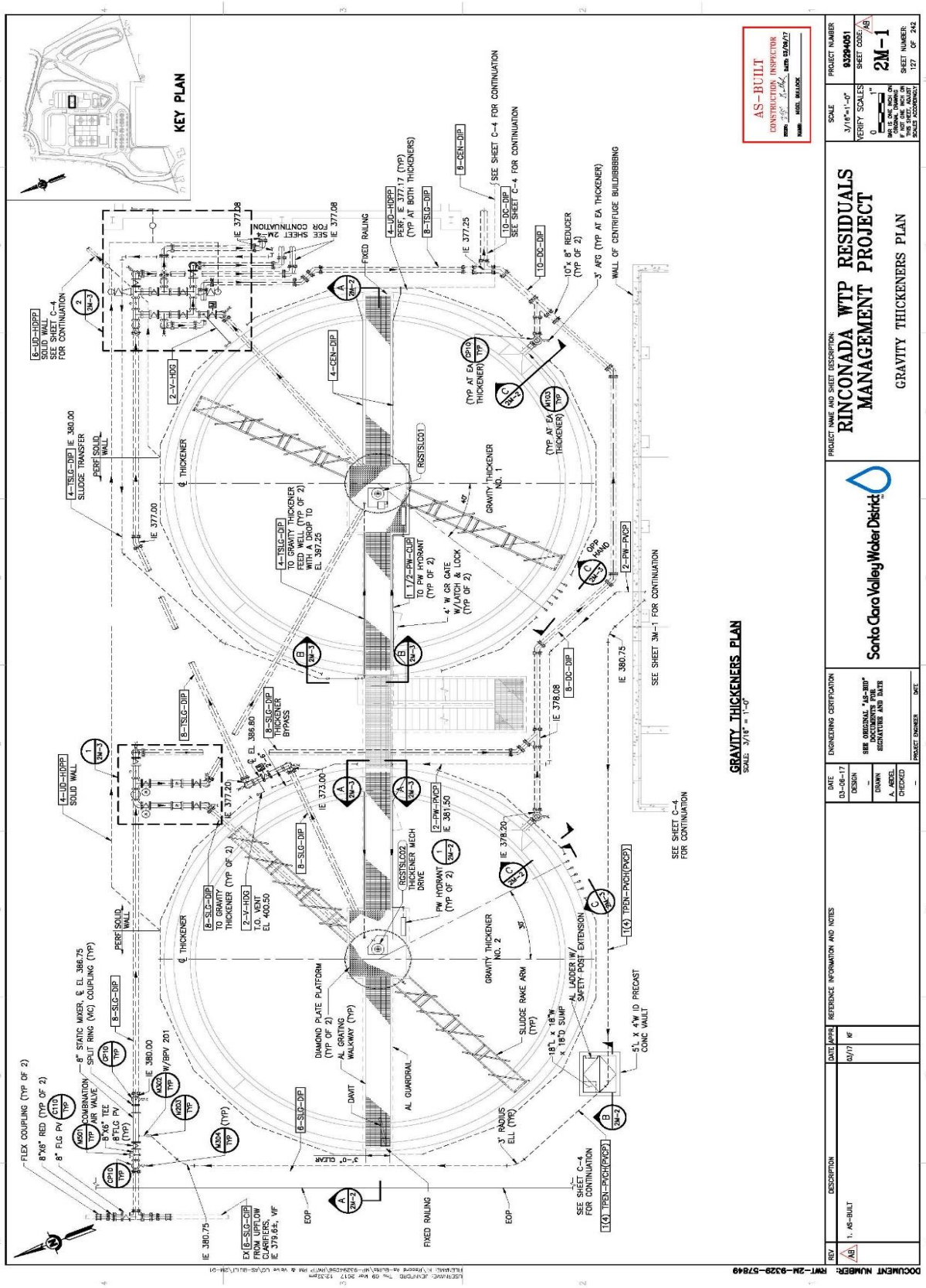
B. The test shall be a dynamic test performed on the clarifier mechanism to verify accurate torque indication and adequacy of the mechanism to safely withstand the torque. The test shall accurately depict actual operation of the mechanism and shall not apply impact loading, jerky loading, or abnormal conditions that may reduce the life of the equipment.

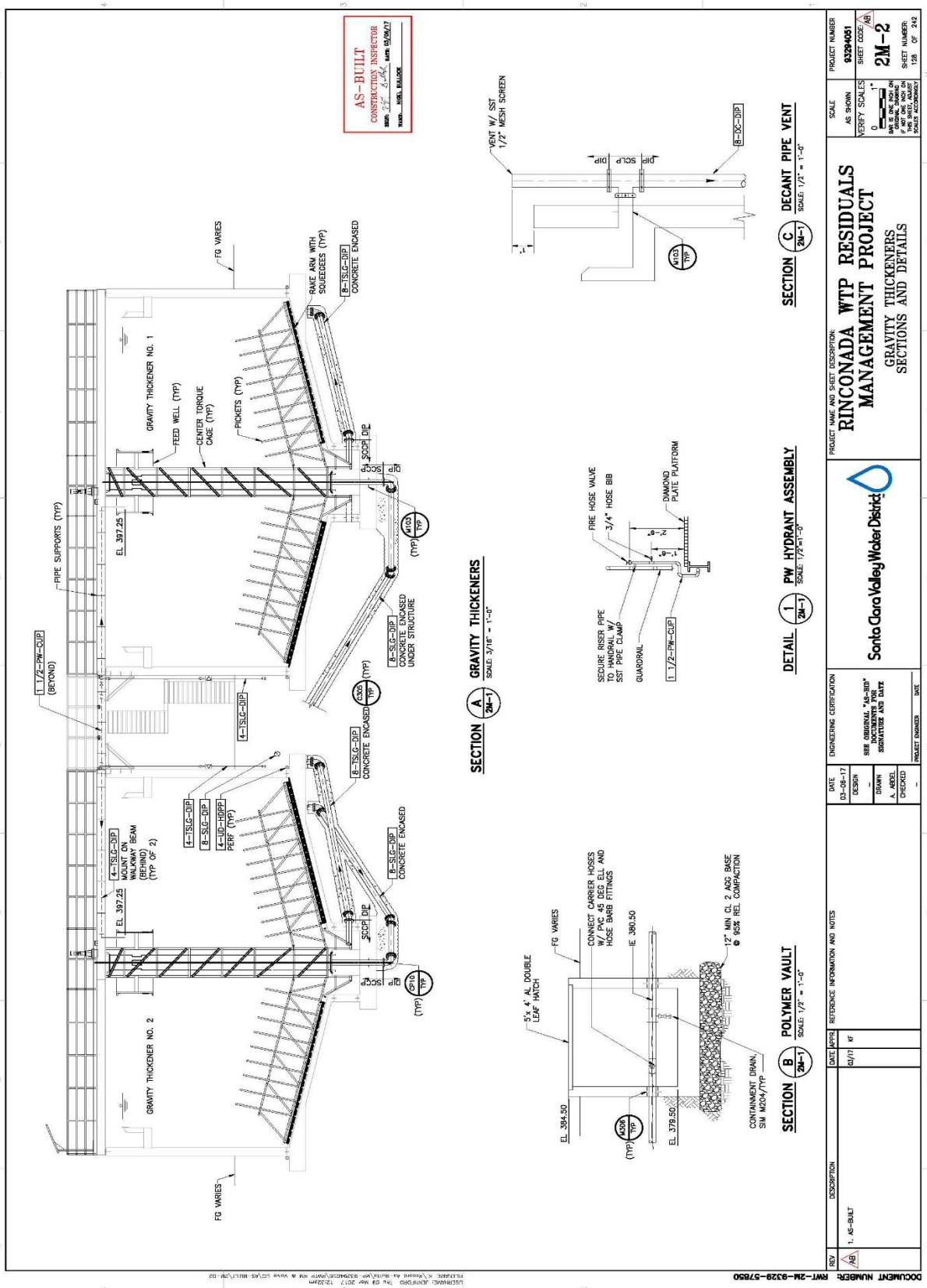
C. A torque test device shall be attached near the outer end of each rake arm. The device shall allow the load to be gradually applied uniformly to each arm as the arm rotates. Readings of the load applied at the arm versus the torque indicator reading shall be taken at 100 pound increments until the indicated cut out torque is achieved. This load shall be applied over not less than one half revolution of the mechanism.

D. Actual torque versus indicated torque shall be accurately indicated within 7 percent of full scale at torque readings across the range.

E. There shall be no permanent deformation of any component. If deformation does occur, or the required torque is not achieved, the CONTRACTOR shall replace the defective parts, and the clarifier shall be retested as part of the WORK.

END OF SECTION


KEY PLAN
GRAVITY THICKENERS PLAN
SCALE 3/16" = 1'-0"
AS-BUILT
CONSTRUCTION INSPECTOR
PROJECT NAME AND SHEET DESCRIPTION:
RINCONADA WTP RESIDUALS MANAGEMENT PROJECT
GRAVITY THICKENERS PLAN
Santa Clara Valley Water District
ENGINEERING CERTIFICATION
REFERENCE INFORMATION AND NOTES
1. AS-BUILT
PROJECT NUMBER 93294051
SHEET CODE 2M-1
SHEET NUMBER 127 OF 242
DOCUMENT NUMBER: RMT-2M-9329-57849


AS-BUILT
CONSTRUCTION INSPECTOR
GRAVITY THICKENER NO. 1
GRAVITY THICKENER NO. 2
FEED WELL (TYP)
CENTER TORQUE CAGE (TYP)
PICKETS (TYP)
RAKE ARM WITH SQUEEGEES (TYP)
PIPE SUPPORTS (TYP)
EL 397.25
FG VARIES
8-TSLG-DIP CONCRETE ENCASED
8-SLG-DIP CONCRETE ENCASED UNDER STRUCTURE
4-TSLG-DIP
4-LID-HDPP PERF (TYP)
1 1/2-PW-CUP (BEYOND)
SCDP DIP
SECTION A 2M-1 GRAVITY THICKENERS
SCALE: 3/16" = 1'-0"
VENT W/ SST 1/2" MESH SCREEN
8-DIC-DIP
SECTION C 2M-1 DECANT PIPE VENT
SCALE: 1/2" = 1'-0"
FIRE HOSE VALVE 3/4" HOSE BIB
DIAMOND PLATE PLATFORM
SECURE RISER PIPE TO HANDRAIL W/ SST PIPE CLAMP
GUARDRAIL
DETAIL 1 2M-1 PW HYDRANT ASSEMBLY
SCALE: 1"=1'-0"
5'x 4' AL DOUBLE LEAF HATCH
CONNECT CARRIER HOSES W/ PVC 45 DEG ELL AND HOSE BARB FITTINGS
IE 380.50
12" MIN CL 2 AGG BASE @ 95% REL COMPACTION
EL 384.50
EL 378.50
CONTAINMENT DRAIN, SIM M204/TYP
SECTION B 2M-1 POLYMER VAULT
SCALE: 1/2" = 1'-0"
RINCONADA WTP RESIDUALS MANAGEMENT PROJECT
GRAVITY THICKENERS SECTIONS AND DETAILS
Santa Clara Valley Water District
AS SHOWN
93294051
2M-2
DOCUMENT NUMBER: RMT-2M-9329-57850

SECTION 46 71 36

CENTRIFUGE DEWATERING EQUIPMENT

PART 1 -- GENERAL

1.01 SUMMARY

A. Section Includes:

1. The WORK of this Section includes providing sludge dewatering solid bowl, scroll type centrifuges complete with vibration isolators, drive motor, hydraulic scroll drive system, belt guard, lubrication system, electrical components, electrical control panel and all necessary components, complete and operable, in accordance with the Contract Documents.

2. The WORK also includes coordination of design, assembly, testing and installation.

1.02 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)

1. ASTM A36 - Standard Specification for Carbon Structural Steel.

2. ASTM A48 – Standard Specification for Gray Iron Castings.

3. ASTM A242 - Standard Specification for High-Strength Low Alloy Structural Steel.

4. ASTM A480 – Standard Specification for Flat-Rolled Stainless and Heat Resisting Steel Plate, Sheet and Strip.

5. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

6. ASTM G65 - Standard Test Method for Measuring Abrasion Using the Dry Sand/Rubber Wheel Apparatus.

B. American Concrete Institute (ACI)

C. American Institute of Steel Construction (AISC)

D. International Society of Automation (ISA)

E. American Welding Society (AWS)

F. National Electrical Manufacturer’s Association (NEMA)

G. National Electrical Code (NEC)

H. Underwriters Laboratories Inc. (UL)

I. Institute of Electrical and Electronic Engineers (IEEE)

J. American National Standards Institute (ANSI)

1. ANSI B15 – Ball Bearings, Local Bearings and Fatigue Life

2. ANSI B16.1 - Standard for Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250 and 800.

K. American Gear Manufacturers Association (AGMA)

L. American Bearing Manufacturers Association (ABMA)

M. The Society for Protective Coatings (SSPC)

1. SSPC SP-6 – Joint Surface Preparation Specification Commercial Blast Cleaning

2. SSPC SP10 – Joint Surface Preparation Standard Near White Blast Cleaning

N. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.03 SOLIDS DEWATERING SYSTEM DESCRIPTION

A. General

1. The Rinconada Water Treatment Plant is a conventional treatment plant. The sludge to be dewatered is generated by its water treatment train which consists of: coagulation with aluminum sulfate (or ferric chloride) and cationic polymer, granular media filtration, and residual disinfection with sodium hypochlorite. Sludge is produced mainly from backwashing of the filters. The spent washwater from the filters is sent to the Washwater Recovery Facility where it is equalized and clarified. Solids that settle in the Washwater Recovery Facility is pumped to the Gravity Thickeners. The sludge thickening is accomplished by allowing sludge to settle within the Gravity Thickeners and decanting the upper, clarified zone. The lower zone of sludge within the Gravity Thickeners is pumped to sludge storage tanks (part of this project) and then is pumped to the centrifuge(s) in service.

a. See the Drawings for more detailed information on the Rinconada WTP's residuals management process schematic, chemical injection points and dose range, and design criteria.

b. Rinconada WTP source water quality parameters:

1)	Daily average turbidity, (min, average, max):	1, 5, 20 NTU
2)	TOC (min, average, max):	2, 4, 8 mg/l
3)	Temperature (min, average, max):	9, 15, 24 degrees C

4) pH (min, average, max): 6.8, 7.8, 8.9

5) Alkalinity (min, average, max): 50, 80, 150 mg/l

B. The Solids Dewatering System consists of four trains. Two of the trains are existing in Centrifuge Building A. The existing transfer conveyors are replaced as part of the this project to accommodate loading from the new centrifuges. Each new train includes the following equipment:

1. Centrifuge Feed Pumps – RCTFP01, RCTFP02, RCTFP03, and RCTFP04.
2. Centrifuges –RDWTCFG03 (new) or RDWTCFG04 (new)
3. Inclined Solids Discharge Conveyors – RDWTCNV08 or RDWTCNV11
4. Vertical Conveyors –RDWTCNV 09 or RDWTCNV12.
5. Horizontal Conveyors - RDWTCNV10 or RDWTCNV13
6. Transfer Conveyors – RDWTCNV05 or RDWTCNV06
7. Polymer Dilution/Feed Units – RPLMFP01, RPLMFP, RPLMFP03 or RPLMFP04 or RPLMFP05

C. Typically, only one dewatering train will be in service. However, the system shall be capable of running all equipment simultaneously.

D. The centrifuge in service shall be continuously fed sludge conditioned with polymer by individual variable speed progressive cavity type sludge feed pumps (Centrifuge Feed Pumps).

E. Polymer will be continuously fed into the sludge by a polymer dilution/feed system with variable speed feed pumps. The polymer type shall be NSF 60 certified and shall be as recommended by the System Integrator and accepted by the District.

F. The dewatered solids (cake, or cake solids) from each centrifuge shall discharge into its discharge conveyor, which will convey the solids onto the transfer conveyor, which in turn will convey the solids onto the loadout conveyor. Each loadout conveyor will discharge the cake into a trailer or dumpster for removal from the water treatment plant.

G. Each dewatering train shall be equipped with a control panel to monitor/control the operation of each train component and the overall operation of the dewatering train.

H. With Vendor-Supply Control Panel (VCP) like the Centrifuge Manufacturer panel, all VCP shall provide access to all proprietary software code for their proprietary PLC, HMI, and Touch Screen to District's SCADA staff. Vendor shall provide all software to allow District to read those proprietary PLC, HMI, and Touch Screen software code. These software packages shall be licensed to the District.

I. VCP's programmer shall work closely with the INSTRUMENTATION SUPPLIER of this project to ensure that VCP's HMI/Touch screens appear and function identically to INSTRUMENTATION SUPPLIER HMI/Touch screens and as specified in Section 40 95 20.

J. Communication, Control and Signal Wiring.

1. Communication, control, and signal wiring for both hard-wired configurations, and network configuration shall be available options and shall be wired. Signals used for controls and alarms between the Manufacturer proprietary Centrifuge PLC and M580 level 6 interfacing Centrifuge PLC shall be hardwired (RCENTCP03). Only distributed PLC to PLC communication shall be either Ethernet or Fiber. Please reference drawing I-11 for PLC to PLC communication between the M580 level 6 interfacing Centrifuge PLC (RCENTCP03) and main PLC (RREMCP01).

a. Only hard-wired signals shall be allowed on the SCADA/PLC network. Please reference 40 90 10, Part 2.B.3.

b. Signal not used for controls and alarms shall go be for Maintenance, Relay Protection, Power Monitoring and other related monitoring functions.

1.04 CENTRIFUGE ASSEMBLY DESCRIPTION

A. Each centrifuge shall be capable of dewatering aluminum sulfate (alum) and cationic polymer sludge with or without powdered activated carbon (PAC) or ferric chloride and cationic polymer sludge with or without PAC from a conventional drinking water treatment plant with the characteristics and to the performance standards described herein. During testing and start-up, the sludge may be any combination of chemical sludges listed above. During the System Commissioning Test, all combinations of sludge will be tested.

B. Dewatering (decanting) centrifuges specified herein are of the "high cake solids type" intended to produce dewatered cake with higher solids content than that produced in conventional centrifuge units. Selection of this type of equipment was based on the ability of the high solids centrifuge to produce dewatered cake of a nature that is economically handled in subsequent disposal operations. Failure to achieve the minimum cake solids specified and/or the consumption of polymers in excess of the maximum amount specified will result in significant financial impacts to the District and liquidated damages to the Contractor.

C. The sludge shall be fed into the center of the equipment where the solids are thrown against the wall of the bowl which is rotating at high speeds thus generating high centrifugal forces. The solids deposited against the bowl wall shall be continuously moved by an internal scroll conveyor to one end of the machine where they are plowed up a beach and discharged out a solids discharge chute. The solids shall discharge into a screw conveyor. The clarified liquid shall continuously overflow adjustable weirs at the other end of the machine where it discharges into a centrate chute that is piped directly to the centrate drain pipe. Centrifuges shall be provided with scroll drives to infinitely vary the speed of the conveyor to optimize torque for sludge dewatering.

D. Each centrifuge assembly includes, but is not limited to:

1. Centrifuge with a rotating assembly consisting of a bowl and scroll conveyor with main bearings, mounted on a frame:

   a. An electric main motor with variable speed drive.

   b. A scroll drive system consisting of a hydraulic power pack.

   c. Amanual grease pump lubrication system for the rotating assembly's main and scroll bearings.

2. Vibration isolators for the centrifuge assembly.

3. A carbon steel base.

4. A centrate chute.

5. A solids (cake) chute

6. All flexible connections for all piping, all wiring, the cake discharge chute, and the centrate discharge chute.

7. Flushing water connections.

8. Solids cake and centrate sampling ports.

9. Centrifuge control panel which includes motor controllers and adjustable speed drives for the centrifuge, and all controls for the associated train of the Solids Dewatering System.

10. Auxiliary and accessory devices, equipment, or materials necessary for system operation, or to interface equipment provided under this Section with equipment provided under other Sections, shall be included whether specified or not.

11. Auxiliary and accessories devices, equipment or materials where not specified shall be as recommended by the SDSS.

E. Facility Design

1. The Contractor shall be aware that the Drawings are generic in their depiction of the centrifuge installation but nominally depict Hiller’s centrifuges.

2. Adjustments to any number or all of the following will be necessary depending on the equipment provided (as shown on the Drawings):

   a. Centrifuge layout and piping.

   b. Concrete pedestals dimensions.

c. Discharge conveyors angle of inclination to avoid conflict with existing access door to Centrifuge Building B.

d. Monorail curvature

3. The Contractor shall be responsible for the design of the centrifuge supports.

4. The centrifuge supports should be designed to support the weight and dynamic loads of the centrifuge, seismic forces, all electrical and mechanical supply and drainage systems, and the centrate and solids chutes. In all design calculations the weights should assume the centrifuge bowl is full of water. Each manufacturer's solids and centrate chutes are configured differently so there will need to be revisions to accommodate the actual equipment furnished.

F. Design Requirements

1. The centrifuges shall be capable of dewatering sludge having the following characteristics:

a. Type of Sludge: aluminum sulfate or ferric chloride, cationic polymer sludge from conventional drinking water treatment plant.

b. Sludge Feed Concentration (Percent dry solids varies): 1.5 to 3

c. Sludge pH (min, average, max): 6.5, 6.8, 7.5

d. Sludge temperature: 8 to 24 degrees C.

2. The centrifuges shall be manufactured to meet or exceed the following physical parameters:

a. Minimum inner bowl diameter, (in): 26 (30 if needed to meet performance criteria)

b. Minimum total bowl length, (in): 104

c. Minimum L/D ratio: 4.0

d. Minimum sludge feed flange connection, (in): 3

e. Minimum polymer feed line connection, (in): R3/4

f. Minimum centrifugal force: 3,000 g

g. Maximum horsepower draw, all drives, backdrive and auxiliary systems, not nameplate horsepower: 300 Hp

h. Minimum Main (Bowl) Drive horsepower: 125 Hp

i. Minimum Scroll Drive horsepower: 30Hp

j. Maximum Main (Bowl) Drive horsepower: 250 Hp

k. Maximum Scroll Drive horsepower: 50 Hp (AD-2)

G. The water supply available at each unit for flushing will be as follows:

a. Flow (gpm): 150

b. Water Pressure (psig): 50

c. Water Temperature (degrees C): 8 to 24

H. Performance Requirements

1. When processing sludge with characteristics as specified above, each centrifuge shall be capable of the following:

a. Guaranteed (minimum) sludge processing feed rate (gpm) at 2% dry solids exclusive of polymer solution flow rate: 300

b. Guaranteed sludge dewatering capacity (Minimum lbs/hr dry weight) exclusive of polymer: 3,050

c. Guaranteed percent cake solids (percent minimum): 22

d. Guaranteed percent recovery (suspended solids) (percent min): 95

e. Guaranteed polymer dosage (lbs. of active polymer/dry tonfeed solids, maximum): 15

2. Polymer used to verify performance requirements shall be emulsion or water solution type and shall be NSF 60 certified. Alternate type polymers will not be acceptable.

3. The polymer will be fed to the centrifuge as a dilute solution (0.5% by volume or less) at a flow rate up to 30 gpm. This is the required polymer solution flow rate under a sludge feed rate of 3,050 dry lbs/hr and an active polymer dose of 15 lbs per dry ton of feed solids. It assumes an emulsion polymer solution with an active content of 29%.

1.05 SUBMITTALS

A. All submittals shall be in accordance with the Standard Provisions.

B. Product Data:

1. Submit data completely describing product including plan and section views and listings of materials of construction.

2. Submit surface preparation and finishes to be applied to all equipment.

C. Provide drawings and product data, showing materials of construction and details of installation for:

1. Rotating assembly with bowl and scroll conveyor.
2. Equipment base and platform.
3. Frame and casing.
4. Main motor drive assembly.
5. Scroll conveyor drive system.
6. Lubrication system for the rotating assembly's main bearings.
7. Centrifuge control and starter panels.
8. Vibration isolators.
9. Centrate chute.
10. Solids chute.
11. Flexible connections.

D. Submittals shall include:

1. Certified general arrangement drawing(s). Manufacturer’s Drawings shall be coordinated with the Drawings, including equipment numbers and piping designations.
2. Assembly anchorage calculations prepared and stamped by a California registered civil or structural engineer in compliance with the Section 01 33 17. Certified anchorage drawings showing anchor bolt locations.
3. Details of construction and dimensional data.
4. Total equipment weight and weight of single largest item or component.
5. List of manufacturer's spare parts for 5 years of operation, including packing, gasket, etc.
6. Minimum clearance distances around equipment required to access equipment for service/repair/removal.
7. Recommended petroleum oil lubricants (POL) products, by grade (winter and summer); list two manufacturers with equal products; list product names and designation.

8. Quantity/quality requirements for electric power, water supply, air, drainage, structural, etc., and any special requirements.

9. Descriptive literature, bulletins and/or catalogs of the equipment.

10. Data on the characteristics and performance of the units to indicate ability to meet the system performance specified herein, including current listing of all operating centrifuges of the size specified herein to define the manufacturer's experience.

11. The weight and live loads created by individual pieces of equipment as well as the total weight of each centrifuge and ancillary equipment.

12. A complete bill of materials of all equipment. This includes a listing of all parts and materials provided under this contract including a description, manufacturer part numbers and quantity required for typical repairs.

13. Complete motor and drive, controls and instrumentation unit data

14. Testing procedures.

15. Copies of all test results, as specified herein.

16. Descriptive literature on surface preparation and shop priming.

17. Complete data on noise as specified herein.

18. Bearing Life: Certified by the centrifuge manufacturer.

19. Detailed descriptions and drawings of proposed structural, electrical, instrumentation, architectural, and mechanical changes to the project facilities and Drawings that are required due to the System Integrator's proposed equipment and systems and written request by the Contractor to incorporate these changes in a reasonable amount at no additional cost to the District. (AD-2)

E. Electrical/Instrumentation Submittals. Submit complete electrical and instrumentation and control information in sufficient detail to allow installation of instrumentation and controls, and electrical components, and demonstrate full compliance with these Specifications. Specifically, the following is required:

1. Instrument data sheets and catalog data giving full technical details of each instrument device. Complete instrumentation and control schematics, presented in conformance with ISA Bulletin S5.1, latest edition.

2. Controller Input/Output Lists identifying all input and outputs used by the system, Include detailed memory mapping scheme from network transfer of system operational data and conform the data mapping structure to the District data exchange requirements as specified in Section 40 91 00.

3. Control programming ladder logic or sequential logic diagrams

4. Point-to-point component interconnection diagrams.

5. Wire numbers and/or color coding.

6. Terminal numbers.

7. Operation, installation and troubleshooting instructions.

8. Complete outline drawings showing such details as are necessary to locate conduit stubups and field wiring. Standard preprinted sheets or drawings simply marked to indicate applicability to this Contract will not be acceptable.

9. Submit complete equipment fabrication drawings for control panels to include the following:

    a. Scaled cabinet assembly and layout drawings including internal and external views.

    b. Control panel front elevation showing all face-mounted instruments, control panel interior layout drawing showing location of major components, motor controls, control power transformers, fuses, circuit breakers and point-to-point wiring drawings.

    c. Detailed bill of materials for all components including manufacturers name, description and catalog number.

    d. Fabrication and painting specifications.

    e. Recommended spare parts list.

    f. Catalog information and performance specifications on all devices such as, but not limited to, circuit breakers, control power transformers, motor starters, terminal blocks, AC or DC drive controllers, switches, lights, timers, relays and related equipment.

10. Provide flow chart style logic diagrams showing the operation logic including process and safety interlocks. Instrument and logic diagrams and schematics shall be prepared using ISA Standard symbols with the identification letters as shown on the P & ID Legend and Notes Drawings.

11. Submit panel cooling calculations confirming that all components shall operate at or below their maximum rated temperature at the maximum ambient temperature conditions at the site as specified in the Contract Documents during full rated operation of the dewatering system. Provide additional cooling equipment at no additional cost to the District if required to achieve the operation within the tolerances of the provided equipment.

12. Sequence of operation describing in detail the various steps of operation in their proper order.

F. Samples. Submit the following:

1. Equipment samples

   a. Scroll abrasive resistant tile.

   b. Solids discharge port abrasion protection (if applicable)

   c. Liquids discharge end weir plate.

2. Sample of manufacturer's field observation/test data collection/recording form.

3. Sample of shop test data collection/recording form.

4. Sample of typical test report.

G. Design Data. Submit manufacturer's standard drawings, catalog cuts, technical data sheets and descriptive literature for the following items:

1. All items fabricated by the manufacturer.

2. All items purchased for use by the manufacturer.

3. Design Data. Submit for the following:

   a. Main drive motor sizing.

   b. Hydraulic power pack motor sizing.

   c. Main drive sheave and belt sizing.

   d. Main bearings.

   e. Solids discharge chute.

H. Test Reports and Procedures

1. Procedures for shop testing of the centrifuges.

2. Procedures for startup and field testing of the centrifuges.

3. Test report of shop testing of the centrifuges.

4. Test report of field testing of the centrifuges.

5. Procedures for startup and testing the entire Solids Dewatering System.

6. Test report of field testing the entire Solids Dewatering System.

7. If the equipment or material to be provided under this Section is not specifically required to be tested in compliance with the requirements specified, the

manufacturer's standard test used for quality control of the equipment or material shall be submitted.

8. Test reports shall be accompanied by the certificates from the manufacturer certifying that the material and equipment propose to be supplied under this Section is of the same type, quality, manufacture and make as that tested.

I. Certifications

1. Certificate stating that equipment has been installed according to manufacturer's instructions.

J. Manufacturer's Installation Instructions

1. Submit the manufacturer's instructions for delivery, unloading, storage, handling and installation of the centrifuge units.

K. Statement of Qualification

1. Submit statement indicating that manufacturer meets the specified experience qualifications.

L. Manufacturer's Field Report

1. Submit manufacturer's field report of inspections, tests and observations for all items furnished under this Section.

2. Include copies of original test data collection forms.

M. Operations and Maintenance Data

1. Complete operation and maintenance data shall be furnished for all equipment included under this Section as specified in Standard Provisions Section 11 and Special Provisions Section 14. The maintenance instructions shall include maintenance plan for the equipment, troubleshooting data and full preventative maintenance schedules, recommended cleaning instructions, procedures and safety precautions for equipment and complete spare parts lists with ordering information.

N. Warranties

1. Submit warranties for work under this Section and special warranties listed below.

O. Resume of Technician to perform adjustments, inspections, observations of test operations, supervision of functional and performance testing, and training.

P. Staff training documentation per Special Provisions Section 22.

1.06 QUALITY CONTROL

A. Qualifications

1. The Contractor shall have built similar equipment of similar type, size and capacity and must have in the opinion of the ENGINEER OF RECORD, appropriate experience and sufficient test data to demonstrate that the equipment to be supplied will meet all specified requirements. The Contractor shall submit documentation demonstrating experience in design, manufacture and start-up of solids dewatering system using high solid dewatering centrifuges of similar size and capacity and complexity and provide documentation of at least three drinking water treatment plant dewatering facilities each of which has been operating in the United States for 3 or more years, or for a minimum of 15,000 hours, whichever is less. Provide two references from operating installations for aluminum sulfate sludge dewatering at a drinking water treatment plant. Similar size and capacity is defined as centrifuge units having the same or larger dimensions than what is specified in Paragraph 1.06F and a hydraulic and dewatering capacity that is the same or higher than what is specified in Paragraph 1.06G.

B. Certifications

1. Certify that materials and equipment specified herein conform to the respective standards referenced.

2. Certify that shop test equipment has been calibrated.

3. Certify that field test equipment has been calibrated and checked.

C. Pre-Installation Conference

1. A pre-installation conference will be held to confirm the scope of work and responsibilities of the attendees.

2. The conference will be held 4 weeks prior to commencing installation work. It shall be indicated on the Contractor's current progress schedule.

3. The conference will be held at the plant site.

D. Services of Contractor's Representative

1. Provide services of a Contractor's services representative(s) specifically trained on type of equipment specified. Submit qualifications of service representative(s) for approval. The number of required days are exclusive of travel time and do not relieve Contractor of obligation to provide sufficient service to place equipment in satisfactory operation.

   a. Installation Assistance: Minimum of one 8-hour day to assist in location of anchor bolts, setting, leveling, field erection, coordination of piping, electrical, miscellaneous utility connections.

   b. Start-up Assistance: Minimum of five 8-hour days to assist in check-out, start-up, calibration, verification of PLC programs, functional testing, acceptance testing and performance testing.

c. PLC to PLC Communications Testing: Minimum of two 8-hour days to assist in point to point testing of all data that is transferred between PLC systems. Testing shall include point by point verification of all analog and digital variables between the Centrifuge PLCs, Centrifuge GIPs, PICS supplied PLC, and the HMI system.

d. Operations and Maintenance Training: Classroom and hands-on instruction which will cover the theory of operation, actual operation of the solids dewatering system, optimization of the centrifuge operations and electrical, mechanical, and instrumentation maintenance. The number of training sessions and duration shall be as required in Special Provisions Section 22.

e. Post-Start-up Assistance: The System Integrator shall schedule no less than five 8- hour days for visits to the site after initial start-up/acceptance to ensure that operation of equipment is in accordance with manufacturer's recommendations. No more than four visits shall be required. These visits shall be in addition to the visits required by the System Integrator to address warranty problems. These follow up visits shall occur within 1 year of initial start-up/acceptance and shall be as required and called upon by the District to make these visits. Personnel making visits to the site should be fully familiar with the equipment and should be able to make recommendations for optimizing the system to achieve the most optimum dewatering conditions for the centrifuge facility.

f. Post-Start-up Maintenance Supervision: The System Integrator shall schedule no less than five 8-hour days to supervise maintenance of the equipment over the 2 year period following acceptance.

g. Allow the District to video tape all training sessions.

1.07 DELIVERY, STORAGE AND HANDLING

A. Equipment and materials provided under this Section shall be delivered, stored and handled in compliance with the Standard Provisions.

B. Deliver centrifuges as completely assembled as practical to minimize field assembly. Contractor shall be responsible for unloading and any necessary field assembly.

1.08 MAINTENANCE

A. Lubricants and Fluids

1. Furnish a one year's supply of lubricants and fluids for all equipment.

1.09 WARRANTIES, PERFORMANCE GUARANTEES AND LIQUIDATED PERFORMANCE DAMAGES

A. Warranty

1. All centrifuges, including main drives, backdrives, gear boxes, lubrication systems, instrumentation and control systems, and appurtenances, furnished shall be warranted to be free from defects in materials and workmanship for such period as specified in the Standard Provisions. The warranty shall cover all repairs including parts and labor for all systems and all costs for removal, transportation and reinstallation. Said warranty shall conform to the requirements herein, shall be in a form acceptable to and be for the benefit of the District, and shall be submitted by the manufacturer. Replacement of equipment caused by neglect or abusive operation shall be the responsibility of the District. If the equipment should fail during the warranty period due to a defective part(s), the part(s) shall be replaced in the equipment and the unit(s) restored to service at no expense to the District.

2. All abrasion-resistant surfaces and components within the centrifuges furnished shall be warranted for a minimum life of 15,000 operating hours after successful completion of Acceptance Testing. When the first unit reaches 15,000 operating hours, or the warranty period elapses, whichever comes first, the manufacturer shall disassemble the unit with the greatest number of operating hours for inspection and prepare a complete report detailing the condition of the units, especially the hard-surfacing and list the areas where wear has occurred. If the 15,000 hour disassembly or a prior unscheduled shutdown indicates the failure of any of the abrasion resistant protection system, the District will examine the wear and determine what the true expected life is. If the expected life is less than 15,000 hours, spare abrasion resistant material shall be provided. The number of spare materials shall be based upon the prorated life less than 15,000 hours. If more than 10 percent of the scroll tiles on any centrifuge require replacement prior to 15,000 hours due to wear, the repairs shall be made off-site by the manufacturer. The warranty shall cover all repairs including parts and labor for all systems and all costs for removal, transportation and reinstallation. Said warranty shall conform to the requirements herein and shall be in a form acceptable to and be for the benefit of the District and shall be submitted by the manufacturer. Replacement of abrasion-resistant surfaces and components caused by neglect or abusive operation shall be the responsibility of the District.

B. Manufacturer's Guarantee/Warranty

1. The Contractor shall submit a manufacturer's guarantee/warranty as required in the Standard Provisions and the additional requirements herein. The guarantee/warranty shall have a stated value of $150,000. The guarantee/warranty provided shall be for guarantee of the performance requirements specified herein, the requirements of the Standard Provisions, and other purposes as defined elsewhere in this Section.

2. In the event that the equipment does not meet the guaranteed performance standards per Paragraph 1.06, the manufacturer shall alter the equipment to meet the guaranteed performance standards. If modifications are made to the centrifuge selected for performance testing for the purpose of meeting performance guarantees, such modifications shall also be made to all other centrifuges supplied in this Contract. All costs associated with modifications shall be borne by the Contractor and at no additional expense to the District. Upon modifying the test centrifuge, the performance tests must be repeated. All costs associated with the

retesting, including the District's costs, shall be borne by the Contractor and at no additional expense to the District.

3. If the equipment has not demonstrated compliance with performance requirements stated herein within six months following initial startup of the equipment, the ENGINEER OF RECORD will assess liquidated performance damages as defined in Paragraph 1.11C below.

C. Liquidated Performance Damages

1. For cake solids: $599,924 times the difference between the inverse of the average measured percent (%) cake solids (ACS) as defined in Paragraph 3.03D, for the centrifuge tested during the performance test and the inverse of the guaranteed performance requirement for percent (%) cake solids (GCS) specified in Paragraph 1.06. The formula for calculation of the liquidated damages is: LD = $599,924 x (1/ACS – 1/GCS), where GCS is 0.22. If the difference between the guaranteed performance (GCS) and the average measured (ACS) is a negative number, there shall be no liquidated performance damages assessed or bonus paid. The $599,924 factor is based on the 20-year present value (based on 2.5% discount rate) of the current cost of hauling and disposing of sludge cake at a landfill of $30/wet ton.

2. For polymer cost: $28,196 times the difference between the average polymer consumption in pounds per dry ton of sludge processed (ACP), as defined in Paragraph 3.03D, for the centrifuge tested during the performance test and the guaranteed performance requirement for polymer consumption in pounds per dry ton of sludge processed (GCP) specified in Paragraph 1.06. The formula for calculation of the liquidated damages is: LD = $28,196 x (ACP-GCP), where GCP is 15. If the difference between the average (ACP) and the guaranteed performance (GCP) is a negative number, there shall be no liquidated damage assessed or bonus paid. The $28,196 is based on the 20-year present value (based on 2.5% discount rate) of the current cost of polymer of $1.41/pound.

3. Maximum liquidated performance damages shall be limited to $150,000. Liquidated performance damages specified in this Paragraph relate only to the performance guarantee and are independent of other liquidated damages in this Contract.

1.10 DEFINITIONS

A. “Plant water”, as used in this Section, is potable water protected by backflow preventers.

B. "Dry Solids" - Measurement of solids remaining from a sludge sample after testing per the Standard Methods test referenced herein.

1.11 SPECIAL COORDINATION

A. The Contractor shall coordinate the design, fabrication and installation of the equipment to assure all utilities (sludge feed, plant water, drains, polymer feeds, chutes, conveyors, etc.,) match with regard to size, location, method of support, etc. The size and location of these utilities shall be coordinated with the manufacturer to position them as close to the connection point on the equipment as possible avoiding unnecessary bends or offsets

while allowing for ease of maintenance and the vibrating nature, i.e., need for flexible connections of the equipment.

B. Plant SCADA/HMI System Interface

1. The HMI software for the dewatering system shall be developed by the PCSI per the requirements of Section 40 95 20. The System Integrator shall coordinate with the PCSI to ensure that the centrifuge systems can be monitored and controlled from the plant HMI system. At a minimum, the SDSS shall provide the following:

   a. Graphic displays developed for the centrifuge GIP systems. GIP displays shall be provided to the Contractor in both printed and electronic format and include all data points and pop-up windows.

   b. A PLC memory map that details tag names, addresses, and descriptions for all data available to the HMI system. The data shall be packed into a contiguous register array that includes both digital and analog data. The data array shall include at least 25% spare registers.

2. Communications to the HMI system shall be via the plant's PLC network and shall utilize Modbus TCP protocol except where specifically shown as hardwired on the Drawings.

C. Centrifuge PLC to SDS PLC Communications

1. The process equipment that is controlled by the System Integrator's system but is not directly connected to the Centrifuge Control Panel PLCs includes the Centrifuge Feed Pumps, Polymer Dilution Feed units, Load-Out Conveyors, and associated gates. The System Integrator shall coordinate with the PCSI to provide control and monitoring of these systems at both the centrifuge GIP and the plant HMI system. The control programs for this equipment will reside in the Solids PLC and be programmed by the PCSI, at the direction of the System Integrator.

2. Equipment control shall be per the requirements specified in Section 40 90 10 and the data required to accomplish the specified control strategies shall be coordinated between the SDSS and PCSI PLC programmers.

3. PLC to PLC communications shall be via the plant's PLC network and shall utilize Modbus TCP protocol. Communication with HILLER SEE control shall be realized with Profibus

4. All data monitored at the Centrifuge PLC and HMI shall be formatted and mapped in a data array or memory map for transfer to the Solids PLC. Memory mapping format shall be configured as a block transfer scheme conforming to the requirements of Sections 40 90 10, 40 91 00 and 40 95 20 except HILLER SEE control, for which addresses are fixed.

5. Reference paragraph 1.03.J.1 above, Communication, Control and Signal Wiring, for additional details.

D. The District's existing and new PLC, SCADA and Data networks as shown on the Drawings are for connection of District owned or controlled equipment only for security and operational reliability purposes. Any equipment being connected to any of the District's networks shall undergo equipment sanitizing by District IT staff that will effectively remove any and all software that does not meet District criteria including non-authorized Windows patches, all unauthorized software, and all non-District related e-mails, documents, and data files. District sanitizing procedures, scheduling constraints, and methods for connection to District networks shall conform to the requirements of the Special Provisions.

E. This coordination effort shall take place during the shop drawing process and during the control system Coordination Workshops as specified under Section 40 91 00.

1.12 CENTRIFUGE SELECTION

A. Qualifications

1. The centrifuges shall be by Hiller Separation & Process.

1.13 MEASUREMENT AND PAYMENT

A. Work shall be considered incidental and compensation shall be included in the Contract prices paid for the various items of work and no additional time or compensation be allowed therefor.

B. Refer to Schedule of Bid Items.

PART 2 -- PRODUCTS

2.01 GENERAL

A. Each centrifuge shall be a solid bowl, horizontal, scroll type unit and shall be specifically designed to handle the sludge specified above. Each unit shall be capable of continuous or intermittent operations with minimum of maintenance.

B. Equipment furnished and installed under this Section shall be fabricated, assembled, erected and suitable for placement in proper operating condition in full conformity with the Drawings and this Section, engineering data, instructions and recommendations of the equipment manufacturer. The centrifuge units shall be the product of suppliers regularly engaged in the design and manufacture of centrifuges and shall be specifically designed for the intended conditions of service. Appurtenant equipment shall be new and shall be designed, fabricated and assembled in accordance with the best engineering and shop practices. Individual parts shall be manufactured to standard sizes and gauges. All centrifuge units for the service intended shall be identical in design and construction. Components of the centrifuge shall be designed for the stresses which may occur during operation or for any additional stresses which may occur during fabrication, shipping, erection or maintenance. Individual parts shall be alike in workmanship, design and shall be interchangeable. Materials shall be suitable for service conditions and as described herein.

C. All centrifuges units shall be supplied by one manufacturer.

2.02 MATERIALS

A. Standard Materials

1. Unless otherwise specified, materials shall conform to the following:

a. Bowl: stainless steel, Type 329 or Duplex

b. Bowl wear strip: stainless steel, Type 316 or better

c. Scroll stainless steel: Type316, 317, 329 or Duplex

d. Scroll tips: Tungsten Carbide tiles on SS carriers, tack welded onto flights from on wrap beyond feed chamber towards solids discharge end; maximum loss of 3 cubic millimeters when tested in accordance with ASTM G65, Procedure A. Rest of scroll protected by tungsten carbide flame spraying.

e. Feed tube: stainless steel, Type 316 or 317

f. Base: Fabricated carbon steel or cast steel

g. Upper case, if applicable: stainless steel, Type 316L or better.

h. Bottom case, if applicable: Fabricated carbon steel or cast steel with stainless steel cladding on all surfaces in contact with process material or Type 316 stainless steel or better

i. Main Bearings: Grease or pressure oil lubricated, B-10 life of 100,000 hours

j. Feed compartment, axial walls Stainless steel, Type 316 or 317*

k. Feed compartment Field replaceable Adiprene or urethane liner or fused tungsten carbide spray or Flame Sprayed Coast 53C or equal

l. Sludge feed Replaceable Adiprene, PUR, silicon carbide, or nozzle/port Sintered Tungsten Carbide liner;

m. Solids discharge port Replaceable Sintered Tungsten Carbide; abrasion protection max. of 3 cubic millimeters when tested in accordance with ASTM G65, Procedure A

n. Case protection solids field replaceable stainless steel, ceramic, Adiprene or urethane liner (discharge end) or equal

o. Solids chute Stainless steel, Type 316 or better

p. Centrate chute Stainless steel, Type 316 or better

q. Fasteners Stainless steel, Type 316 or better (unless higher strength is recommended by the SDSS or specified herein)

r. Anchor bolts, nuts Stainless steel, Type 316, sized as required and washers by the Contractor.

B. The Contractor shall require the supplier of stainless steel castings and abrasion-resistant materials to supply certified copies of the mill test results certifying that the materials supplied are in accordance with the applicable ASTM or comparable standards. Three copies shall be forwarded to the CONSTRUCTION MANAGER prior to the initiation of centrifuge fabrication.

C. The mill test reports shall include:

1. The actual material analysis.

2. ASTM or comparable standard.

3. Date of manufacture.

4. Place of manufacture.

5. Manufacturer's name.

6. Markings on the materials to denote the batch number.

D. All abrasion resistant materials shall have a volume loss less than 3 cubic millimeters when tested in accordance with the ASTM G65, Procedure A, Standard Practice for Conducting Dry Sand/Rubber Wheeler Abrasion Tests, or comparable tests, where applicable. All test reports shall be furnished in English. Non-ASTM standards and requirements shall be referenced to appropriate ASTM.

E. Fasteners shall be traditional American (inches) or all metric, mixtures of both types will not be allowed.

2.03 MATERIALS AND CONSTRUCTION

A. Bowl

1. The bowl shall be designed to withstand, with an adequate safety factor, all centrifugal forces encountered during operation. The bowl shall be supported on each end on cylindrical or spherical roller-type bearings,. The centrifuge bowl shall have minimum dimensions as required in Paragraph 1.06 (length measured from hub to hub; diameter measured in the cylindrical section) and a conical beach extension.

2. The bowl shall be centrifugal cast of high tensile strength stainless steel or stainless steel sheet, rolled and longitudinally welded, followed by x-ray examination. All centrifugal cast material shall be examined for cracks, shrinkage, porosity, or other defects by means of a liquid penetrant test. Pool depth level must be readily

adjustable via weir plates located at the large diameter end of the bowl where liquid is discharged. Solids shall be discharged from the small diameter (opposite) end of the bowl. Centrifuge designs with centrate return tubes are not acceptable. For an alternate arrangement of liquid and solids discharge, the Contractor shall provide drawings detailing the required changes in piping arrangement in order to match with the proposed piping layout of the system as a whole. All bowls shall be interchangeable.

3. A minimum of eight evenly spaced longitudinal, replaceable bowl strips shall be provided the entire length of the bowl to trap solids and form a layer of solids to protect the bowl from wear. If grooves are machined in the bowl in lieu of ribs, the bowls shall be designed to allow wear without reducing the life of the machine.

4. The scroll shall be dynamically independently balanced to allow for a scroll exchange without the need of rebalancing of the entire centrifuge.

5. Centrifuge bowl shall utilize a jetted discharge weir or other means to reduce power consumption.

B. Main Bearings

1. The main centrifuge bearings shall be ball or cylindrical roller-type bearings mounted in the housing or in split horizontal pillow blocks. All bearings shall have a calculated B-10 life rating of not less than 100,000 hours. Bearings shall be guaranteed against replacement within the first 15,000 hour period. Annual replacement of main bearings will not be acceptable.

C. Conveyor (Scroll)

1. The unit shall include a stainless steel horizontal cylindrical-conical scroll conveyor equipped with helical flights. The conveyor shall be independently mounted concentrically within the bowl. All scrolls shall be completely interchangeable. All conveyor bearings shall be anti-friction roller or roller type:

   a. Sealed from process contamination, externally greaseable and easily accessible for proper maintenance or permanently greased lubricated.

   b. Rated with a calculated B-10 life of not less than 100,000 hours.

   c. Bearings shall be guaranteed against replacement within the first 15,000 hour period. Annual replacement of conveyor bearings will not acceptable.

2. The scroll conveyor shall be designed to handle sludge solids without clogging and with minimum disturbance to the pool.

3. The edge and the face of the conveyor flights shall be protected against abrasion over the entire length of the scroll from the solids discharge end of the conveyor through the feed chamber plus one wrap by a series of welded-on assemblies consisting of sintered tungsten carbide tiles. The bonding between wear surface and back-up tile shall be able to withstand a minimum shear stress of 5,000 lbs/sq in and

a minimum edge wear of 1/2-in on the diameter must occur before the parent metal of the conveyor flight is exposed to wearing. Each tile shall be individually replaceable and shall have an ability to monitor wear by means of a visual inspection. Protect the edge and flight in the conveyor against abrasion from the feed zone through the liquid discharge end with fused tungsten carbide spray or flame sprayed Coast 53C or comparable ground to match the diameter of the tungsten carbide tile assemblies.

4. The scroll shall be dynamically independently balanced.

D. Feed Arrangement and Polymer Distribution

1. The feed zone shall be provided with measures that enable proper but gentle mixing of polymer into the sludge stream.

2. Polymer addition to condition sludge feed shall be introduced through a 3/4-inch connection on the centrifuge feed pipe.

3. If the selected centrifuge manufacturer requires a second polymer addition point to optimize centrifuge performance, the manufacturer shall coordinate that with the Contractor and it shall be provided at no additional cost to the District.

E. Bases

1. The centrifuge unit components shall be mounted on bases.

2. The centrifuge bowl and scroll assembly must be removable without removal of the drive motor in its operating position.

3. The centrifuge and main (bowl) drive motor may be separate or on a common base.

4. The drive motor stand shall incorporate a motor base plate.

5. The scroll drive system components shall be mounted on the centrifuge or on a base installed near the centrifuge.

6. An appropriate tensioning device for the belts shall be provided.

7. Bases for hydraulic equipment shall be provided with collection pans and drains.

8. The base shall be provided with lifting eyes or facilities which will permit the lifting of the entire assembled centrifuge unit.

9. Machined surfaces shall be provided at all points where support loads are transferred to the base.

10. The centrifuge shall be enclosed in a stainless steel or coated steel case with stainless steel cladding on all surfaces in contact with process material. If removable upper case is provided it shall be of stainless steel or steel with stainless steel cladding in the centrate and sludge discharge compartments. A stainless steel case

shall be provided with a brush or sandblasting finish. The solids end of the casing shall include a replaceable adiprene or urethane liner. In order to limit splashing and air leakage, the casing shall be provided with a gasket on the flanges where the upper and lower casings join and a seal or splash collector and drain on the feed tube

11. The case shall also be designed to act as a protective guard and to provide a complete enclosure to minimize noise. The bottom of the case shall contain flanged centrate and sludge cake discharge connections. Each end of the case shall be equipped with a covered handhole opening to facilitate inspection, adjustment and maintenance.

12. The centrifuge case shall be vented as recommended by the equipment manufacturer. Lifting eyes shall be provided for lifting the case.

13. The case shall include flushing connection for cleaning the case. Provide a case drain to drain the case to the centrate chute or alternatively provide a case that drains by gravity to its respective centrate and solids discharge chutes.

14. The cover shall be partitioned to guide the centrate and the solids discharge to their respective discharge outlets and to prevent liquid solids contamination to the rest of the unit.

F. Main (Bowl) Drive Motor

1. Each machine supplied shall be equipped with electric motors and V-belt drive system complete with necessary vibration isolators for the individual support of the motor and centrifuge. The belt drive system shall consist of multiple belts as required to provide full capacity and withstand the full starting torque of the system. Belt, pulley and gear box guards shall be provided for protection from all moving parts.

2. Drive motor shall be 460 volt, 3 phase, TEFC, premium efficient, severe duty, inverter duty, maximum 3600 rpm, continuous duty, Class F insulation, with a B rise, NEMA A design, 1.15 service factor, and capable of making two complete starts in succession after coasting to rest between starts. The motor shall be capable of at least one restart within 1 hour after any shutdown. The motor shall comply with all provisions of Section 16222. The motor shall be provided with an oversized NEMA 4X terminal box.

3. Motor shall be provided with bimetallic motor over-temperature switch and 120 Volt, low watt density, silicone rubber type, anti-condensation motor space heaters with leads brought out to the accessory NEMA 4X conduit box.

4. Motor shall be of low noise design. Motor sound pressure level shall not exceed 85 dBA measured at 3 feet under free field, no load conditions in accordance with IEEE Standard 85.

G. Scroll Drive System

1. Scroll drive system shall be hydraulic/electric type to provide an infinitely adjustable differential speed variation over its full range of operation.

2. Hydraulic/Electric Option

   a. The hydraulic/electric scroll drive system shall consist of a variablegear type hydraulic fluid pump and a hydraulic motor mounted on the centrifuge to drive the scroll conveyor. The hydraulic motor shall be mounted directly to the bowl and between the main bearings to minimize noise and vibration. The drive shaft of the hydraulic motor shall be directly connected to the scroll conveyor. The hydraulic motor shall be powered by a hydraulic pump unit to create the differential speed. The hydraulic pumping system shall be powered by a CFD driven electrical motor that automatically adapts to performance requirements in terms of required differential speed and pressure. A pressure filter with electronic contamination indication shall be provided. The hydraulic pumping unit shall be located adjacent to the centrifuge.

3. The scroll drive system shall be capable of operating in either a manual or automatic mode. In the manual mode, it shall provide for operation at a specific adjustable scroll differential speed. In the automatic mode, it shall operate at a constant torque setting via an automatic torque module incorporated into the control panel. In the automatic torque control mode, the scroll drive shall be automatically adjusted to maintain constant torque, thereby compensating for varying feed characteristics while optimizing residence time and separation.

4. The control system for the scroll drive assembly shall control the scroll drive as described in the following two modes of operation. Automatic operation shall be possible in both modes.

   a. Differential speed - maintains the preset differential speed between the scroll and bowl while the torque will vary within the preset limitations.

   b. Differential speed over torque control - maintains constant torque by entering into the controller the desired torque control point and varies the speed within the preset differential speed limitations automatically in order to maintain the torque control point, while a minimum differential speed set point provides safety, i.e., clogging, etc.

H. Lubrication System

1. Lubrication of main bearings shall be by means of grease guns

2.04 VARIABLE FREQUENCY DRIVES (VFDS)

A. All VFDs shall comply with Section 26 29 33 and the following general requirements:

1. Input power: 460 VAC, plus 10 percent, minus 5 percent, 3 Phase, 60 Hz.

2. Input frequency: 57 to 63 Hz.

3. Ambient temperature: 0 to 40 degrees C.

4. Elevation: Up to 2000-ft above mean sea level.

5. Relative humidity: Up to 90 percent non-condensing.

6. Drive output: 100 percent rated current continuous, suitable for operation of the driven equipment over the required speed range without overloading. Drives shall be capable of a continuous overload up to 110 percent rated current for variable or constant torque loads as required by the driven load. Starting torque shall be matched to the load.

B. Operator interface

1. Provide a unit-mounted or door-mounted digital keypad/display, capable of controlling the drive and setting drive parameters. The digital display shall normally display:

   a. Speed demand in percent

   b. Output current in amperes

   c. Frequency in Hz

   d. Control mode - manual or automatic

2. The digital keypad shall allow operators to enter exact numerical settings in English engineering units. A user menu shall be provided as a guide to parameter settings. Coded messages on keypad will not be acceptable. Parameters are to be factory set in EEPROM and resettable in the field. Parameters shall be password protected. The EEPROM stored variables shall be transferable to new and spare boards.

3. The keypad/display module shall have a key switch or security password to enable or disable the keypad. The key shall be removable in either the "Enabled" or "Disabled" positions. The keypad module shall contain a "self-test" software program that can be activated to verify proper keypad operation. The keypad display shall contain a full alphanumeric character set.

4. The following controls and indicators shall be provided, either separately or as part of the keypad/display:

   a. POWER ON, RUN AND FAULT indication.

   b. FAULT RESET control.

   c. LOCAL-OFF-REMOTE control mode selector.

   d. Manual START/STOP controls.

   e. Manual speed adjust capability.

C. External Interface

1. Provide one set of NO/NC auxiliary dry contacts for remote indication of VFD running status.

2. Provide one set of NO/NC auxiliary dry contacts for remote indication of VFD fault.

3. Provide one set of NO/NC auxiliary dry contacts for remote indication of LOCAL-OFF-REMOTE selector switch position.

4. Input and output signals shall be isolated at the drive.

5. Zero and span adjustability shall be provided for speed signals.

6. A 4-20 mA DC isolated output signal proportional to speed shall be provided for remote speed indication.

7. Provide Modbus TCP for network interface to the VFD from the system PLC. Provide addressing scheme for each drive conforming to the District's IP standards as specified in Section 13410. Include provision for transmitting up to 20 discrete variables and five analog variables including the VFD fault code over the network interface. Provide VFD memory mapping scheme conforming to the District standards as specified under Section 13410 and as shown on the Drawings.

   a. Communication, Control and Signal Wiring:

      1) Communication, control, and signal wiring for both hard-wired configurations, and network configuration shall be available drive options and shall be wired and terminated into the closed control cabinet.

         a) Only hard-wired signals shall be allowed to be on the SCADA/PLC network. Please reference 40 90 10, Part 2.B.3.

         b) Signal not used for controls and alarms shall go be for Maintenance, Relay Protection, Power Monitoring and other related monitoring functions.

D. Protective and Operational Features

1. Field adjustment of the following parameters through the keypad/display shall be provided:

   a. Current limit and boost.

   b. Voltage (Volts/Hz)

   c. Frequency (Minimum/Maximum)

   d. Independently adjustable acceleration and deceleration rates.

e. Auto restart delay.

2. The following short circuit and input protective features shall be provided:
   a. High speed current limiting input fuses and line reactors.
   b. Solid state instantaneous overcurrent trip.
   c. Undervoltage protection with automatic restart.
   d. Ground fault protection.
3. The following internal protective features shall be provided:
   a. Transient surge protection.
   b. Transistor overcurrent protection.
   c. Current limit, inverse time type.
   d. DC bus fuse protection and discharge circuit.
   e. DC bus overvoltage trip.
4. The following output protective features shall be provided:
   a. Inverse time motor overload protection.

E. Diagnostic and Fault Capability

1. The following conditions shall cause an orderly drive shutdown and lockout.
   a. Incorrect phase sequence.
   b. Blown input fuse or single phasing of supply.
   c. Control power supply failure.
   d. Instantaneous overcurrent.
   e. Sustained overload.
   f. Transistor overcurrent.
2. Provide complete built-in diagnostic and test capability.

F. Manufacturers

1. VFDs shall be one of the following:

a. TOSHIBA VF-AS3 or Eaton

2.05 GUARDS

A. OSHA approved guards shall be provided for all gear boxes and belt drives.

1. The guards shall be minimum 11 gauge steel.

2. The guards shall completely enclose the entire drive system and shall be designed to minimize vibration and noise.

3. Guards, except for the main drive motor, shall have a hole with cover plate coinciding exactly with the shafts of all equipment to allow the rpm to be checked.

4. The guards shall be lined on the inside with minimum 1/2-in thick sound absorbing rubber foam where permitted by guard design for noise attenuation

5. Fasteners shall be externally accessible.

2.06 VIBRATION ISOLATION AND MONITORING

A. Each centrifuge unit shall be mounted on rubber or spring type isolators. The number, capacity and vibrator constant of the isolators shall be as recommended by the isolator manufacturer for the load and impact resulting from operation of the centrifuge provided. Each spring type isolator shall be provided with built in leveling bolts and built in resilient shocks to control oscillation and withstand lateral forces in all directions. The isolators shall be self-leveling or designed for internal leveling and adjustment. Snubber inserts shall be oil resistant synthetic rubber. Housings shall be welded steel and springs shall be oil tempered high carbon chrome vanadium steel. After installation, the isolators shall be inspected and adjusted by a qualified representative of the isolator or centrifuge manufacturer. A maximum of 2.5 mils of displacement at operating speed will be acceptable under dry run shop test conditions.

B. Movement between interconnecting structures, piping, discharge chutes, conduit, etc, shall be avoided. To ensure proper installation and to prohibit the propagation of vibration through connecting pipe, and equipment, provide flexible rubber hoses, flexible pipe connectors and other flexible connectors to the unit. Flexible connectors shall be provided for, but not limited to, the following items:

1. Flushwater Piping.

2. Centrifuge Polymer Piping.

3. Electrical Conduit.

4. Sludge Feed Piping.

5. Centrate Piping.

6. Hydraulic Oil Lines.

7. Case Drain.

8. Cake Discharge.

9. Centrate Discharge.

C. Flexible pipe connectors shall be by Red Valve Company, Inc.; Redflex Flexible Pipe; General Rubber; Garlock Flexomatic Pipe; or equal, and have physical and chemical characteristics suitable for the particular service. Flexible centrate and cake discharge connectors shall be between the centrifuge and the discharge chutes. Flexible discharge connectors shall be provided of black molded neoprene, two ply fabric reinforced with polyester cord and complete with stainless steel back-up flanges and hardware. Flexible discharge connectors shall have a minimum face-to-face flange distance of 6-in.

D. A vibration monitoring system shall be furnished for each centrifuge. The system shall consist of a vibration sensing transducers mounted on the centrifuge with location to be determined by the manufacturer. The transducers shall send a 4 to 20 mA signal of vibration to the centrifuge PLC control system for monitoring and control. The vibration monitor shall measure vibration velocity in inches/sec., have a full scale range of 0 to 3 inches/sec. Vibrations reaching the preset values will initiate an alarm warning and a centrifuge shutdown. Actual setpoints for alarm and shutdowns shall be as recommended by the SDSS. Vibration signals, setpoints, and alarms shall be displayed on the local graphical interface panel and shall be available for monitoring and trending by the plant SCADA system via the Ethernet network.

2.07 DISCHARGE CHUTES

A. A minimum 10 gauge Type 316 stainless steel centrate and solids discharge chutes shall be provided for each centrifuge unit. Each chute shall have dimensions, connections and general shape as indicated on the Drawings and as required by the centrifuge unit. Each chute shall be provided with a flange suitable for bolting to the flexible discharge connector. Hinged, quick-opening inspection openings with gasketed watertight covers using De-Sta-Co type latches shall be provided on the side of each chute in accessible locations. Openings shall be reinforced to prevent leakage. The juncture of all joints in plates shall be continuously seal welded inside and out so that the chute is watertight. Stiffeners shall be provided as required to limit stresses and deformation in plates during shipping, installation and operation. The chutes shall be supported from the structures and not the centrifuge. All hardware shall be Type 316 stainless steel.

B. Provide grab sampling ports with quick disconnect cap and chain for both centrate and solids chutes. Provide a minimum 3/4-in sample connection and funnel within the centrate chute to allow continuous sampling at the unit from the operating level.

C. The centrate and solids discharge chutes shown on the Drawings are for illustrative purposes only. Submit detailed drawings of the proposed chutes as a part of the shop drawings. If additional drains are required it shall be the SDSS's responsibility to coordinate with the Contractor to provide a complete functioning system.

2.08 NOISE LEVEL

A. Each centrifuge shall be equipped with noise suppression devices such that the noise level at any point 3-ft from the centrifuge equipment and drive motor, while operating in a loaded condition, shall not exceed 89 dBA. Main drive motor shall be a low noise type.

2.09 SURFACE PREPARATION AND SHOP PAINTING

A. All exterior surfaces, except stainless steel, shall be prepared, primed and finish painted in the manufacturer's shop as part of the work under this Section.

2.10 FABRICATION

A. Shop Assembly

1. The centrifuges shall be assembled in the factory to check for proper fit and shipped assembled to the site.

2.11 CONTROLS

A. The SDSS shall furnish all labor, materials, equipment, and incidentals required to design and furnish the specified instrumentation and control system hardware and software for the entire solids dewatering system. The instrumentation and control materials furnished shall comply with the applicable sections of Division 40 and Division 26, and the Drawings. The District recognizes that dewatering system design practices may vary between System Suppliers, and the System shown on the Drawings and specified herein is intended to represent minimum requirements. Accordingly, responsibility is not limited to the system shown and shall include all additional skid-mounted equipment, instruments, and controls required by any proposed system in order to meet the performance requirements specified.

B. Each dewatering train shall be provided with a separately mounted control panel. Each panel shall include a power section and a low voltage controls sections. The two sections may be separated internally by a full barrier, with a separate door for each section, or may be two separate panels mounted immediately adjacent to each other. If separate panels are used, interconnection wiring shall be provided by the SDSS in bushed wireways between the panels. Panels shall be freestanding NEMA 4X type conforming to the requirements of Sections 40 95 13. Panels shall be suitable for top and bottom entry of conduits and have lifting eyes. The control panel equipment shall be fully rated for a short circuit current of 10,000 Amps RMS symmetrical.

C. A single 800 amp, 480 volt, 3 phase circuit will be provided to each panel under Division 16. All power needs for that train's equipment shall be derived from this circuit, including power for the centrifuge, the transfer and discharge conveyors, control devices and circuits, solenoids, instrumentation devices at the centrifuge and PLC inputs and outputs.

D. Provide panel heating, fans, or air conditioning as required to keep the panel interior within the temperature range of the panel devices. Submit heat dissipation calculations to verify sizing.

E. Panel power section shall include:

1. Main power disconnect with flange-mounted external operating handle
2. PWM type VFD with circuit breaker for the bowl motor
3. Either a PWM type VFD with circuit breaker or an SCR controller for the scroll motor to control the differential speed between the bowl and scroll.
4. Control power transformers
5. 15 Amp 120 VAC duplex service ground fault outlet
6. Fluorescent service lamp with door activated switch
7. Accessories such as terminals, circuit breakers and fuses, as needed.

F. Panel control section shall include:

1. Programmable logic controller (Schneider Automation M580 PLC).
2. Graphic interface panel (GIP).
3. Fluorescent service lamp with door activated switch
4. Accessories such as terminals, circuit breakers and fuses, as needed.

G. Dewatering control system shall be PLC based control panel with Graphical Interface Panel (GIP). The PLC System shall be a Schneider Automation M580 Unity Level 6 system, no equal, to match the District's existing SCADA system hardware.

1. PLC CPU memory size, speed, and capabilities shall be selected by the OSS to perform the functions as required and specified. The PLC shall control sequencing from startup to shutdown.
2. The CPU shall perform on-line diagnostics that monitor the internal operation of the PLC. If a failure is detected, the CPU shall initiate system shutdown and fail- over. The following, at a minimum, shall be monitored: memory failure, memory battery low, and general fault, communications port failure, scan time over run, I/O failure, and analog or special function I/O module failure. The PLC shall have indicators and on-board status display to indicate the following conditions:
    a. CPU run
    b. CPU error or fault

c. I/O failure or configuration fault.

d. Battery good

e. Communications indicator

3. The user program and data shall be contained in non-volatile battery backed memory. Type: CMOS RAM program memory.

4. Memory Backup: lithium battery backup or flash memory system capable of retaining all memory for a minimum of three months.

5. Backup Battery: The backup battery shall be capable of being replaced without disrupting memory integrity. Provide a visual indication of low battery voltage and a low battery alarm contact.

6. Flash Memory: Upon power loss, the PLC shall transfer internal memory to flash memory before the PLC powers down.

7. The operator should be able to backup volatile memory, including data and program logic onto a personal computer storage disk.

8. The operating system shall be contained in non-volatile firmware. The memory containing the operating system shall be field updateable via a separate update tool.

9. The System Integrator shall provide a PLC configuration and application development complete with documentation and labeled compact disks.

10. Communication with Plant SCADA will be via Modbus TCP Interface. See the P&ID Drawings for a full listing of the inputs and outputs to and from the Solids Dewatering System.

11. The GIP shall be packaged with configuration and programming software. The software shall include alarms, graphic symbols, animation. The GIP display size shall be a minimum of 10” with Color Active Matrix TFT or equal. The display resolution shall be a minimum of 320 x 240 pixels. Display shall support touch screen input. GIP shall be rated to maintain the rating of the control panel in which it is mounted. The GIP shall be a Magellis XBT GT series, Allen Bradley PanelView 1000 series, or equal.

12. GIP displays developed by the System Integrator shall meet the requirements of 40 91 00 and match the standards established by the District for the existing SCADA system with respect to the “look-and-feel” of the control graphics.

H. Control system shall include all control and protective devices and functions as recommended by the System Integrator for a complete and operational system; however, as a minimum, each control panel shall incorporate the following general control concepts:

1. Control and status functions shall be displayed for each centrifuge control panel by GIP with a multifunction membrane-style keyboard entry system for indication of setup data, operating data, circuit analysis data and diagnostic parameters and a combination of hardwired analog devices and control switches.

2. The control system design shall enable startup and shutdown from centrifuge control panel and shutdown initiated from interlocks with other equipment, even if supplied by others.

3. The control panels shall be equipped with an alarm system to protect the centrifuge from damage

4. The centrifuge control panel shall incorporate a "jog control" for each motor. The jog control shall be for the purpose of checking motor rotation, connections and maintenance purposes.

I. Front of panel devices shall include:

1. Graphical Interface Panel

2. Lamp Test pushbutton

3. Alarm Acknowledge pushbutton

4. Reset pushbutton

5. Emergency STOP pushbutton

J. The following controls shall be included:

1. The following alarm conditions shall initiate a signal to the SCADA system to stop the sludge transfer pump(s) and the polymer feed unit(s):

a. High torque or hydraulic pressure.

b. High vibration.

c. Slide gates from Distribution Conveyor fail to open

2. The following alarm conditions shall shut down the centrifuge, and initiate a signal to the SCADA system to shut down the sludge transfer pump(s) and polymer feed unit(s):

a. High High Vibration.

b. Main (Bowl) Drive Motor Overload.

c. High High Torque

d. Low Bowl Speed

e. Low Differential Speed

f. Bowl Motor High Temperature.

g. Scroll Motor High Temperature.

h. Scroll VFD Malfunction

i. Low oil level on hydraulic scroll drive (if applicable)

j. High oil pressure on hydraulic scroll drive (if applicable)

k. Emergency Shutdown Activity

l. Any others considered by SDSS as essential to safe operation that are also approved by the ENGINEER OF RECORD.

3. Alarms derived from internal PLC logic based on input signals from SCADA will be displayed at the centrifuge control panel if sludge transfer pumps fail to start or stop, or sludge tank isolation or transfer pump inlet valves fail to open or close after being commanded by the Solids Dewatering System.

4. The PLC/GIP shall perform the following:

   a. Measure and Display (at a minimum):

      1) Bowl speed.

      2) Scroll conveyor drive gear shaft speed, if gear box is supplied.

      3) Drive motor amperage.

      4) Differential speed - scroll conveyor vs. bowl.

      5) Bearing temperature.

      6) Scroll/backdrive torque (if applicable).

      7) Vibration

      8) Elapsed run time for bowl and scroll drives

   b. Display and Modify (Control) Characteristics Constants/Setpoints (at a minimum):

      1) Normal minimum differential speed.

      2) Normal scroll/backdrive torque.

      3) Maximum allowable differential speed.

4) Maximum scroll/backdrive torque

5) Minimum electrical resistance before departure from normal differential speed.

6) Maximum allowable electrical resistance to achieve max. allowable differential speed.

K. Dewatering system start shall be initiated by a "single key" command from the centrifuge control panel. This command shall instruct the centrifuge control system to begin its start sequence. The logic for the control sequence below shall be programmed in the panel PLC by the System Integrator.

1. The inlet (suction) valve of the centrifuge feed pump shall be opened.

2. The scroll drive system shall be energized. Simultaneously, the centrifuge control system shall begin a cleaning cycle (duration of cleaning cycle shall be as recommended by the System Integrator). This shall be accomplished by driving the scroll conveyor with the bowl stationary. During this period of time the feed flushing water valve shall be signaled open, the discharge cake conveyor shall be energized to the reverse position and the discharge cake conveyor flushing water solenoid valve shall open.

3. When the cleaning cycle is complete and the scroll reaches standstill (0 rpm) conditions for 30 seconds via a time delay, the centrifuge control system shall bring the bowl gradually up to full speed. During this period the main drive RUN light will blink and the NOT READY FOR SLUDGE light will energize. During start-up, the centrifuge control system starts the scroll drive simultaneously with the main drive motor and maintains a preset scroll speed to convey any remaining solids out of the bowl before the bowl reaches full speed. When the bowl and scroll have reached full operating speed in approximately 5 minutes, the main drive RUN light will go on-steady. The NOT READY FOR SLUDGE light will de-energize, the READY FOR SLUDGE light will energize and signals sent to the SCADA system to indicate the centrifuge is running and ready for sludge and polymer. Interlocks shall be provided to prevent sludge feed, polymer feed and flush water from activating.

4. Subsequently, the centrifuge control system shall energize to the forward position the discharge cake conveyor and cake transfer conveyor. The loadout conveyor and slide gates of the solids distribution conveyor are manually controlled at either the centrifuge control panel, or loadout conveyor control panel.

5. The centrifuge feed pump and centrifuge polymer feed system may now be manually started by the operator or automatically activated.

6. The centrifuge feed pump and centrifuge polymer feed system are started and given a speed command.

7. If the centrifuge feed pump on duty (e.g. pump no. 1 for dewatering train no. 1, or pump no. 2 for dewatering train no. 2) does not start, then the other centrifuge feed pump and its inlet valve is started/opened automatically (unless already in operation), and an alarm indicated. If the other centrifuge feed pump is in operation, indicate an alarm and stop the solids dewatering system components.

8. Upon handling feed and after reaching a select torque, the discharge cake conveyor shall be energized to the forward position and the discharge cake conveyor flushing water solenoid valve shall close, and the control system will begin automatic constant torque control. After time, if torque begins to rise above the desired setpoint, the controller shall increase the differential speed to scroll solids out of the bowl at a faster rate, thereby lowering the torque back to the setpoint. Conversely, if torque begins to drop below the desired setpoint, the controller shall decrease the differential speed to reduce solids withdrawal out of the bowl, thereby increasing the torque back to the setpoint.

9. Once the low-low level of the sludge storage tank in service is reached, the solids dewatering system will shut down.

L. Normal shutdown of the dewatering system shall be initiated by a single pushbutton “STOP” command from the local control panel or remotely from SCADA. This "STOP" command shall be a hardwired input to the PLC I/O interface and instruct the centrifuge control system to begin its shut down sequence.

1. The “STOP” signal shall remove the centrifuge feed pump and centrifuge polymer feed permissive and de-energize the bowl drive motor. The centrifuge control system shall maintain a preset differential speed to clear the remaining cake from the bowl during coast down. Upon reaching a select torque, and after sufficient time for removal of resident solids, the centrifuge control system shall open the bowl flushing water valve for cleaning. After a predetermined (adjustable) time period flushing and spray water flows shall cease. When this occurs, the scroll motor system shall be stopped. The machine shall then coast to a standstill awaiting another operating cycle. The conveyors shall stop. The centrifuge shall not be allowed to start more than the stated number of times per hour as recommended by the motor manufacturer (minimum of 2 starts per hour).

M. During normal operation an excessive solids build-up shall be detected by the centrifuge control system as a higher than normal torque requirement. Should the torque exceed a preset point, the "High" torque alarm shall energize. Should the centrifuge experience unbalanced load conditions where vibration exceeds a preset limit, the “High” vibration alarm shall energize. Both the “High” torque and/or “High” vibration alarms shall signal the SCADA system to shut down the sludge feed and centrifuge polymer systems. This action shall normally result in a reduction of torque and vibration as the build-up is removed from the bowl. These systems shall reset open when the torque and/or vibration falls to an acceptable limit operation and the sludge feed and centrifuge polymer feed system interlock contacts shall close to allow the feed systems to restart. The high torque control shall be not more than twice the normal operating torque. The controls shall also allow operation at a set differential speed with torque allowed to vary within the normal operating limits.

N. Emergency shutdown shall be initiated by depressing the emergency stop mushroom type pushbutton on the control panel which will de-energize the centrifuge drive motor and scroll motor/ simultaneously and the bowl flushing water valve opened for a predetermined (adjustable) time period for cleaning. Depression of the emergency stop pushbutton shall shut down the sludge feed and polymer systems.

O. In the event that the above clearing action fails to remedy the high torque condition and/or high vibration condition and the torque and/or vibration continues to increase, the centrifuge control system shall respond by issuing a “High-High” torque alarm at the centrifuge control panel in addition to issuing an automatic shutdown command as described above. This shall stop the bowl drive motor and remove the sludge and polymer feed permissive. The centrifuge shall be allowed to coast to a standstill.

1. The same procedure shall be followed for shutdown due to excessive vibration, scroll motor/ system problem, or other malfunctions detected in the centrifuge system. Automatic shutdown due to faults shall require reset action at the centrifuge control system cabinet or the detection device before the unit can be started. The specific shutdown condition shall be displayed by the centrifuge control panel.

P. During normal operation, if sludge feed is stopped and the torque falls below a desired setpoint, the discharge cake conveyor shall reverse. After the discharge cake conveyor reverses, the discharge cake conveyor flushing water valve shall open a sufficient time for removal of resident solids. The centrifuge shall continue to run until a normal shutdown command is given or a "restart" of the sludge feed is initiated.

Q. The entire centrifuge control system installation shall be installed strictly in accordance with instructions of and under direct supervision of the System Integrator. The start-up shall be performed by the System Integrator.

R. Configuration of the PLC shall include memory mapping of all monitored variables and alarms for monitoring by District SCADA PLCs and/or HMIs. System data shall be configured for block transfer per the requirements of Section 40 90 10, 40 92 30, 40 95 10, and 40 95 20.

2.12 FACTORY TESTING

A. Witnessed Shop Testing/Inspection

B. The manufacturer of the equipment supplied under this Section shall allow inspection and witness of the shop test of the equipment by the ENGINEER OF RECORD at the site of manufacture.

C. Equipment to be shop tested and witnessed by the ENGINEER OF RECORD shall include:

a. Dewatering centrifuge and appurtenances.

b. All power control panel functions, displays, and controls.

2. Notify CONSTRUCTION MANAGER of the test date(s) and test schedule not less than 14 days in advance.

3. Should Engineer decide to witness testing, the ENGINEER OF RECORD will pay for its own travel expenses to visit the site of manufacture to witness the test. Expenses are defined here as all direct expenses such as but not limited to air fare, lodging, meals, transportation, etc. If retesting is required, for any reason, the manufacturer shall reimburse the District for all reasonable expenses incurred to revisit the site of manufacture plus the District's time billed at $1,700 per day. Time shall include the round trip travel time to and from the manufacturer's facility. The total costs incurred for repetitive visits, if required, shall be deducted from payments due the Contractor.

4. Test conditions

   a. Each unit shall be tested when completed.

   b. Unit and control system shall be tested as a unit with the approved starter and control panels.

   c. All circuits shall be checked and all alarms and shutdown conditions simulated to check the alarm circuits.

   d. System data mapping of variables shall be tested to verify delivery of all mapped variables in conformance with the specified requirements.

5. Test equipment/procedures

   a. Test equipment to be used in the shop test shall have been checked and calibrated within 30 days prior to the shop test.

   b. Submit certified calibration data for test equipment.

   c. Submit proposed test procedures for approval.

D. After completion of tests, submit certified test results.

PART 3 -- EXECUTION

3.01 PREPARATION

A. All equipment shall be properly labeled and crated to protect any and all components from damage during shipment.

B. All parts shall be properly protected so that no damage or deterioration will occur during a prolong delay from the time of shipping until installation is complete and the units and equipment are ready for operation.

C. Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing from the CONSTRUCTION MANAGER.

D. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion.

E. After hydrostatic or other tests, all entrapped water shall be drained prior to shipment and proper care shall be taken to protect parts from the entrance of water during shipment, storage and handling.

F. No shipment shall be made until approved by the CONSTRUCTION MANAGER in writing.

G. A year's supply of the manufacturers' recommended oil, grease and hydraulic fluids required for the equipment operation shall be delivered with the centrifuges.

3.02 INSTALLATION

A. Installation shall be in strict accordance with the manufacturer's instructions and recommendations in the locations shown on the Drawings.

B. Supply all anchor bolts with necessary nuts and washers for the mounting of all equipment supplied. The anchor bolts shall be as sized by the Contractor and made of Type 316 stainless steel. Anchor bolt layout drawings shall be supplied to the CONSTRUCTION MANAGER with shop drawing submittals.

3.03 FIELD TESTING

A. Field Inspection

1. The System Integrator shall provide technicians who have complete knowledge and experience in the proper installation, startup and operation of the equipment to inspect the final installation and supervise the field acceptance tests of the equipment. No equipment shall be energized unless there is written authorization from the manufacturer or unless it is done in the presence of the System Integrator's service representative. All controls, interlocks and alarms shall be checked in the presence of the CONSTRUCTION MANAGER to ensure proper control and equipment protection.

B. Functional Test

1. Functional testing shall be conducted after the installation of the centrifuges and all appurtenances and the equipment has been operated a sufficient period to make any corrections or adjustments. Each complete unit shall be subject to field acceptance tests under actual operating conditions to determine that operation is satisfactory and in compliance with the requirements specified.

2. The functional tests shall be made under the direct supervision of the qualified representative of the System Integrator and in the presence of the CONSTRUCTION MANAGER. Provide, calibrate and install all temporary gauges and meters, make necessary tapped holes in the pipes and install all temporary piping and wiring if required for the field acceptance tests. Written test procedures

shall be submitted to the CONSTRUCTION MANAGER for approval 30 days prior to testing.

3. The functional tests shall be initially made with water and without sludge to demonstrate that the equipment and appurtenances furnished under this Section:

   a. Have not been damaged by transportation or installation.

   b. Have been properly installed.

   c. Have no mechanical defects.

   d. Are in proper alignment.

   e. Have been properly connected.

   f. Are free of overheating of any parts.

   g. Are free of objectionable vibration and noise as specified.

   h. Are free of overloading of any parts.

4. The functional test shall also demonstrate satisfactory operation of all equipment, controls, interlocks and alarms. System data mapping strategy shall be specifically tested for conforming to District standards during the Functional Testing.

C. Acceptance Test

1. Prior to acceptance, the System Integrator's representative shall operate each centrifuge for a minimum 3 day, 8 hours per day period under actual conditions with sludge from the plant to demonstrate that the installed equipment will operate continuously, trouble-free and meet or exceed the performance requirements. During this test, the System Integrator's representative shall record bearing temperature, motor input, torque, speeds, differential speed, vibration and noise every hour and verify operations are within tolerances.

2. The System Integrator shall recommend a commercially available and NSF 60 approved polymer for testing (either emulsion or water based solution). If requested by the System Integrator, the District will supply sufficient quantities of sludge to conduct bench- scale testing.

3. The District will furnish all operating and support personnel, power, water, chemicals and all other incidentals required to take samples and perform the tests specified herein. The District will be responsible for collecting all required samples and measurements. The testing procedures shall be monitored by the District SCADA system using the specified system memory mapping scheme.

4. The centrifuge will be fed sludge and polymer in a proportion recommended by the System Integrator.

D. Performance Test

1. After acceptance and prior to Contract Closeout, one centrifuge shall be selected by the District for testing to determine compliance with the performance criteria as specified in PART 1. This time period will give the District the opportunity to operate all centrifuges before selecting one centrifuge for performance testing

2. The unit shall be fed sludge and polymer and shall be operated until the unit reaches steady state optimum performance. The unit shall then begin a 3 day, 8 hours per day test period during which the average performance of the unit must equal or exceed the specified performance parameters. If the unit fails to equal or exceed that required, or cannot operate continuously for the 3 day period due to unit failure, that days' test period shall be repeated. The System Integrator will be given 30 calendar days to optimize performance to produce results to equal or exceed the specified performance criteria.

3. During each day's performance test, the System Integrator will be responsible for collecting all required samples and measurements at 1.0 hour intervals in order to make the following determination. The first set of samples and measurements shall be taken 1.5 hours after the beginning of the test run.

   a. Sludge feed concentration – total solids (% TS)

   b. Polymer feed – total solids (% TS)

   c. Centrate concentration – total solids (% TS)

   d. Final cake discharged – total solids (% TS)

   e. Plant water (one or two daily composites) total solids (% TS)

   f. Centrifuge Feed (sludge + polymer + dilution water) – total solids (% TS)

   g. Polymer feed rate in gallons per minute

   h. Sludge flow rate in gallons per minute

   i. Centrate flow rate in gallons per minute

   j. Centrifuge discharge rate in pounds per hour

   k. Solids capture in percent. Percent solids capture shall be defined as follows:

      1) Solids percent capture = $\frac{T}{F} \times \frac{F-C}{T-C} \times 100$

      2) Where:

         T = Cake Solids Concentration (% TS) i

F = Sludge Feed Concentration (% TS)

C = Centrate Concentration (% TS)

l. Setting for polymer feed pump

m. Setting for sludge feed pump

n. Differential speed (rpm)

o. Drive and backdrive torque

p. Motor amperage

q. Sludge Cake Produced (pounds) as determined from weight scale measurements of container to be hauled to landfill. Tare weight of container to be from actual readings of container on certified scale by others.

4. The Contractor shall engage services of a certified independent laboratory acceptable to the CONSTRUCTION MANAGER to analyze the SDSS's set of samples and make all solids determinations. The Contractor shall take split samples of which one set will be furnished to the District for comparison to the SDSS's test results.

5. The tests shall be performed in accordance with the procedures outlined in Standard Methods, latest editions, as follows:

   a. Dry Solids – In accordance with "Residue on Evaporation".

   b. Suspended Solids – In accordance with "Total Suspended Matter".

6. The Contractor shall prepare a formal test report including all laboratory analysis reports, measurements and calculations. Six copies of the certified report shall be submitted to the CONSTRUCTION MANAGER within fifteen days after completion of the tests.

7. For the dewatering process, including the centrifuge and appurtenant equipment, to qualify for acceptance, the average values of the test conducted during the test period shall meet and exceed the performance criteria specified herein and no data shall fall more than 40 percent below the specified criteria.

8. Polymer consumption in excess of the specified maximum shall be the basis for rejection; alternatively, at the option of the CONSTRUCTION MANAGER, the System Integrator will be permitted to offset the additional cost of polymer consumption using the formula for liquidated damages described in Paragraph 1.11.

9. Test data that are in apparent error, in the opinion of the CONSTRUCTION MANAGER, shall be discarded. Should it become necessary to discard more than one-third of the data, the CONSTRUCTION MANAGER may declare the test invalid.

10. If the performance criteria are not met during the test, in the opinion of the CONSTRUCTION MANAGER, up to one additional test period will be permitted. Scheduling of the test shall be subject to the approval of the CONSTRUCTION MANAGER. The System Integrator shall be permitted to modify its equipment and/or the operation, completely at no additional cost to the District and the test repeated, as described above.

11. If after the completion of the additional test period, the equipment, in the opinion of the ENGINEER OF RECORD, does not meet the performance specifications, the System Integrator shall be subject to action by the District as specified in Paragraph 1.11.

12. The testing procedures shall be monitored by the District SCADA system using the specified system memory mapping scheme.

3.04 TRAINING AND STARTUP

A. Training shall be in accordance with the requirements of Section 46 01 00 and Section 01 75 06.

B. Start-up shall be in accordance with the requirements of Section 46 01 00 and Section 01 75 06.

END OF SECTION

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FERRUM PROCESS SYSTEMS INC – 2125 Center Avenue, Suite 507, Fort Lee, NJ 07024, USA

Santa Clara Valley Water District
400 More Avenue
Los Gatos, CA 95032
USA

QUOTATION	
Quotation number	**Q21-2356-rev3**
Documentation date	30th Mar. 2021
Valid until	30th Aug. 2021
Currency	**US-$**
Sales office	Ferrum Process Systems Inc.
Contact	**Sheilah Pickel**
Telephone number	+1 512-556 5707
eMail	Sheilah.pickel@hiller-us.com
Prepared by	Albert Stangl
Telephone	+49 8741/48 - 212
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eMail	Albert.stangl@hillerzentri.de

PROJECT NAME **Rinconada II - Extention of dewatering unit**

To whom it may concern,

Below is our updated quotation for two off HILLER DECAPRESS DP66-422 VA HY de-watering decanter centrifuges and associated equipment (Control Boards) for the sludge dewatering with a flow capacity of 300 gpm at 2-3% feed solids.

The units would be identical to the 2 installed units on site and also comply with the specifications of 46 71 36 from Stantec dated 16 Feb 2021.

Within this budgetary offer we have also included for 18 pulse VFDs to be installed in the control boards, similar to the delivered ones in the already installed centrifuges.

The offer validity is extended until end of August in order to meet your project timeline.

The Hiller dewatering systems are engineered and assembled in the US according to US standards. All system components are purchased and delivered by US sub-suppliers. The projects are individually designed according to clients' requirements and the on-site conditions.

We trust that this offer meets your requirements. If you have any queries, please don't hesitate to contact us, either directly, or via our local representative

Jeff Frey, General Manager

Email: jfrey@envirotrolwater.com
Tel: (916) 939-7924
Fax: (408) 598-1671

Envirotrol
15431 Murieta South Parkway
Rancho Murieta, CA 95683

We would be more than pleased to discuss details to the requirements and the scope of supply, as well as the implementation into the new site conditions.

In case of any queries please do not hesitate and contact us.

With kind Regards,

i.A. Albert Stangl

Area Sales Manager
Hiller GmbH

on behalf of Ferrum Process Systems Inc.

PRICE OVERVIEW

Quotation no. Q21-2356-rev3

Project name: Rinconada II - Extention of dewatering unit

Item	Article No. Description	Price US-$	Qty.	Total Price US-$
100	DP66-422-VA-HY HILLER DecaPress DP66-422 VA HY	384,770.00	2.000	769,540.00
200	Set of chutes and compensators	9,770.00	2.000	19,540.00
300	Control Panel	132,780.00	2.000	265,560.00
400	Pre-Engineering, Submittals and Drawings	29,740.00	1.000	29,740.00
500	Installation Supervision and Check *OPTIONAL*	10,975.00	1.000	
510	Site Service & Commissioning, Optimization and Training	44,210.00	1.000	44,210.00
600	Project Management	10,140.00	1.000	10,140.00
700	Packaging C	9,570.00	1.000	9,570.00
800	Freight of Decanter	14,990.00	1.000	14,990.00
810	Freight of Other Goods	4,690.00	1.000	4,690.00
900	Spares Package - OPTIONAL	281,020.00	1.000	
Amount				1,167,980.00
Sales Tax - none considered				0.00
Final amount				**1,167,980.00**

Terms of payment	30% down payment with order 30% after centrifuge ex-works delivery from Germany 30% after delivery 10% after acceptance (latest 90 days after delivery) Payments in USD within 30 days without deduction All goods remain property of Ferrum Inc. until final payment has been received. All payments have to be made within the period after the date of the invoice quoted above.
Terms of delivery	DAP Los Gatos, CA, USA, (according to Incoterms ® 2020, ICC), further details on freight and packaging below.
Delivery time	Approx. 6 - 7 months after receipt of written order and final technical and commercial clarification and down payment Please allow another 5 to 6 weeks for transport to site California.
Delivery Address	Santa Clara Valley Water District Rinconada WTP 400 Moore Avenue Los Gatos, CA 95032 USA
Consignee	Ferrum Process Systems Inc. 2125 Center Avenue, Suite 507 Fort Lee, NJ 07024 USA

Permitted Assignment:

Ferrum Inc. reserves the right to assign any or all of its rights and obligations under this Agreement to any affiliated company within the Ferrum Group of companies of which it is a part. Ferrum Inc. may do so at its sole discretion, at any time and without prior notice.

Process Description

Quotation no. Q21-2356-rev3

Project name: Rinconada II - Extention of dewatering unit

Typical performance requirement

The quoted new centrifuges are in design and spare parts identical to the two existing decanters of type HILLER DECAPRESS DP 66-422 VA HY, machine no H5369 and H5370.

Sludge type	Sludge from Water Treatment	
Water source	Lake Water / River Water	
Treatment	PAC and Alum-salt dosed for sedimentation	
Flow rate	Up to 300	gpm
Sludge concentration	2.0 – 3.0	% wt TSS
Turbidity	Not given	NTU
Temperature	60 – 85	°F
pH	4.0 – 6.5	

Separation results depending on the applied water treatment process, the NTU value of the raw water and the throughput rate of the decanter centrifuge.

SPECIFICATION OF ITEMS

100: HILLER DecaPress DP66-422 VA HY

Qty. 2.000

The quoted new centrifuges are in design and spare parts identical to the two existing decanters of type HILLER DECAPRESS DP 66-422 VA HY, machine no H5369 and H5370.

(Photo may differ from product)

Description

The decanter centrifuge with scroll comprises of the rotating bowl, consisting of a feed pipe, a cylindrical section where the separation of the suspension takes place and a conical section where the scroll removes the dewatered sludge, the housing enclosing the rotor, the base frame bearing rotor and housing, and the bowl and scroll drive systems.

Application

High dewatering of sludge. The continuous separation of a solid-liquid suspension in which the specific gravity of the liquid is less than the specific gravity of the solid is accomplished using high bowl speeds and low scroll differential speeds at high scroll torques.

Operating principle

The feed suspension enters the rotating feed compartment through the feed pipe. There it is accelerated in the direction of rotation and enters the rotating bowl via the feed ports in the scroll hub.
The solid particles move towards the bowl wall of the cylindrical section under the effect of the centrifugal forces. The settled solids are moved by the scroll to and through the conical section, at the end of which they are discharged through the discharge ports of the bowl as dewatered solids.
The liquid effluent is discharged from the bowl via adjustable weir plates at the feed end.

Drive unit:	HILLER HYDRAULIC-DRIVE
Bowl diameter:	660 mm
L x W x H:	4460 mm x 1950 mm x 1510 mm
Weight:	8,500 kg

For further technical details please refer to below technical specification.

HILLER DECAPRESS DP66-422 VA HY

High performance sludge dewatering decanter
with HILLER DECATORQUE hydraulic scroll drive system
all wetted parts in stainless steel
including EcoJet weir plates

SPECIFICATION:
Materials:

Bowl:	Duplex stainless steel 1.4462 / 1.4470 (AISI 329/UNS S32205)
Scroll:	Duplex stainless steel 1.4470 / 1.4571 (UNS S32205/AISI 316Ti)
Casing:	Stainless steel 1.4571 (AISI 316Ti)
Frame:	S235 painted according to Hiller standard (RAL 5002)

Preliminary drive sizes:

Bowl:	125 HP (90 kW), 460 V, 60 Hz, NEMA mechanical and electrical design, with 120 VAC space heater, motor make Baldor Premium efficiency for VFD start up (VFD not included)
Hydraulic power pack:	30 HP (22 kW), 460 V, 60 Hz, NEMA mechanical and electrical design, with 120 VAC space heater, motor make Baldor Premium efficiency, water cooled

Wear protection system:

Feed chamber:	Replaceable PUR feed chamber
Feed ports:	Replaceable PUR bushings
Bowl wall:	Strips
Scroll flights:	70 % covered with tungsten carbide tiles on a SS carrier and tack welded onto the flights from one wrap beyond feed chamber towards solids discharge end. Rest of scroll is protected by tungsten carbide flame spraying
Cake outlet:	Replaceable tungsten carbide bushings
Cake casing:	Replaceable Polyurethane liner

Lubrication:
Main bearings:

Lubricant:	Grease
System:	Nipple, individually lubricated
Operation:	Manual for main bearing

Scroll bearings:

Lubricant:	Grease
System:	Nipple, individually lubricated
Operation:	Manual for scroll bearing

Dimensions:

Inner bowl diameter:	660 mm
L:D (L=to edge of cake discharge port):	4.2:1
Maximum bowl speed:	2900 rpm

g-force at maximum bowl speed:	3100 x g
Typical operating speed:	2850 rpm
g-force at typical operating speed:	2980 x g
L x W x H:	4460 x 1950 x 1510 mm
Weight, empty:	8500 kg
Weight including sand filling:	10580 kg

Scope of delivery:
- Rotating assembly
- HILLER DECATORQUE hydraulic scroll drive system, incl. hydraulic motor and water cooled hydraulic power pack
- Bowl drive motor and belt drive
- Casing
- Base frame with hollow rubber buffers
- Control system HILLER SEE-Control for differential speed and torque control for installation in your client's switchboard / plant control system
- Feed device to feed sludge and polymer into the centrifuge's feed flange; made of stainless steel; incl. flexible connector for sludge pipeline

Machine safety equipment:
- Vibration switch according to DIN EN 13489-1
- Overspeed control according to DIN EN 13489-1 with relay and sensor for installation in your client's switchboard / plant control system
- temperature measuring sensors PT 100 mounted on the pillow blocks of the main bearings

Documentation:
Standard documentation in English language (3x on CD-ROM, 3x in paper form)

Special features:
- Fume tight housing with suction flange on top of housing

200: Set of chutes and compensators Qty. 2.000

One set per centrifuge, comprised of:

- Centrate chute, length approx. 700 mm, with centrate sampling tap and return funnel for centrate chute.
- Flexible connector for centrate chute with stainless steel wear protection inside, length approx. 150 mm
- Flexible connector for solids chute with stainless steel wear protection inside, length approx. 150 mm
- Solids chute, with sampling point, length approx. 500 mm
- All metal parts are made from 3 mm thick grade 1.4401 stainless steel (=SS 316)
- All flanges are made from 8 mm thick grade 1.4401 stainless steel (=SS 316)

300: Control Panel

Qty. 2.000

One off NEMA Control Panel (NEMA 12 enclosure) per centrifuge with all associated instrumentation - according to the Tender Specification from 2013/2021 (Contract No. C0591/Tender 46 71 36).

Including, but not limited to, Allen Bradley Compactlogix PLC system with 9" OIT touchscreen, 18 Pulse VFD Enclosures, etc.

Where possible, all deliveries are based on the 2013 Specification, to have the same spare parts for the complete installation.

400: Submittals and Drawings

Qty. 1.000

Set of pre-engineering services and documents necessary for the tender release according to the quoted scope of supply, based on the year 2021 tender documents 46 71 36.

Including the requirement for 18 pulse VFD's, and the integration into the local system.

500: Installation Supervision and Control *OPTIONAL*

Qty. 1.000

We have included that a supplier's representative shall inspect the installation of all machines and provide a Certificate of Proper Installation.

Therefore we have calculated with 3 days at site plus 2 days travelling time and travelling fares.

Details to be negotiated.

Waiting times / additional services:

Waiting times which are not the fault of HILLER and services which are not part of this scope of delivery are separately charged with the daily rate as mentioned.

510: Site Services & Commissioning, Optimization and Training

Qty. 1.000

Including travel cost, expenses and accommodation (max. 8 working hours per day).

For electrical commissioning of the dewatering system (Decanter centrifuges and control boards) we have included 3 to 5 working days at site.

Description of the activities of the electrician during the start-up of the decanter.

- Check of sensors incl. signal check
- Functional test of electrical drives
- Check of direction of rotation of all electrical drives
- Test run dry, with water and finally with product
- Adjustment and optimization of the decanter
- Test of all available safety sensors (vibration switch, etc.) for their correct function, by tripping them locally, thus starting the respective shut-down sequence
- Optimization of the PLC program with regards to optimum start/stop-sequence - for manual and automatic operation (together with electrician)
- Clarification of details of the system as well as special questions from the site personnel.

For mechanical and process commissioning and optimization of the dewatering system (Decanter centrifuges and control boards) we expect approx. 5 working days at site.

Description of the activities during the start-up of the decanter:

- Removal of the transportation locks and check of smooth running of bowl
- Connection of the scroll drive and filling in of hydraulic oil, if necessary
- Check of sensors incl. signal check
- Check of the peripheral installation for function and tightness (slider, chutes, etc.) - Functional test of electrical drives
- Check of direction of rotation of all electrical drives
- Test run dry, with water and finally with product
- Adjustment and optimization of the decanter
- Test of all available safety sensors (vibration switch, etc.) for their correct function, by tripping them locally, thus starting the respective shut-down sequence
- Optimization of the PLC program with regards to optimum start/stop-sequence - for manual and automatic operation (together with electrician)
- Clarification of details of the system as well as special questions from the site personnel.

Following optimization and training services have been considered:

We have included that a supplier's representative will be at site for the training for a minimum time of 40 hrs. Therefore we have calculated with 5 days at site plus 2 days travelling time and travelling fares.

We have considered that the training will be scheduled due to work done at site; i.e. we would suggest to have three different training sessions during the completion of the complete work.

1) Pre-startup training:

- Operations Training: Two (2) sessions, four (4) hours per session
- Maintenance Training: Two (2) sessions, four (4) hours per session

2) Operations Training:

- Four (4) sessions, four (4) hours per session

3) Maintenance Training:
- Two (2) sessions, four (4) hours per session

Upon completion of the training activities, the Supplier will provide a Certification of Training Completion.

Optimization:
During/after commissioning there shall be a period of one week in which a specialist reviews the existing water quality analysis, sets up an improvement approach, performs the tests, analyses the results and finally implements the optimizations accompanied with a written report. These activities shall be combined with comprehensive operator training in how to improve centrifugal solid liquid separation processes in water treatment plants.

Waiting times / additional services: Waiting times which are not the fault of HILLER and services which are not part of this scope of delivery are separately charged.

600: Project Management

Qty. 1.000

Provision of Project Management Services for the delivery contract, including provision of all required documents and information, not covered within item 400 and 410.

Complete engineering services for the total scope of the building project for example comprise:
- Registration of actual values on site
- Elaboration of installation drawings
- Elaboration of the P+I diagram
- Provision of parts from sub-suppliers
- Time scheduling
- Construction-site monitoring
- Elaboration of dimensions
- Troubleshooting

We have considered two site meetings from our Project Manager with customers PM team to clarify the scope of supply, the timing and the scheduled work.

700: Packaging C

Qty. 2.000

Machines are packed in wooden packing cases made of 24 mm wood, base with longitudinal and cross skids (crane loading possible) if required with filling materials, cover with moisture absorbent AKYLUX-sheet, sealed in aluminum compound foil with addition of drying agents for a transport and storing duration up to 24 months from packing date.

Packaging is required for the sea freight transport from manufacturing site to SF harbor.

Control Panels and VFD boards are suitable packed for transport within a trailer or on flatbed from transport through the US on highway.

800: Freight of Decanter

Qty. 1.000

Freight cost for delivery of both centrifuges to DAP Santa Clara Water Treatment Station, Los Gatos, CA, according to Incoterms 2020, ICC.

Combined Land-Sea-Land Transport from Hiller, Vilsbiburg, Germany to Santa Clara Water Treatment Station, Los Gatos, CA, USA.

It is assumed that equipment is crated in wooden boxes as described and will be stored for ship transport additionally in a container.

810: Freight of Other Goods

Qty. 1.000

Transport cost for delivery of chutes and compensators as well as for the Panels with VFD Enclosures within a trailer or on flatbed truck to DAP Santa Clara Water Treatment Station, Los Gatos, CA, USA, according to Incoterms 2020, ICC.

900: Spares Package - OPTIONAL

Qty. 1.000

The spares package includes the items as stipulated in the tender draft document, particularly a spare scroll assembly as well as an inspection after 15,000 operating hours.

Please understand, that bowl or scroll trucks/carts cannot be supplied due to safety regulations.

- 1 off Spare scroll without custom cart
- 420 l hydraulic oil DEKA68
- 12 off grease cartridges
- 12 off v-belts
- 5 off roller bearings (scroll, bowl, etc)
- 6 off radial shaft seals
- 20 off wear bushings
- 6 off wearing plates
- 70 off wear segments
- 6 off EcoJet weir plates
- 14 off sealing rings
- 2 off round seal packings

- 10 off O-rings
- 2 off v-rings
- 7 off felt strips
- 1 off dowel pin
- 10 off soft rubber
- 10 off filter elements
- 1 off torque wrench with adjustment scale
- 1 off ratchet head handle
- 3 off hexagon socket
- 1 off high performance hook extracting tool
- 1 off double open ended spanner
- 4 off hex bit socket
- 1 off tri-section plate
- 1 off lifting device
- 1 off load traverse
- 2 off round slings
- 1 off sheet steel toolbox standard

COMMERCIAL CONDITIONS

Not included in our scope of supply are:

- Civil works, incl. earthworks, brickworks, etc.
- Lubricants and oils (Except first filling which is included)
- Cabling between the delivered components
- Pipework
- Steelworks, including decanter support structure, platforms, etc.
- Pumps, conveyors, analysers, instrumentation
- Consumables, such as electrical power, water, and polymer, etc.
- Offloading
- Removal and disposal of packing materials
- Mechanical and Electrical installation and/or final operational assembly at site (to be done by local contractor)
- All supplies and deliveries not explicitly specified herein

Technical data:

All technical information provided in this offer is subject to change without prior notice.

Delivery time: Approx. 6 -8 months after receipt of written order and final technical and commercial clarification and down payment (depending on production capacity).

Liability: Our liability is limited to the amount of damages that could reasonably be foreseen by us at the time of entering into the contract, but not more than the total ex works net value of the contract. We shall in no case be liable for consequential or indirect damages including loss of profit or increased production costs.

Payment Terms:

30% down payment with order
30% after centrifuge ex-works delivery from Germany
30% after delivery
10% after acceptance (latest 90 days after delivery)
Payments in USD within 30 days without deduction. All goods remain property of Ferrum Inc. until final payment has been received.

Terms of delivery

DAP Los Gatos, California (according to Incoterms ® 2020 ICC), further details on freight and packaging below

Validity of offer: 6 months

No special security against humidity or corrosive atmospheres will be done.

Permitted Assignment:

Ferrum Inc. reserves the right to assign any or all of its rights and obligations under this Agreement to any affiliated company within the Ferrum Group of companies of which it is a part. Ferrum Inc. may do so at its sole discretion, at any time and without prior notice.

STANDARD TERMS AND CONDITIONS

1. **Applicable Terms**. These terms govern the Service Order on the reverse side or attached hereto and Seller's associated proposal, quotation, or acknowledgement "HILLER's Documentation". Whether these terms are included in an offer or an acceptance by HILLER, such offer or acceptance is conditioned on customer's assent to these terms. HILLER rejects all additional or different terms in any of customer's forms or documents.

2. **Payment**. Customer shall pay HILLER the full service fee as set forth in HILLER's Documentation. Unless HILLER's documentation provides otherwise, all taxes, duties or other governmental charges relating to the services provided shall be paid by Customer. If HILLER is required to pay any such charges, Customer shall immediately reimburse HILLER. 3% added to invoice total if customer uses a credit card or pays through pay pall. All payments are due within 30 days after receipt of invoice. Customer shall be charged 6% of balance due after 30 days of receipt of invoice. After 60 days customer will be charged 12% of balance due, and after 90 days 18% of balance due will be charged to the customer.

3. **Scope of Services**. HILLER shall provide the services specifically described in Seller's Documentation during normal business hours, unless otherwise specified in HILLER's Documentation. Services requested or required by the customer outside of these hours will be charged at HILLER's then current schedule of rates and will be in addition to the charges outlined in HILLER's Documentation. Where the Customer requests additional Services which are outside of the scope of work itemized in HILLER's Documentation, HILLER may provide those services at standard time and material rates and conditions then in effect.

4. **Ownership of Materials**. All devices, equipment, designs (including drawings, plans and specifications), estimates, prices, notes, electronic data and other documents or information prepared or disclosed by HILLER in connection with services provided, and all related intellectual property rights, shall remain HILLER's property. HILLER grants Customer a non-exclusive, non-transferable license to facilitate Customer's use of the equipment services. Customer shall not disclose any such material to third parties without HILLER's prior written consent.

5. **Changes**. HILLER shall not implement any changes in the scope of services described in HILLER's Documentation unless customer and HLLER agree in writing to the details of the change and resulting price, schedule or other contractual modifications. This includes any changes necessitated by a change in applicable law.

6. **Warranty**. HILLER warrants that while providing services to the Customer as outlined in Seller's Documentation all work will be carried out with due care and attention and that HILLER will use suitably qualified personnel. HILLER warranty is 12 months days from the date of the start-up. In the event of a warranty claim, HILLER shall, at its sole option and as Customer's sole remedy, repeat the service at its own expense or refund the service fee actually paid to HILLER. If HILLER determines that any warranty claim is not, in fact, covered by this service warranty, Customer shall pay HILLER its then customary charges for any additionally required service. HILLER's service warranty is conditioned on Customer's (a) operating and maintaining the Equipment in accordance with HILLER's instructions, (b) not making any unauthorized repairs or alterations which effect the service, and (c) not being in default of any payment obligation to HILLER. HILLER's service warranty does not cover damage caused by negligent operation of the water system by Customer, chemical action or abrasive material or misuse which has damaged the equipment serviced, usage of non-potable feed water with SDI equipment, or improper installation (unless installed by HILLER). THE WARRANTIES SET FORTH IN THIS SECTION ARE HILLER'S SOLE AND EXCLUSIVE WARRANTIES. HILLER MAKES NO OTHER WARRANTIES OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION, ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR PURPOSE.

7. **Indemnity**. HILLER shall indemnify, defend and hold Customer harmless from any claim, cause of action or liability incurred by Customer as a result of third party claims for personal injury, death or damage to tangible property, to the extent caused by HILLER's negligence. HILLER shall have the sole authority to direct the defence of and settle any indemnified claim. HILLER's indemnification is conditioned on Customer (a) promptly, within the service warranty period, notifying HILLER of any claim, and (b) providing reasonable cooperation in the defence of any claim.

8. **Force Majeure**. Under no circumstances shall either HILLER or Customer have any liability for any breach (except for payment obligations) caused by extreme weather or other act of God, strike or other labour shortage or disturbance, fire, accident, war or civil disturbance, delay of carriers, failure of normal sources of supply, change in law or other act of government or any other cause beyond such party's reasonable control.
9. **Cancellation**. Either party may terminate the services specified in HILLER's Documentation by providing reasonable notice sufficient to avoid costs incurred by the other party. If Customer cancels or suspends its service order for any reason other than HILLER's breach, Customer shall pay HILLER for work performed prior to cancellation or suspension and any other direct costs incurred by HILLER as a result of such cancellation or suspension.

10. **LIMITATION OF LIABILITY**. NOTWITHSTANDING ANYTHING ELSE TO THE CONTRARY, HILLER SHALL NOT BE LIABLE FOR ANY CONSEQUENTIAL, INCIDENTAL, SPECIAL, PUNITIVE OR OTHER INDIRECT DAMAGES, AND HILLER'S TOTAL, LIABILITY ARISING AT ANYTIME FROM THE SERVICE OR USE OF THE EQUIPMENT SHALL NOT EXCEED THE PRICE PAID UNDER THIS AGREEMENT. THESE LIMITATIONS APPLY WHETHER THE LIABILITY IS BASED ON CONTRACT, TORT, STRICT LIABILITY OR ANY OTHER THEORY.

11. **Leased Equipment**. Any Leased Equipment provided by HILLER shall at all times be the property of HILLER with the exception of certain miscellaneous installation materials purchased by the Customer, and no right or property interest is transferred to the Customer hereunder, except the right to use any such Equipment as provided here. Customer agrees that it shall not pledge, lend, or create a security interest in, part with possession of, or relocate the equipment. Customer shall be responsible to maintain the Equipment in good and efficient working order. Upon the expiration or termination of this Agreement, Customer shall promptly make any Leased Equipment available to HILLER for removal. Customer hereby agrees that it shall grant HILLER access to the Equipment location and shall permit HILLER to take possession of and remove the Equipment without resort to legal process and hereby releases HILLER from any claim or right of action for trespass or damages caused by reason of such entry and removal.

12. **Miscellaneous**. If these terms are issued in connection with a government contract, they shall be deemed to include those federal acquisition regulations that are required by law to be included. These terms, together with any quotation, purchase order or acknowledgement issued or signed by HILLER, comprise the complete and exclusive statement of the agreement between the parties (the "Agreement") and supersede any terms contained in Customer's documents, unless separately signed by HILLER. No course of dealing or performance, usage of trade or failure to enforce any term shall be used to modify the Agreement. If any of these terms is unenforceable, such term shall be limited only to the extent necessary to make it enforceable, and all other terms shall remain in full force and effect. Customer may not assign or permit any other transfer of the Agreement without HILLER's prior written consent. The Agreement shall be governed by the laws of the state of Texas without regard to its conflict of laws provisions.

Design basis: This offer is based on ambient conditions as follows:
- Temperature: 10-30 deg. Celsius
- Relative humidity: 20-50%
- Geodetic height: 0-1000 m above sea level

It is further assumed that the machinery is installed such that it is protected from:
- Weather
- Large variations in temperature and / or relative humidity
- Dust
- Saltwater or saltwater mist (e.g. seaborne)

These conditions are the basis of our material selection as well as our mechanical warranty. Please advise and check with Hiller if any of these conditions cannot be guaranteed.

EC Machinery Directive: HILLER centrifuges and centrifuge plants are designed and manufactured in full compliance with the EC Machinery Directive 2006/42/EG. HILLER will provide a Declaration of Incorporation or a Declaration of Conformity as applicable in accordance with the Directive, subject to the scope of supply.

Explosion-protection / ATEX Guidelines: The goods as detailed in the scope of supply above are not designed and manufactured in accordance with EC Guideline 94/9/EC (referred to as ATEX 95, formerly referred to as ATEX 100a). The goods are therefore not designed and manufactured for use in an explosion-risk area, or for processing of products that can cause an explosive atmosphere.

Find more information on our homepages

www.hillerzentri.de
www.hiller-us.com

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APPENDIX A

Agreement
Payment Bond
Performance Bond
Sample Small/Micro Business Enterprises (SBE) Utilization Report Escrow Agreement for Security Deposits in Lieu of Retention

The following is an agreement entered into as of _____ by and between the SANTA CLARA VALLEY WATER DISTRICT, State of California, hereinafter referred to as "District" and _____, hereinafter referred to as "Contractor."

For the considerations hereinafter specified, Contractor and District agree as follows:

ARTICLE I: Work to Be Done and Documents Forming the Contract

Contractor agrees to do all the work and furnish all materials necessary to construct and complete, in accordance with the Specifications the following work:

[

Said work shall be performed to the satisfaction of the Engineer all in accordance with the Drawings, Specifications, Notice to Bidders, and the Proposal of the Contractor, all of which documents are hereby specially referred to and by such reference made a part of this Contract.

ARTICLE II: Contract Price

District hereby agrees and promises to pay to Contractor the sum of _____ Dollars ($_____).

For the performance of said work; provided, however, that the above mentioned sum is one determined by the Proposal of Contractor as based upon the estimated amount of work to be done, and should there be any variance between the estimated amount of work to be done and the actual amount of work performed, then the final payment price shall be computed on the basis of the unit prices contained in the Proposal of Contractor.

ARTICLE III: Completion of Contract

It is hereby agreed that the work called for under this Contract, in all its parts and requirements, shall be completed before the expiration of _____ calendar days from the First Chargeable Day of the Contract as stated on the Notice to Begin Work unless the time for completion is extended, as allowed by the Specifications.

ARTICLE IV: Bonds Required

This Contract shall have no force or effect whatsoever unless and until Contractor delivers to District a Payment Bond in the sum of _____ Dollars ($_____).

Nor shall such Contract be effective until Contractor also gives a good and sufficient bond in the sum of _____ Dollars ($_____) for the faithful performance of the work to be done under the terms of this Contract.

ARTICLE V: Certification by Contractor

Contractor hereby certifies as follows:

"I certify that I am aware of the provisions of Section 3700 of the Labor Code which requires every employer to be insured against liability for workers' compensation or to undertake self insurance in accordance with the provisions of that Code, and I will comply with such provisions before commencing the performance of the work of this Contract."

ARTICLE VI: Gift Policy Observance

Contractor hereby acknowledges that District policy prohibits the acceptance by District personnel of gifts of any kind from vendors or contractors. Contractor shall honor this policy by not sending or bringing gifts to the District.

IN WITNESS WHEREOF, Contractor and District have caused this Agreement to be subscribed as of the day and year first hereinabove written.

Date Contractor signature affixed:

_____

By _____

_____ Title _____

Federal I.D. "Contractor"

SANTA CLARA VALLEY WATER DISTRICT

Date District signature affixed: By _____

Chair/Board of Directors

_____

BE IT KNOWN BY THESE PRESENTS:

WHEREAS, the Santa Clara Valley Water District (hereinafter called "the Public Entity"), and _____ (hereinafter designated as "Principal") have entered into an agreement for the _____ Project which said agreement is dated as of _____, 20_____; and

WHEREAS, said Principal is required by California Civil Code Sections 9550 and 9554 to furnish a bond in connection with said agreement;

NOW, THEREFORE, we, the Principal and _____, a corporation duly organized under the laws of the State of _____, having its principal place of business at _____ in the State of _____, and authorized to do business in the State of California, hereinafter "Surety," are held and firmly bound unto the Public Entity in the penal sum of _____ Dollars ($_____) lawful money of the United States of America for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, Administrators, and successors and assigns, jointly and severally, firmly by these presents.

1. THE CONDITION OF THIS OBLIGATION IS SUCH that if the Principal or the Principal's subcontractor fails to pay any of the persons named in Section 9100, or amounts due under the California Unemployment Insurance Code with respect to work or labor performed under the agreement, or for any amounts required to be deducted, withheld, and paid over to the Employment Development Department from the wages of employees of the Principal and the Principal's subcontractors pursuant to Section 13020 of the Unemployment Insurance Code, with respect to such work and labor, that the Surety or Sureties will pay for the same, in an amount not exceeding the sum hereinabove specified, and also, in case suit is brought upon the bond, a reasonable attorney's fee, to be fixed by the court. The Principal may require of the Principal's subcontractors a bond to indemnify the Principal for any loss sustained by the Principal because of any default by the Principal's subcontractors under Section 9554 of the California Civil Code.
2. This bond shall inure to the benefit of any of the persons named in Section 9100 of the California Civil Code, so as to give a right of action to such persons or their assigns in any suit brought upon this bond.
3. Surety, for value received, hereby agrees that no change, extension of time, alteration or addition to the terms of the Contract or to the work to be performed thereunder or to the Contract Documents accompanying the same shall in any way affect its obligations on this bond, and it does hereby waive notice of any such change, extension of time, alteration or addition to the terms of the Contract or to the work or to the other portions of the Contract Documents.
4. Should the condition of this bond be fully performed, then this obligation shall become null and void; otherwise, it shall be and remain in full force and effect.

IN WITNESS WHEREOF two identical counterparts of this instrument, each of which shall for all purposes be deemed an original thereof, have been duly executed by the Principal and Surety or Sureties above named on the _____ day of _____, 20_____.

PRINCIPAL:	**SURETY**:
_____ Signature	_____ Signature
_____ Name	_____ Name (Seal)
_____ Title	_____ Title
_____ Address	_____ Address

NOTE: Signatures of those executing for the Surety or Sureties must be properly acknowledged.

BE IT KNOWN BY THESE PRESENTS: That

WHEREAS, the Santa Clara Valley Water District, State of California, has awarded to _____ _____ (hereinafter designated as "Principal") a Contract for , and

WHEREAS, said Principal is required under the terms of said Contract to furnish a bond for the faithful performance of said Contract,

NOW, THEREFORE, we, the Principal and _____ as Surety, are held and firmly bound unto the Santa Clara Valley Water District (hereinafter called "District") in the sum of _____ Dollars ($_____) lawful money of the United States, for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH that if the above bounden Principal, or heirs, executors, administrators, successors, or assigns shall in all things stand to and abide by, and well and truly keep and perform the covenants, conditions and agreements in the said Contract and any alteration thereof made as therein provided, to be kept and performed at the time and in the manner therein specified, and in all respects according to their true intent and meaning, and shall indemnify and save harmless District, its officers, agents, and employees, as therein stipulated, then this obligation shall become null and void; otherwise it shall be and remain in full force and effect.

And the said Surety, for value received hereby stipulates and agrees that no change, extension of time, alteration, or addition to the terms of the Contract or to the work to be performed thereunder or the Specifications accompanying the same shall in any wise affect its obligation on this bond, and does hereby waive notice of any such change, extension of time, alteration, or addition to the terms of the Contract or to the work or to the Specifications.

In the event suit is brought upon this bond by District and judgment is recovered, Surety shall pay all costs incurred by District in such suit, including a reasonable attorney's fee to be fixed by the Court.

IN WITNESS WHEREOF two identical counterparts of this instrument, each of which shall for all purposes be deemed an original thereof, have been duly executed by Principal and Surety above named, on the _____ day of _____, 20_____.

PRINCIPAL:	**SURETY**:
_____	_____
Signature	Signature
_____	_____
Name	Name (Seal)
_____	_____
Title	Title
_____	_____
Address	Address

NOTE: Signature of those executing for Surety must be properly acknowledged.

Escrow Agreement for Security Deposits in Lieu of Retention

Escrow Account No.: _____

This Escrow Agreement is made and entered into by and between:

SANTA CLARA VALLEY WATER DISTRICT whose address is 5750 Almaden Expressway, San Jose, CA 95118 hereinafter called "**Owner**," and

_____ whose address is _____ hereinafter called "**Contractor**," and

_____ whose address is _____ hereinafter called "**Escrow Agent**," and

For the consideration hereinafter set forth, the Owner, Contractor, and Escrow Agent agree as follows:

1. Pursuant to §22300 of the Public Contract Code of the State of California, Contractor has the option to deposit securities with Escrow Agent as a substitute for retention earnings required to be withheld by Owner pursuant to the Construction Contract entered into between the Owner and Contractor for] in the amount of $_____ dated _____ (hereinafter referred to as the "Contract"). Alternatively, on written request of the Contractor, the Owner shall make payments of the retention earnings directly to the Escrow Agent. When the Contractor deposits the securities as a substitute for Contract earnings, the Escrow Agent shall notify the Owner within 10 days of the deposit. The market value of the securities at the time of the substitution shall be at least equal to the cash amount then required to be withheld as retention under the terms of the Contract between the Owner and Contractor. Securities shall be held in the name of **Santa Clara Valley Water District**, and shall designate the Contractor as the beneficial owner.

2. The Owner shall make progress payments to the Contractor for those funds which otherwise would be withheld from progress payments pursuant to the Contract provisions, provided that the Escrow Agent holds securities in the form and amount specified above.

3. When the Owner makes payment of retentions earned directly to the Escrow Agent, the Escrow Agent shall hold them for the benefit of the Contractor until the time that the escrow created under this contract is terminated. The Contractor may direct the investment of the payments into securities. All terms and conditions of this agreement and the rights and responsibilities of the parties shall be equally applicable and binding when the Owner pays the Escrow Agent directly.

4. Contractor shall be responsible for paying all fees for the expenses incurred by Escrow Agent in administering the Escrow Account and all expenses of the Owner. These expenses and payment terms shall be determined by the Owner, Contractor, and Escrow Agent.

5. The interest earned on the securities or the money market accounts held in escrow and all interest earned on that interest shall be for the sole account of Contractor and shall be subject to withdrawal by Contractor at any time and from time to time without notice to the Owner.

6. Contractor shall have the right to withdraw all or any part of the principal in the Escrow Account only by written notice to Escrow Agent accompanied by written authorization from the Owner to the Escrow Agent that Owner consents to the withdrawal of the amount sought to be withdrawn by Contractor.

7. The Owner shall have a right to draw upon the securities in the event of default by the Contractor. Upon seven days' written notice to the Escrow Agent from the owner of the default, the Escrow Agent shall immediately convert the securities to cash and shall distribute the cash as instructed by the Owner.

8. Upon receipt of written notification from the Owner certifying that the Contract is final and complete, and that the Contractor has complied with all requirements and procedures applicable to the Contract, Escrow Agent shall release to Contractor all securities and interest on deposit less escrow fees and charges of the Escrow Account. The escrow shall be closed immediately upon disbursement of all moneys and securities on deposit and payments of fees and charges.

9. Escrow Agent shall rely on the written notifications from the Owner and the Contractor pursuant to Sections (5) to (8), inclusive, of this Agreement and the Owner and Contractor shall hold Escrow Agent harmless from Escrow Agent's release and disbursement of the securities and interest as set forth above.

10. The names of the persons who are authorized to give written notice or to receive written notice on behalf of the Owner and on behalf of Contractor in connection with the foregoing, and exemplars of their respective signatures are as follows:

11. Throughout the term of this Escrow Agreement, the Escrow Agent herein agrees to provide monthly statements indicating the account balances and status of the account, directly to the Owner, the Santa Clara Valley Water District, at the address provided below, to the attention of the District's representative identified below. The Escrow Agent may submit a request to provide such statements in electronic format.

12. The Escrow Agent must provide written notice to the Owner in advance of any action that will negatively impact the account.

On behalf of Owner:

Signature Date

Name
Capital Program Deputy Operating Officer
Designated Engineer
Title

5750 Almaden Expressway
San Jose, CA 95118
Address

On behalf of Contractor:

Signature Date

Name

Title

Address

On behalf of Escrow Agent:

Signature Date

Name

Title

Address

At the time the Escrow Account is opened, the Owner and Contractor shall deliver to the Escrow Agent a fully executed counterpart of this Agreement.

IN WITNESS WHEREOF, the parties have executed this Agreement by their proper officers on the date first set forth above.

OWNER:

Signature Date

Name
Capital Program Deputy Operating Officer
Designated Engineer
Title

5750 Almaden Expressway
San Jose, CA 95118
Address

CONTRACTOR:

Signature Date

Name

Title

Address

Appendix B

Guidelines for Contractor's As-Built Mark-Ups or Engineer's Record Drawings

Santa Clara Valley Water District
CADD Services Unit

Version: 1.2
Effective Date: July 2017

EXTERNAL USERS:

The version provided by the "District" represents the applicable version.

INTERNAL "DISTRICT" STAFF:

Printed or downloaded versions are for reference only. See the Technical Review Committee (TRC) website for current version.

Guidelines for Contractor's As-Built Mark-Ups or Engineer's Record Drawings

CADD Services Unit

These guidelines were originally developed and written by Emmanuel Aryee (formerly of CADD Services unit). The example figures were provided by Roberto Parmituan (Construction Inspection unit). The Plans and Specifications Standardization team then reviewed these guidelines.

TABLE OF CONTENTS

FIGURES

1.0 REDLINE MARKING IN THE FIELD OR THE OFFICE

Redline mark ups should be neat, legible, clear, and orderly and should accurately record and reflect the actual as-built condition.

It should be done with the correct symbols, lines, lettering and text, details, dimensioning, etc. using red pencil or ink.

All construction changes are based on authorized change documents or Engineer's instructions. These documents are kept in the Project or Construction files.

Change documents include addendum, request for information (RFI), contract change order (CCO), engineers work order or extra work order (EWO), field memo, etc. See Figure 4 & 6. It is not acceptable to attach change documents to the drawings to avoid having to mark up changes on the drawings. Changes should be interpreted and then transferred by redline markings on to the drawing sheets; they should be referred to in the listing of the changes or revisions in the title block of the drawing sheet. See Figure 4 to 8.

Already drafted changes, sketches, diagrams of the changes (not the complete change document) may be attached on blank spaces on the drawing sheet or a separate blank sheet, (not to cover the original drawing information) to show or illustrate the extent of the changes, if that will be helpful.

Features, items, details that were changed should be clearly detailed, dimensioned, located (survey information, tying to control lines, other features or monuments, station offsets or reference lengths, distances, etc.) and described in detail with lines, lettering & text, etc. with redline mark up.

Redline mark ups should be done in a manner that enables any competent technician or drafter to draft the as-built mark-up or the record drawings with minimum difficulty.

Redline marking includes making changes, additions and/or deletions representing the actual construction changes for the as-built drawings or changes authorized by the engineer on the record drawings.

1.1 CHANGE

A change is made when an item(s) on the drawing sheet is modified or replaced with completely new item(s). It may involve the change of a simple line, dimension, note or re-sketch of a part or a component. Only those areas of a drawing that are affected should be marked up. Item(s) changed should be clouded.

> **Clouding**—The use of a cloud to surround the area or item, text or symbol changed so as to make the changes stand out and be easily identified. The original content that is not affected by the change is left unclouded. See Figure 8.

1.2 ADDITIONS

Additions occur when new item(s) are introduced on to the drawing sheet to supplement or clarify information without modifying or replacing the original items. When additions are made to the drawings that affect only the drawing content, the additions should also be clouded since they are revisions to the original drawings.

1.3 DELETIONS

Deletions occur when features, details or items on the drawings are not constructed, are removed, are changed and/or replaced.

When preparing As-built drawings, all original drawing details, items are preserved. Deleted items should not be erased or removed from the marked up drawing. Deletions are shown by **crossing** out the deleted elements, details, lines, text, symbols, or any other items involved, with one of these methods;

– a slanted/horizontal line (strike-out line) across the element,
– a heavy “X” over the element,
– a bold, big X across a major element or across the entire drawing sheet.

The area or item affected should be clouded to indicate the limits of removal. See Figure 8.

2.0 ADDITIONAL SHEETS

When changes involve the incorporation of new additional sheet or sheets, it may or may not be necessary to do clouding on the original sheet. If there is a reference to a new sheet in the set, then the reference area should be clearly clouded and the call out to the additional sheet made. Otherwise the new drawing should be marked as normal but tracking notation should show that this is an additional sheet with the original sheet left intact.

In cases where the marking up of several changes on the same sheet leaves the drawing content unclear, crowded, or when features and items become unidentifiable or make the drawing unreadable, use of additional sheets should be considered.

3.0 TRACKING OF “AS-BUILT” CHANGES OR REVISIONS

All changes marked up must be tracked. They must be clearly identified with the triangle symbol with the revision number (used in the change document) or the letters “AB” embedded (if no revision numbers are used). The triangle symbol should be placed by the side of all changes, outside the cloud, on the affected drawing sheet.

Figure 1—As-Built (AB) Triangle Symbol

A subscript representing the number (#) assigned to track and identify the particular change or revision is placed by the triangle symbol as shown above in Figure 1.

4.0 LISTING OR RECORDING OF CHANGES OR REVISIONS

All changes that have been done since the final (construction) drawings were issued must be listed or recorded on the Contractor's "As-Built" drawing sheets and/or the Engineer's record drawings.

Changes made during construction must be listed or recorded and identified under the revision section of the title block of the drawing sheet. Each listing should be identified with the corresponding number (subscript) of the triangle symbol. The listing consist of a short description of the change and an abbreviated name of the change document such as CCO #2 for contract change order number 2, placed in brackets, under the "DESCRIPTION" heading.

It could also be "as per the Engineer instructions" for some of the changes done under the direct instructions of the Engineer. It must include a date and the initials of the person who authorized the change. See Figure 2.

REV	DESCRIPTION	DATE	APPR.
AB	1. REMOVE AND REPLACE EXISTING PIPE SYSTEM (LOC #1) 2. REVISE ANODE LEAD WIRE (CCO #2)	08/01 05/02	S.C. D.M.

Figure 2—Listing or Recording of Changes

5.0 SIGNING OF THE AS-BUILT OR THE RECORD DRAWINGS

Each sheet must be signed and dated by the contractor's representative for the contractor's as-built mark-ups. The representative must also include his/her printed name and his/her company's name. Similarly the Engineer must do the same for the record drawings. See sample below.

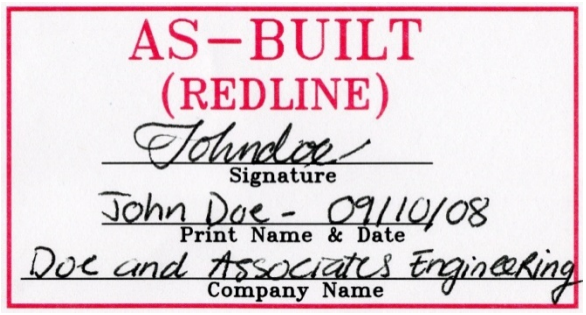

Figure 3—Sample of As-Built Signature Stamp

Santa Clara Valley Water District

REQUEST FOR INFORMATION
FC 825 (04-10-86)

To: John Doe (Resident Inspector)

Date: Feb. 6, 2008

From: R. B. Construction Co., Inc. (Contractor, Utility, etc.)

Contractor File No.: 001

Contract: PWTP Landscaping

RFI Consec. No.: 4

Contract No.: C0526

Reply Needed By: Feb. 12, 2008

Item No.	INFORMATION ACTION NEEDED	Ref.Spec/Plan No.
1.	An existing buried concrete block was discovered during the trench excavation for the irrigation mainline. Location is shown in the attached drawing.	PLAN SHT I-4
	This buried concrete block will not allow for the installation of the proposed irrigation mainline in the location shown. Please provide direction on how to proceed.	

Figure 4—Request for Information

ENGINEER'S RESPONSE

Santa Clara Valley Water District

REQUEST FOR INFORMATION
FC 825 (04-10-86)

To: John Doe (Resident Inspector) Date: Feb. 6, 2008

From: R. B. Construction Co., Inc. (Contractor, Utility, etc.) Contractor File No.: 001

Contract: PWTP Landscaping RFI Consec. No.: 4

Contract No.: C0526 Reply Needed By: Feb. 12, 2008

Item No.	INFORMATION ACTION NEEDED	Ref.Spec/Plan No.
1.	An existing buried concrete block was discovered during the trench excavation for the irrigation mainline. Location is shown in the attached drawing.	PLAN SHT I-4
	This buried concrete block will not allow for the installation of the proposed irrigation mainline in the location shown. Please provide direction on how to proceed.	

DISTRIBUTION: Pink = retained by Initiator 3 copies to Resident Inspector

Item No.	REPLY	Extra WO Forthcoming (Yes/No)
1.	Please re-route/re-align the irrigation line installation as shown in the attached drawing.	TBD

Design Consultant: Date:	Project Engineer Mr. Smart Date: 2/11/08	Resident Inspector John Doe Date: 2/11/08

NOTICE TO CONTRACTOR: This form has been designed to expedite responses to your inquiries. You may include more than one request on one form, but separate forms should be used for the different construction disciplines, e.g., architectural; civil; structural; mechanical; electrical.

Distribution: White = Retained by Resident Inspector Yellow = Project Engineer
Pink = Initiator Goldenrod = Returned to Initiator with reply

Figure 5—Engineer's Response to RFI

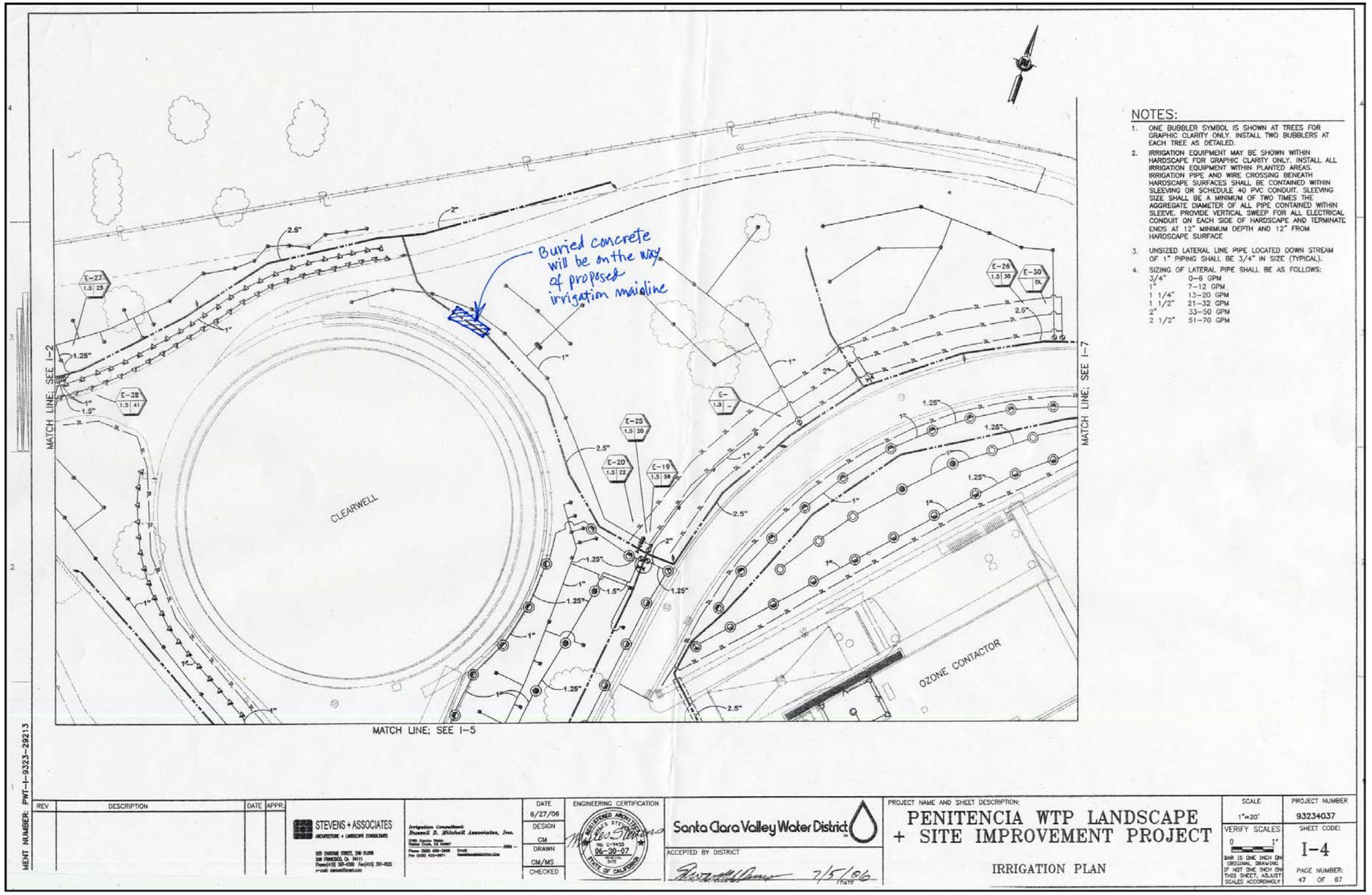

Figure 6—Mark-Up on Drawing Showing RFI

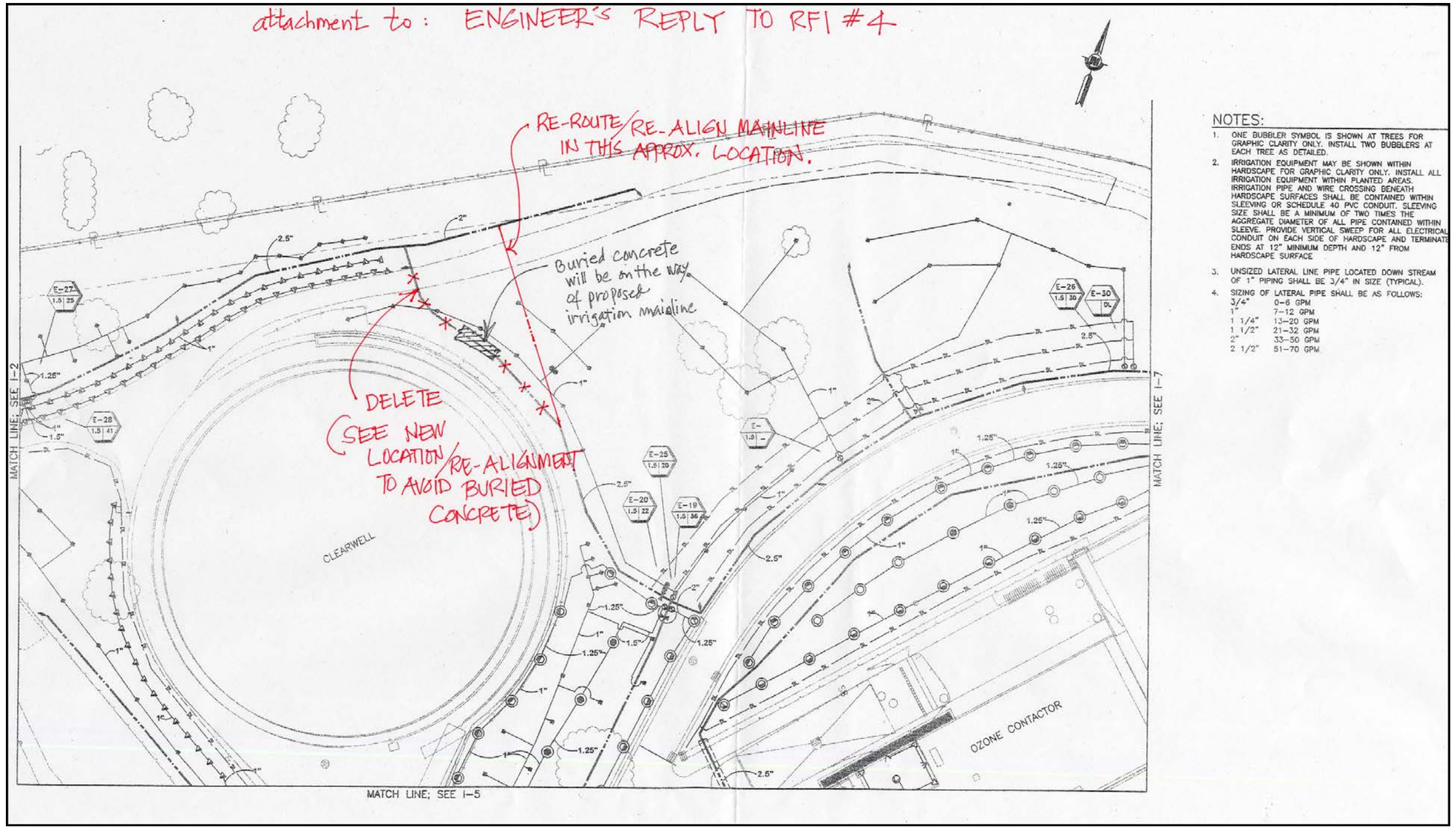

Figure 7—Mark-Up on Drawing Showing Engineer's Response to RFI

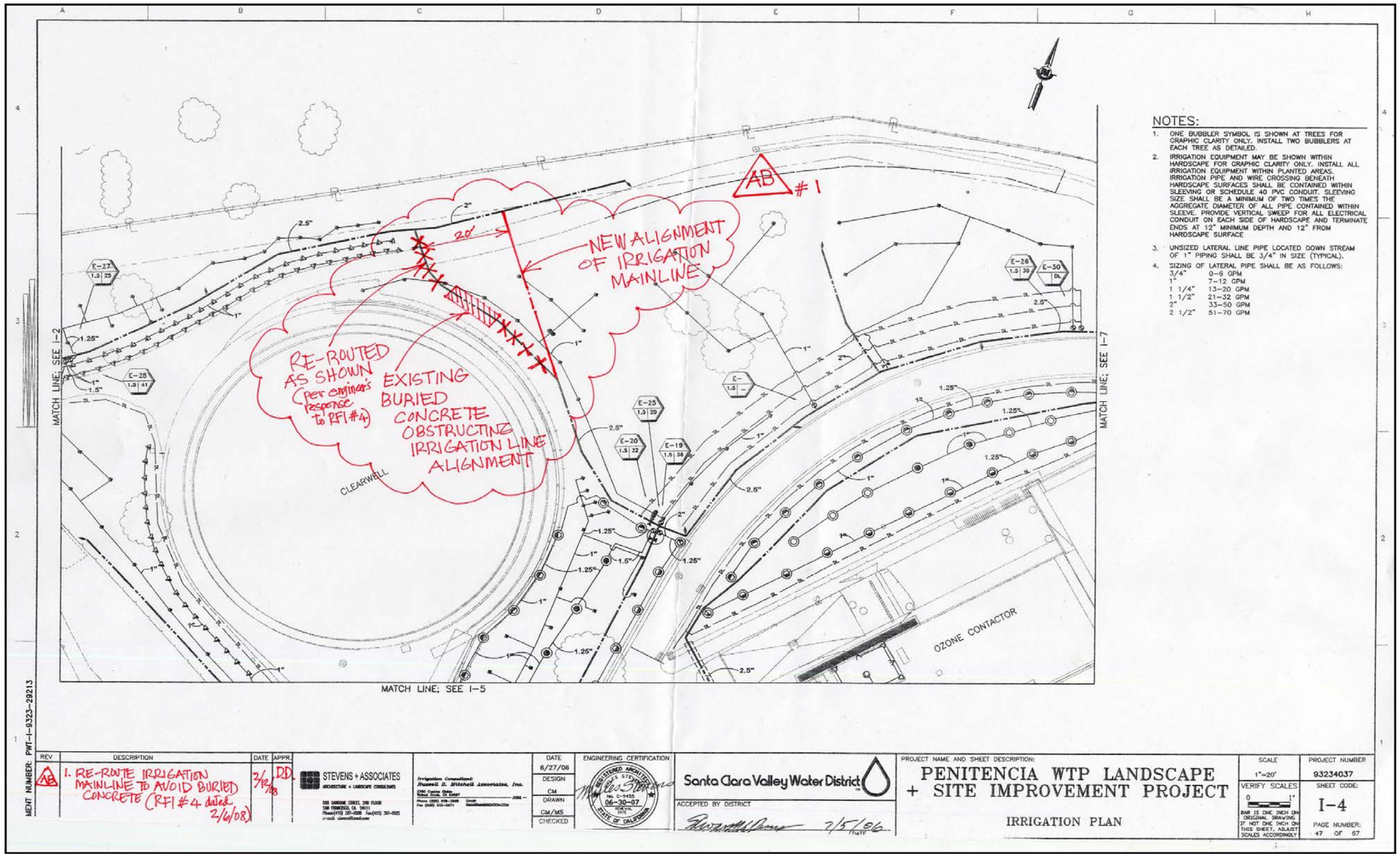

Figure 8—Contractor's Mark-Up Showing Actual Field Work

Appendix C

DISPUTE REVIEW BOARD

THREE-PARTY AGREEMENT

I. PARTIES

A. Santa Clara Valley Water District herein after referred to as the District.

B. _____, herein after referred to as the Contractor.

C. Dispute Review Board, hereinafter referred to as the DRB, consisting of three members:

1. _____

2. _____

3. _____

II. CONTRACT

A. The Contractor has entered into a Contract with the District for the construction of the Rinconada Water Treatment Plant Residuals Remediation Project hereinafter referred to as the Project.

B. The Project Contract Documents provide for the establishment and operation of a DRB to assist in resolving disputes.

C. The DRB is composed of three members, selected in accordance with the Specifications.

III. PURPOSE OF DRB

A. Assist in and facilitate avoidance of disputes and the timely and impartial resolution of disputes that are referred to it.

IV. DRB SCOPE OF WORK

A. General:

1. Stay abreast of project developments by means of periodic meetings and site visits, review of progress reports, meeting minutes, and other job documents, and by other means as mutually agreed by all parties.

2. Examine site conditions or specific construction problems relating to an existing or potential dispute, unless such examination is not practical, or, in the judgment of either the District or the Contractor, would result in a delay to the project.

3. One of the selected members shall serve as Chairperson.

4. Execute this Agreement at the first meeting with representatives of the District and the Contractor.

B. DRB Meetings

1. Scheduled DRB progress meetings shall be held at or near the project site. DRB shall meet at least once at the start of the project, and at least once every three months thereafter. Additional meetings or site visits shall be as recommended by the DRB and approved by the parties consistent with the construction activities or matters under consideration and dispute. Scheduled progress meetings and site visits can be waived/delayed, if the parties are in agreement.

2. Each DRB meeting shall consist of a round table discussion and a field inspection of the work being performed on the contract, if necessary. Each meeting shall be attended by representatives of both parties. The agenda shall generally be as follows:

   a. Meeting opened by the DRB Chairperson.

   b. Remarks by the District's representative.

   c. A description by the Contractor's representative of work accomplished since the last meeting; the current schedule status of the work; and a forecast for the coming period.

   d. An outline by the District's representative of the status of the work as the District views it.

   e. An outline by the Contractor's representative of potential problems and a description of proposed solutions.

   f. A brief description by the Contractor's and the District's representative of potential claims and disputes that have surfaced since the last meeting.

   g. A summary by the District's representative, the Contractor's representative, or the DRB of the status of past potential claims and disputes.

   h. When mutually agreed, an option for an advisory opinion.

3. The District's representative will prepare a meeting summary of all progress meetings and circulate them for revision and approval by all concerned within 10 days of the meeting.

C. Establish DRB operating procedures consistent with the requirements and general guidelines set forth below:

1. The DRB Chairperson shall establish operating procedures mutually agreeable to all parties, such as administrative duties; content and format of information which may be presented at DRB hearings; conduct of hearings; and invoicing details. Establish these procedures at the first meeting with representatives of the District and the Contractor.

2. Initiate new procedures or modify existing procedures as mutually agreed to by all parties.

3. Provide all parties with these operating procedures, including all modified procedures, in written form. Include the procedures for progress meetings and for advisory opinions.

4. The DRB operating procedures shall be in accordance with Article 3.13 of the Contract Specifications.

D. Recommend Resolution of Disputes:

1. Upon receipt by the DRB of a referral of a dispute from either the District or Contractor, schedule and conduct a hearing at a time and location set by the DRB following consultation with the District and Contractor.

2. When proper evaluation of the dispute requires expertise that is not within the collective experience of the DRB, engage, with the prior written approval of the District and the Contractor, the services of one or more outside consultants as may be needed to advise the DRB.

3. Convene internal meetings as needed and approved to review and discuss the dispute, and to formulate the report.

4. Following each hearing and DRB deliberation, issue timely executed written reports to the District and the Contractor, including the supporting rationale.

5. When requested and deemed appropriate by the DRB, provide executed written responses to requests for clarification or reconsideration made by either the District or the Contractor.

6. All DRB reports and responses to requests for clarification or reconsideration shall be signed by all three Board members.

E. Perform services and assume responsibilities, as agreed by all parties, as may be required, including those necessary but not listed herein, to achieve the purpose of this Agreement.

V. RESPONSIBILITIES OF THE PARTIES

A. DRB Responsibilities:

1. Maintain impartiality and avoid conflicts of interest by continuing to meet the specified requirements for nominees for Board members. Promptly advise all parties upon becoming aware of any development that could be perceived as a conflict of interest.

2. During progress or dispute resolution meetings, DRB members shall refrain from expressing opinions on the merits of statements on matters under dispute or potential dispute. Opinions of DRB members expressed in private sessions shall be kept strictly confidential. Individual DRB members shall not meet with, or discuss contract issues with individual parties.

3. Discussions regarding the project between the DRB members and the parties shall be in the presences of all three members and both parties. Individual DRB members shall not undertake independent investigations of any kind pertaining to disputes or potential disputes, except with the knowledge of both parties and as expressly directed by the DRB Chairperson.

4. Do not discuss, individually or collectively, issues with the District or the Contractor that could possibly be construed as compromising the DRB's ability to impartially resolve future disputes, such as the conduct of the work and the resolution of construction problems.

5. Do not express an individual or collective opinion of merit, in whole or in part, for any potential or other dispute at any time prior to the issue of a report, except in the case of an advisory opinion.

6. Except as required when performing the duties of the Chairperson or conducting a hearing which the District or Contractor refuses to attend, do not meet or communicate with either the District or Contractor in the absence of the other.

7. Consider the facts and conditions forming the basis for a referred dispute impartially, and independently and evaluate the merits based on careful consideration of all contract requirements, applicable law and regulations, and the facts and circumstances of the dispute. Do not:

   a. Ignore or undermine the clear intent of the contract, or disregard or alter any requirements of the contract or allocation of risk specified therein.

   b. Supplant or otherwise interfere with the respective rights, authority, duties, and obligations of either the District or Contractor as set forth in the contract documents.

8. Make every effort to reach unanimous recommendations. If this cannot be accomplished, include written minority recommendations and supporting rationale with the report.

B. District Responsibilities:

1. Except for participation in the DRB's activities as provided in the contract documents and this Agreement, do not solicit advice or consultation from the DRB or its members on matters dealing with the conduct of the work or resolution of problems which might compromise the DRB's ability to impartially resolve future disputes.

2. Furnish to each Board member one copy of the conformed contract documents, progress schedule and updates, weekly progress reports, minutes of progress meetings with the Contractor, change orders, and other documents pertinent to the performance of the contract and necessary for the DRB to conduct its operations.

3. Coordinate DRB operations in cooperation with the Contractor.

4. Arrange for or provide conference facilities at or near the site, and provide copying services.

5. Cooperate with the Contractor and the DRB to facilitate prevention of disputes and the timely and impartial resolution of disputes.

C. Contractor Responsibilities:

1. Except for participation in the DRB's activities as provided in the contract documents and this Agreement, do not solicit advice or consultation from the DRB or its members on matters dealing with the conduct of the work or resolution of problems which might compromise the DRB's ability to impartially resolve future disputes.

2. Furnish to each Board member and to the District, one copy of pertinent documents other than those furnished by the District as may be requested.

3. Cooperate with the District and the DRB to facilitate prevention of disputes and the timely and impartial resolution of disputes that are referred to it.

VI. TIME FOR BEGINNING AND COMPLETION OF DRB ACTIVITIES

A. Unless the DRB Chairperson has been previously identified by the parties, the DRB shall begin its activities by selecting the Chairperson. After selection of the Chairperson, DRB activities shall proceed with preparation for the first meeting, including preparation of the DRB operating procedures.

B. This Agreement shall survive the termination, resignation, or death of any member.

C. The DRB's jurisdiction under this Agreement shall end on the date of final payment under the CONTRACT, unless terminated earlier by mutual agreement of the District and Contractor.

VII. PAYMENT

A. Payments made to the Board members shall constitute full compensation for work performed, travel time and services rendered, and for all materials, supplies, and incidentals necessary to serve on the DRB.

B. Each DRB member shall be compensated at an agreed rate of $1,500 per day for time spent per meeting either at the start of the project, for scheduled progress, or dispute meetings. A member serving on more than one District DRB, regardless of the number of meetings per day shall not be paid more than the agreed rate per day. The agreed rate shall be considered full compensation for on-site time, travel expenses, transportation, lodging, time for travel, and incidentals for each day or portion thereof that the DRB member is at an authorized DRB meeting.

C. No additional compensation will be made for time spent by DRB members in review and research activities outside the official DRB meetings unless that time, such as time spent evaluating and preparing recommendations on specific issues presented to the DRB, has been specifically agreed to in advance by the District and Contractor. Time away from the project, which has been specifically agreed to in advance by the District and Contractor, will be compensated at an agreed rate of $150 per hour. The agreed amount of $150 per hour shall include all incidentals including expenses for telephone, fax, and computer services.

D. Payment for services rendered by Board members shall be at the rate and conditions per above unless otherwise agreed to in writing between the District and the Contractor and each Board member.

E. Payment made to Board members in the form of bonus, commission, or consideration of any nature other than that specified hereinabove for performance and service provided under this Agreement, before, during, or after the period that this Agreement is in effect, is prohibited.

F. Board members shall individually submit invoices for work completed to the Contractor:

1. Not more often than once per month.

2. Based on the agreed billing rate and conditions and on the number of hours expended.

3. Accompanied by a description of activities performed daily during that period.

G. The Contractor shall pay acceptable invoices, approved by the District, within 30 days of their receipt.

H. The Contractor shall be reimbursed for the District's portion of the DRB costs in accordance with payment provisions specified elsewhere in the contract.

VIII. CONFIDENTIALITY AND RECORDKEEPING

A. No Board member shall divulge information identified as confidential that has been acquired during DRB activities without obtaining prior written approval from the District and the Contractor.

B. Board members shall maintain cost records pertaining to this Agreement for inspection by the District or the Contractor for a period of three years following the end or termination of this Agreement.

IX. ASSIGNMENT

A. No party to this Agreement shall assign any duty established under this Agreement.

X. TERMINATION

A. This Agreement may be terminated by mutual agreement of the District and Contractor at any time upon not less than four weeks written notice to the other parties.

B. Individual Board members may be terminated only by agreement of both the District and the Contractor.

C. If a Board member resigns, is unable to serve, or is terminated he or she shall be replaced within four weeks in the same manner as he or she was originally selected. This Agreement shall be amended to indicate the member replacement.

XI. LEGAL RELATIONS

A. The parties to this Agreement expressly acknowledge that each Board member, in the performance of his or her duties on the DRB, is acting in the capacity of an independent agent and not as an employee of the District or the Contractor.

B. Board members shall not participate in subsequent dispute proceedings.

C. The District and the Contractor acknowledge that each Board member is acting in a capacity intended to facilitate the resolution of disputes. Accordingly, it is agreed and acknowledged that, to the fullest extent permitted by law, each Board member shall be accorded quasi-judicial immunity for any actions or decisions associated with DRB activities.

D. Each Board member shall be held harmless for any personal or professional liability arising from or related to DRB activities. To the fullest extent permitted by law, the District and the Contractor shall indemnify and hold harmless all Board members for claims, losses, demands, costs, and damages (including reasonable attorney fees) for bodily injury, property damage, or economic loss arising out of or related to Board members carrying out DRB activities. The foregoing indemnity is a joint and several obligation.

E. DRB members shall have no claim against the District or the Contractor, or both from claimed harm arising out of the parties' evaluations of the DRB's opinions.

F. Each DRB member shall provide and maintain at their own expense, during the term of this agreement, the following insurance coverages:

Auto Liability Insurance with coverages: $500,000 each person, $500,000 each occurrence for bodily injury and $100,000 each occurrence for property damage, covering all owned, non-owned and hired vehicles.

XII. DISPUTES REGARDING THIS THREE-PARTY AGREEMENT

A. Disputes among the parties arising out of this Agreement that cannot be resolved by negotiation and mutual concurrence and actions to enforce any right or obligation under this Agreement shall be initiated in the _____ [Court Name] Court of the_____[Jurisdiction].

B. All questions shall be resolved by application of _____ [Jurisdiction] law.

C. The Board members hereby consent to the personal jurisdiction of the Court of the_____[Jurisdiction].

XIII. FUNDING AGENCY REVIEW

The project funding agencies have the right to review DRB reports and to attend DRB hearings, but not to attend private DRB deliberations.

XIV. THREE-PARTY AGREEMENT

Entered into on_____, 20___ between:
(month) (day)

BOARD MEMBERS

By: _____ (Signature)_____
(Name)

By: _____ (Signature)_____
(Name)

By: _____ (Signature)_____
(Name)

CONTRACTOR

By: _____
(Signature)

_____
(Name)

Title: _____

DISTRICT

By: _____
(Signature)

_____
(Name)

Title: _____

Appendix D

Partial Outage or Plant Shutdown Form (POPS)

Date submitted		**Valve Shutdown No.**		**List Valves/Actuators being replaced:**	
Date of Walk throughs		**Partial Outage No.**			
Date of Shutdown/Outage Start/ (Duration)		**Time of Shutdown/Outage Start**		**Comments:**	
End of Shutdown/Outage Date		**Time of Shutdown/Outage End**			
Contractor Signature/Date		**Engineer Signature/Date:**			

Valve ID	**Position of Valve during Normal Operations (to be completed by Engineer)**				**Position of Valve During Outage or Shutdown Check off when completed**				**Use E for Engineer and C for Contractor**		**Position of Valve After Outage or Shutdown**				**Use E for Engineer and C for Contractor**	
	Contractor		**District**		**By Contractor**		**By District**		**Begin of SD-Outage**		**Contractor**		**District**		**End of SD-Outage**	
	Open	**Close**	**Open**	**Close**	**Open**	**Close**	**Open**	**Close**	**Lock-Out**	**Tag-Out**	**Open**	**Close**	**Open**	**Close**	**Remove Lock**	**Remove Tag**

Appendix E

Santa Clara Valley Water District

SOLID MATERIALS MANAGEMENT REPORT

FC 1810 (07-21-16)

Project Name:	Project Number:	
Contract Number:	Reporting period (month and year): From: To:	
Contractor Name:	Phone Number:	FAX Number:
Street Address:	City, State, and Zip:	
Preparer's Name (please print):	Signature:	Date:

A. Construction and Demolition Waste Management Report

Note 1: Earth and rock material, ground water, and construction and demolition waste material that contains contaminated or hazardous materials shall not be reported as either waste material diverted from or disposed to landfill. See specifications for project-specific list of construction and demolition waste materials.

Note 2: Contractor to attach facility receipts for loads taken for disposal in landfill and loads taken for recovery/recycling.

Note 3: If no minimum diversion rate is specified, contractor has the option of reporting material quantity by weight (ton) or volume (cubic yard).

Name and Address of Recycling or Disposal Facility	Type of Material Enter letter as follows: A = asphalt C = concrete M = metal D = mixed debris W = wood/cleared vegetation O = other (described) **See Note 1.**	Type of Activity Enter number as follows: 1 = source-separated materials recycling 2 = on-site reuse 3 = mixed debris recycling 4 = reuse of salvageable items 5 = disposal at landfill or transfer station 6 = other (described)	Quantity of Material Taken to Landfill (ton) **See Notes 2 and 3.**	Quantity of Material Diverted From Landfill (ton) **See Notes 2 and 3.**	Total Material Generated (ton) **See Note 3.**	Material Diversion Rate (%)

Total Quantity Taken to Landfill (ton)				
Total Quantity Diverted from Landfill (ton)				
Total Material Generated (ton)				
Total Material Diversion Rate (%)				

B. Post-Consumer Recycled Content Report

Note 1: Contractor to attach documentation certifying % of post-consumer recycled material content

Material/Product Description	Manufacturer (Name, Address, and Phone Number)	Post-Consumer Recycled Content Required per Contract (%)	Certified Post-Consumer Recycled Content (%) **See Note 1.**
Specification writer to list material/equipment specified to be furnished/installed which must contain a minimum specified percentage of post-consumer recycled material	*(Contractor to complete)*	*Specification writer to list, for each material/product, the minimum % content of post-consumer recycled material*	*(Contractor to complete)*

Contractor Certification: I certify under penalty of perjury that the information provided in this form is complete and accurate.

SIGNATURE:	DATE OF REPORT:
PRINT NAME AND TITLE:	

I have reviewed the information submitted in this report for completeness.

ENGINEER SIGNATURE:	DATE:
PRINT NAME:	

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Washington D.C. 20240

In Reply Refer To:
FWS/DMBM/AMB/068029

Memorandum

To: Regional Directors

From: Assistant Director, Migratory Birds /sgd/ Jerome Ford 6/14/2018

Subject: Destruction and Relocation of Migratory Bird Nest Contents

The purpose of this memorandum is to clarify the application of the Migratory Bird Treaty Act (50 C.F.R. §§ 703-712; MBTA) to the destruction and relocation of migratory bird[1] nests and provide guidance for advising the public regarding this issue. This Memo replaces Migratory Bird Permit Memorandum MBPM-2 on Nest Destruction (Apr 15, 2003). This memo does not supersede or apply to other Federal, State, or Tribal laws and regulations, including the Endangered Species Act (16 U.S.C. §§ 1531; ESA) and the Bald and Golden Eagle Protection Act (16 U.S.C. §§ 668–668d; Eagle Act).

BACKGROUND:
The MBTA protects migratory birds, including migratory bird nests, eggs, and chicks. The prohibitions of the MBTA include *possession, transport, import, export, purchase, sale, barter,* and *take*. The regulatory definition of take, as defined by 50 C.F.R. § 10.12, means to *pursue, shoot, wound, kill, trap, capture,* or *collect,* or *attempt thereof.* This memo clarifies the Service's interpretation of how these prohibitions apply to migratory bird nests, eggs, and chicks.

The MBTA does not prohibit the destruction of an inactive[2] migratory bird nest, provided that no possession occurs during the destruction and no permit or other regulatory authorization is required (see Policy #1 below). Additionally, the Service should make every effort to inform the public of how to

[1] A list of species protected by the MBTA can be found at 50 C.F.R § 10.13
[2] An active nest is one that contains viable eggs and/or chicks. A nest becomes active when the first egg is laid and remains active until fledged young are no longer dependent on the nest. Nests that are empty, contain non-viable eggs, or are being built but do not yet have an egg in them are considered inactive.

minimize the risk of killing migratory bird species whose nesting behaviors make it difficult to determine occupancy status or continuing nest dependency (e.g., cavity and burrow nesting species).

On December 22 2017, the Department of Interior released M-Opinion 37050 (Opinion) regarding whether incidental take (the taking of migratory birds that results from an activity, but is not the purpose of the activity) is prohibited under the MBTA. The Opinion concludes that "the MBTA's prohibition on pursuing, hunting, taking, capturing, killing, or attempting to do the same applies only to direct and affirmative purposeful actions that reduce migratory birds, their eggs, or their nests, by killing or capturing, to human control" (M-Opinion, pg. 41). The Opinion clarifies that the MBTA does not prohibit the incidental or unintentional take of migratory birds and/or their active nest contents.

Therefore, an individual or entity may destroy an active nest while conducting any activity where the intent of the action is not to kill migratory birds or destroy their nests or contents. However, because the MBTA specifically protects migratory bird nests, eggs, chicks, and adults from possession and transport without a permit, individuals and entities cannot, in most cases, take reasonable protective actions (such as removing eggs and chicks prior to nest destruction or relocating nests) without first obtaining authorization to do so.

Currently, there are two mechanisms explained in Policy #2 and Policy #3 below for the temporary possession and transport of healthy, unaffected birds for the purpose of removing them from imminent danger (i.e., immediate threat of mortality). Policy #2 explains in more detail the Service's Good Samaritan provision included in the Rehabilitation regulation (50 C.F.R. § 21.31(a)). Policy #3 outlines the permitting mechanism under the Special Purpose regulation (50 C.F.R. § 21.27) for active nest situations that fall outside the Good Samaritan provision.

POLICY:

1. Inactive Nest Destruction

A permit or other regulatory authorization is not required under the MBTA to destroy an inactive migratory bird nest[3], provided no possession occurs during or after the destruction. The MBTA does not authorize the Service to issue permits in situations where the prohibitions of the Act do not apply, such as the destruction of inactive nests.

The public should be made aware that, due to the biological and behavioral characteristics of some migratory bird species, destruction of their nests entails an elevated risk of unknowingly killing them. For example, it is difficult to detect whether or not the nest of a cavity-nesting species, such as a burrowing owl or a bank swallow, is active. Before destroying this type of nest, we recommend consulting with an expert (e.g., USDA-Wildlife Services, Wildlife Professionals, Environmental Consultants, or Rehabilitation experts) who can help determine nest activity.

[3] An inactive nest is one that is empty, contains non-viable eggs, or is being built but does not yet have an egg in the nest.

Inactive nests may be protected by federal statutes other than the MBTA, such as nests of bird species federally listed as threatened or endangered under the ESA as well as nests of bald eagles and golden eagles, which are protected under the Eagle Act. State, Tribal, and local laws may also protect inactive bird nests. The Service should make every effort to ensure awareness regarding these possible additional protections and should inform the public of factors that will help minimize the likelihood that bird deaths would occur should nests be destroyed (i.e., when active nesting season normally occurs).

2. Good Samaritan Provision

For active nests, an individual or entity whose activity unintentionally or incidentally destroys an active nest, or is likely to do so, may collect the eggs or chicks and temporarily possess them for the purposes of transport to a federally-permitted rehabilitator under the Good Samaritan authorization in the rehabilitation regulation (50 C.F.R. § 21.31(a)). This Good Samaritan provision states: *"*Any person who finds a sick, injured, or orphaned migratory bird may, without a permit, take possession of the bird in order to immediately transport it to a permitted rehabilitator*"* (50 C.F.R. § 21.31(a)). The Service interprets the definition of "finds" to include encountering birds that become sick, injured, or orphaned while conducting activities where the intention is not to kill migratory birds or destroy their nests. "Finds" also applies when a planned activity is likely to cause or is about to cause destruction of an active nest resulting in the death, injury, or orphaning of eggs or chicks because, if nest destruction is imminent, any egg or chick in that nest can be considered orphaned. The Good Samaritan provision applies to the landowner of where the action is taking place and anyone designated to act on their behalf (e.g., wildlife professionals, pest-control contractors, rehabilitators, etc.). The Good Samaritan provision does not apply to regularly re-occurring actions where a single entity purposefully removes nests (e.g., a company that needs to purposefully remove nests from electrical distribution poles). For these situations a permit is recommended (see #3 below).

If the landowner is not comfortable with collecting the eggs or chicks, they may designate someone else to conduct the work on their behalf. After the eggs or chicks are collected, a federally-permitted rehabilitator may accept them as orphaned birds, consistent with their rehabilitation permit. All requirements and conditions of a rehabilitation permit apply. Rehabilitators have discretion as to what they will and will not accept and to determine the fate of any eggs or chicks accepted, including euthanasia. If a rehabilitator is unavailable or will not accept the eggs or chicks, the landowner (or the person acting on their behalf) may take the eggs or chicks to a licensed veterinarian who may temporarily possess, transfer, or euthanize the eggs or chicks without a permit (50 C.F.R. § 21.12(c)).

The Service can provide contact information for federally-permitted rehabilitators. The Service does not maintain or provide information on contractors, such as wildlife professionals, contractors, or pest control companies. Finally, the Service will provide information for voluntary reporting of active nest destruction in our Injury and Mortality Reporting System.

3. Special Purpose Permits

Permits are required to relocate a nest rather than destroy it, as possession of any nest is prohibited under the MBTA without prior authorization. Permits may also be appropriate for entities with ongoing projects that regularly need to intentionally remove or destroy nests. In these cases, permits can authorize possession of nests for various purposes, including active and inactive nest relocation, collection of nest contents for humane disposal, a combination thereof, or other compelling justifications. The Service can issue Special Purpose permits (50 C.F.R. § 21.27) to individuals or entities in these situations. In the case of utilities, authorization to destroy or relocate active and inactive nests is covered by applying for a specific type of special purpose permit: Special Purpose – Utility (https://www.fws.gov/forms/3-200-81.pdf).

Biologically, the success of nest relocation varies widely based on a number of factors, such as the distance moved, the presence of chicks, the nesting substrate, and the tolerance of the species and individual birds. Service biologists can provide technical assistance as to whether or not nest relocation is likely to succeed. Nest relocation should only be recommended for consideration when likely to result in success or when there are no other viable alternatives to achieve a conservation outcome. Relocation permit conditions will include short-term monitoring requirements by the person doing the nest relocation to ensure adults return to attend to the nest and an alternative protocol in the event nest abandonment occurs (such as collection and transport to a rehabilitator or veterinarian for euthanasia).

4. Other Permits and Authorizations

Other situations where there is purposeful take of active nests may fall under different permit types or regulatory authorizations. The Service will advise when a different permit or authorization may be appropriate.

NOTICE OF TEMPORARY DISCHARGE

Santa Clara Valley Water District

for Water Utility Operation and Maintenance

Facility Name (origination of discharge: _____

Location of discharge: _____

Facility discharging to: _____

Name of person responsible for reporting/monitoring: _____

Type of water being discharged:

☐ Raw Water ☐ Treated Water (dechlorinated) ☐ Groundwater

Volume of water being discharged: _____ gallons

Date of discharge: _____

Time discharge began: _____ am/pm

Time discharge ended: _____ am/pm

Flow rate: _____ cfs

BMPS to be implemented during discharge (check and list all that apply):

☐ Erosion control (list BMPs used): _____

☐ Sediment control (list BMPs used): _____

☐ Turbidity monitoring (attach monitoring sheet) ☐ Dechlorination (attach monitoring sheet)

Explanation of discharge, discharge location, BMPs to be implemented, monitoring, etc.:

_____

_____

_____

_____

_____

_____

_____

MC12417

Appendix I
QUALIFIED CRITICAL PATH METHOD (CPM) SCHEDULER STATEMENT of EXPERIENCE

THIS SCHEDULERS STATEMENT FORM IS SUBMITTED AS PART OF THE SUBMITTAL DOCUMENTS REQUIRED IN ARTICLE 5.06. CONFIRMING – SCHEDULERS QUALIFICATIONS IN PERFORMING CRITICAL PATH METHOD (CPM) SCHEDULING WORK.

If Contractor will be performing CPM scheduling work with its own forces, the Contractor shall complete the applicable portions of this form, specifically General items B and F and all of the project-specific items. If Contractor will be performing the CPM scheduling work with its own forces, references in this form to "CPM Scheduling, Subcontractor" or "Subcontractor" shall be understood to mean "Contractor."

The Contractor authorizes the District to use the information provided on this form and/or obtained from the Owners listed below to evaluate the Contractor's CPM Scheduling Subcontractor's or the contractors named Scheduler, as applicable experience and qualifications.

The Contractor shall not add, delete or change CPM Scheduling Subcontractor or Contractor's named Scheduler, as applicable, following the submittal of this information to the Engineer, without advance written authorization by the Engineer.

Engineer reserves the right to not consent to Contractor's request to add, delete or change CPM Scheduling Subcontractor or Contractor's submitted Scheduler, as applicable, for any reason including, but not limited to, the failure of the contractor's proposed replacement to meet the minimum experience requirements specified in Article 5.05. of these Specifications.

I. **General** (Contractor: Provide Sub Contractor information if Subcontractor is used).

A. Name of CPM Scheduling Subcontractor: _____

B. Name of CPM Scheduling Subcontractor's Scheduler: _____

C. CPM Scheduling Subcontractor has been engaged in the CPM scheduling business, under its present business name for _____ years.

D. Other Scheduling Subcontractor's experience in the type of scheduling work specified in Article 5.06., extends over a period of _____ years.

E. CPM Scheduling Subcontractor's Scheduler's experience in the type of scheduling work specified in Article 5.06. extends over a period of _____ years.

F. CPM Scheduling Subcontractors has never been disqualified or otherwise prevented from providing CPM Scheduling services on a project funded by an agency of the Federal

government, any State, or any local agency, except as follows:_____

_____

_____

(List any exceptions and reason therefor. Use attachments, if necessary).

G. CPM Scheduling Subcontractor has never failed to satisfactorily complete a CPM scheduling contract except as follows:

_____

_____

_____

(List any exceptions and reason therefor. Use attachments, if necessary). If no exceptions state, none).

2. Project Specific Experience:

A. Type of work: WATER TREATMENT PLANT CONSTRUCTION_____

B. YEAR PROJECT COMPLETED:_____

C TOTAL CONTRACT AMOUNT: $_____

D. PROJECT NAME AND LOCATION: _____

E. NAME OF PROJECT OWNER: _____

F. PERSON TO CONTACT: _____

G. NAME: _____

H. TELEPHONE: ( )_____

CPM Scheduling Subcontractor shall provide the following information for the contract listed above. Attach additional pages as required.

3. Project Specific Experience Performance Questions:

A. Did the contract documents for the project specify that the Owner would approve the CPM schedule? (Circle one) YES NO

B. Did the Owner, in fact, approve the Baseline CPM Schedule and subsequent CPM schedule updates? (Circle one) YES NO

C. If the answer to question No. 2 is YES, how long did it take the Contractor and Owner to agree on the Baseline Schedule and subsequent CPM schedule updates?

_____.

D If the answer to question No. 2 is NO, how were the work activities planned and tracked if the Baseline schedule and CPM schedule updates were not approved by the Owner?

_____

E. Was the CPM schedule used to analyze time delays to the construction schedule?

(Circle one) YES NO

F. Were the Contractor and Owner able to agree on time delays using the CPM scheduling method? (Circle one) YES NO

G. If the answer to question No. 6 is NO, provide an explanation.

_____
_____
_____

4. Project Specific Experience:

A. Type of work: WATER TREATMENT PLANT CONSTRUCTION

B. YEAR PROJECT COMPLETED: _____

C TOTAL CONTRACT AMOUNT: $ _____

D. PROJECT NAME AND LOCATION: _____

E. NAME OF PROJECT OWNER: _____

F. PERSON TO CONTACT: _____

G. NAME: _____

H. TELEPHONE: ( ) _____

CPM Scheduling Subcontractor shall provide the following information for the contract listed above. Attach additional pages as required.

Appendix I
QUALIFIED CRITICAL PATH METHOD (CPM) SCHEDULER
STATEMENT of EXPERIENCE

5. Project Specific Experience Performance Questions:

A. Did the contract documents for the project specify that the Owner would approve the CPM schedule? (Circle one) YES NO

B. Did the Owner, in fact, approve the Baseline CPM Schedule and subsequent CPM schedule updates? (Circle one) YES NO

C. If the answer to question No. 2 is YES, how long did it take the Contractor and Owner to agree on the Baseline Schedule and subsequent CPM schedule updates?

_____.

D If the answer to question No. 2 is NO, how were the work activities planned and tracked if the Baseline schedule and CPM schedule updates were not approved by the Owner?

_____

E. Was the CPM schedule used to analyze time delays to the construction schedule?

(Circle one) YES NO

F. Were the Contractor and Owner able to agree on time delays using the CPM scheduling method? (Circle one) YES NO

G. If the answer to question No. 6 is NO, provide an explanation.

_____

_____

_____

6. Other Information

A. If none of the referenced projects listed in items 2 and 4, did CPM Scheduling Subcontractor file claims against the Project Owner(s) which led to litigation, except as follows:

Appendix I
QUALIFIED CRITICAL PATH METHOD (CPM) SCHEDULER
STATEMENT of EXPERIENCE

_____

_____

_____

(Describe any such claims and the name of the case, the court in which it was filed, and the action or docket number of the lawsuit).

B. The CPM Scheduling Subcontractor is not a defendant in any criminal legal action at present, except as follows:

_____

(Provide name of case, court in which it is pending and action and docket number).

C. The answers and information provided in this form are correct and complete to the best of my knowledge and belief.

Name of CPM Scheduling Subcontractor:

By:_____ Date: _____
Signature

Name:_____
Print

Title: _____

Valley Water

SANTA CLARA VALLEY WATER DISTRICT
NON-DISCLOSURE AGREEMENT

This Agreement is between the Santa Clara Valley Water Valley Water (hereinafter "Valley Water"), and ("Receiving Party") identified as:

_____
(Full exact legal name -- whether corporation, LLC, partnership, individual natural person.)

_____
(Street Address, City, State, Zip, Country)

Now, in consideration of the mutual covenants herein contained, Valley Water and Receiving Party agree as follows:

1. **Purpose**. This Agreement is to protect Valley Water from the misuse or disclosure of Valley Water confidential or proprietary information that is disclosed in connection with Receiving Party performing work for the Valley Water.

2. **Confidential Information:** Valley Water confidential information includes the following:

   A. **Information Technology Data and Information,** including but not limited to, proprietary, internally-developed Valley Water computer models and algorithms, rule curves, and programs, non-public network and system information, District software code, licensed computer software and other information technology programs, apps, or customized hardware or software, licensed or purchased third-party data and information maintained on Valley Water servers or computers.

   B. **Employee Personnel Information**, including but not limited to, employees' personnel files (including but not limited to performance reviews and/or disciplinary information), spouse and family information or other emergency contact person information, home addresses, Social Security Numbers, telephone numbers, personal email addresses, driver's license information, tax withholding information, resumes, job application, etc.

   C. **Critical Infrastructure or Sensitive Security Information**, such as detailed designs, specifications, vulnerability assessments, and location information concerning dams, water treatment or purification plants, pipelines, etc. This includes information that is not customarily in the public domain and relates to the security of critical infrastructure or protected systems and includes information regarding systems, facilities, or operational security, or that is proprietary, business sensitive, or which might be used to plan or carry out a terrorist attack. Sensitive security information includes information about security, protocols, operations, facilities or other assets or capital projects whose disclosure would be detrimental to the security of Valley Water's employees or patrons, or would invade an individual's privacy, or reveal trade secrets or privileged or confidential information.

   D. **Utility Usage Records** and non-public financial information of any District customer or client.

   E. **Information Designated or Communicated as Confidential,** meaning all information that Valley Water protects against unrestricted disclosure to others and which: (i) if in written or other tangible form, is clearly designated as "Confidential" or "Proprietary"; and (ii) if disclosed orally, is designated to be "Confidential" at the time of its disclosure or which under the circumstances surrounding disclosure ought to be treated as confidential. By way of illustration, but not limitation, confidential information may include equipment, products, inventions, concepts, designs, drawings, schematics, plans, production specifications, source code, libraries, agents, applets, script, Javascript, object classes, software architecture, object code, flowcharts, source listings, software-related documentation, databases, structures, formulas, algorithms, techniques, processes, circuits, computer disks or tapes whether machine or user readable, market data, financial information, data regarding suppliers and customers, and confidential information received from third parties. Such confidential information shall include all copies, reproductions, photographs, images, records, and extracts thereof, as well as all notes and summaries prepared by the Receiving Party from Information of the Disclosing Party which is Confidential Information.

Valley Water

SANTA CLARA VALLEY WATER DISTRICT
NON-DISCLOSURE AGREEMENT

F. **Other**. To the extent not already listed or described above, Valley Water also designates the following information as confidential information protected by this agreement: _____.

The information described above is hereinafter referred to as "Confidential Information."

3. **Exclusions/Not Confidential Information**. This Agreement does not apply to any information that: (a) was in Receiving Party's possession or was known to Receiving Party without an obligation to keep it confidential, before such information was disclosed to Receiving Party by Valley Water; (b) is or becomes public knowledge through a source other than Receiving Party and through no fault of Receiving Party; or (c) is disclosed by Receiving Party with Valley Water's prior written approval.

4. **Restrictions on Use of Confidential Information.** Receiving Party shall not directly or indirectly disclose, display, provide, transfer or otherwise make available any Confidential Information to any third party. In addition, Receiving Party shall not directly or indirectly disclose, display, provide, transfer or otherwise make available any Confidential Information to any other person, including to its own employees, consultants and/or independent contractors or subcontractors, unless: (a) such employee, consultant or contractor has a need to know such Confidential Information in order to perform work for Valley Water; *and* (b) such employee, consultant or contractor has signed the attached Personal Agreement to be Bound By Valley Water NDA (Attachment 1 hereto). Once any employee, subconsultant or subcontractor has signed Attachment 1, Receiving Party shall promptly provide Valley Water with an executed copy of such document. Except as specified above, Receiving Party may not disclose any Confidential Information to any person or business entity. Receiving Party shall not make copies of Confidential Information or any portion thereof, including electronic copies. Receiving Party acknowledges that Confidential Information may be utilized only in accordance with providing services to Valley Water.

5. **Safeguarding of Confidential Information**. Receiving party shall take all necessary measures to ensure that any Confidential Information it receives is maintained as confidential and safeguarded from unauthorized copying or distribution. Receiving Party shall encrypt or password-protect all Confidential Information that is electronic data, and store hard copies in a locked secure location. Receiving Party agrees that it shall treat all Confidential Information with at least the same degree of care as it accords its own confidential information, but not less than a reasonable degree of care.

6. **Confidential Information Property of Valley Water**. All Confidential Information delivered pursuant to this Agreement shall be and remain the property of Valley Water. Nothing herein shall be construed as granting or conferring any rights by license or otherwise, express or implied, regarding any idea made, conceived or acquired prior to or after the Effective Date, nor as granting any right with respect to the use or marketing of any product or service. The Parties shall use the Confidential Information only for the Business Relationship.

7. **Violation of Agreement**. Receiving Party acknowledges that Valley Water, because of the unique nature of the Confidential Information, would suffer irreparable harm in the event that Receiving Party breaches its obligation under this Agreement in that monetary damages would be inadequate to compensate Valley Water for such breach. Receiving Party agrees that in such circumstances, Valley Water shall be entitled, in addition to monetary relief, to injunctive relief as may be necessary to restrain any continuing or further breach by Receiving Party, without showing or approving any actual damages sustained by Valley Water. In the event either Party is required to enforce this Agreement through legal action, the prevailing party will be entitled to recover from the other Party all costs incurred thereby, including without limitation, reasonable attorney's fees.

8. **Indemnification**. Receiving Party agrees to indemnify Valley Water against any and all losses, damages, claims or expenses incurred or suffered by Valley Water as a result of Receiving Party's breach of this Agreement.

9. **Return or Destruction of Confidential Information**. Receiving Party shall promptly, upon request, return to Valley Water, or, at Valley Water's option, destroy, any documents or media containing or reflecting Confidential Information, and all copies thereof. Receiving Party agrees to erase, delete or destroy any notes, documents, magnetic media, or other computer storage, including system backups that contain any

Valley Water

SANTA CLARA VALLEY WATER DISTRICT NON-DISCLOSURE AGREEMENT

Confidential Information copies or derived from the Confidential Information. Receiving party shall provide written verification to Valley Water of such destruction. The obligation to return or, upon request, destroy Confidential Information shall survive the completion or abandonment of the business relationship and remain binding for a period of one (1) year after such completion or abandonment.

10. **Notice of Disclosure**. Receiving Party shall notify Valley Water within 24-hours of any unauthorized disclosure, loss of Confidential Information and shall further take all reasonable steps to retrieve and prevent further unauthorized disclosure of such proprietary information. Such disclosure of a loss shall in no way limit Valley Water's remedies under this Agreement including, but not limited to, immediate injunctive relief. Notwithstanding the foregoing, nothing herein shall restrict the right of Receiving Party to disclose such Confidential Information that is disclosed pursuant to a judicial order, but only to the extent so ordered, provided, however, that Receiving Party receiving such order shall notify Valley Water of such order in sufficient time to permit Valley Water to intervene in response to such order and provided that the confidential or proprietary markings remain on the information disclosed.

11. General

11.1 **Entire Agreement**. This Agreement sets forth the entire understanding and agreement between the parties hereto as to the subject matter of this Agreement and supersedes any previous communications, negotiations, warranties, representations, and prior non-disclosure agreements, either oral or written, with respect toobligations of confidentiality of the subject matter hereof, and no addition or modification of this Agreement shall be binding on either party hereto unless reduced to writing and duly executed by each of the parties hereto.

11.2 **Applicable Law/Disputes**. This Agreement is governed by the laws of the State of California. In any dispute arising out of this Agreement, the parties hereby consent to personal and exclusive jurisdiction and venue in the State and Federal Courts in Santa Clara County, California.

11.3 **Survival of Receiving Party's Obligations**. All obligations of Receiving Party under this Agreement shall survive the return of the Confidential Information and termination of this Agreement.

11.4 **Authority**. The undersigned individuals represent that they have the authority to enter into and bind the parties to this Agreement.

RECEIVING PARTY:	**SANTA CLARA VALLEY WATER DISTRICT**:
By: _____ (Signature)	**By**: _____ (Signature)
Name: _____ (Printed)	**Name**: _____ (Printed)
Title: _____	**Title**: _____
Date: _____	**Date**: _____

Valley Water

PERSONAL AGREEMENT TO BE BOUND BY VALLEY WATER NDA

(Attachment One to the Santa Clara Valley Water District Non-Disclosure Agreement)

I acknowledge that I have read and understood, and agree to be bound by, the attached Santa Clara Valley Water Valley Water Non-Disclosure Agreement ("NDA") entered into between the Santa Clara Valley Water District ("Valley Water") and _____ ("Receiving Party") ("NDA").

I acknowledge that Valley Water may make available to me from time to time certain information that is highly confidential to Valley Water, as defined in the attached NDA ("Confidential Information"). I acknowledge that such information is sensitive and agree that I will not disclose this Confidential Information to any person, firm, corporation, association, or partnership without the express written permission of Valley Water, including other employees, consultants or independent contractors or subcontractors of Receiving Party that do not have a need to know such information.

I will at all times hold all of Valley Water's Confidential Information in trust and in the strictest confidence. This obligation shall continue after any and all business engagement(s) working with Valley Water has ended. I will prevent the impermissible release of Valley Water's Confidential Information. I will neither copy, retain nor incorporate any Confidential Information into any database or any medium other than as may be required for Valley Water's exclusive benefit. I will not duplicate or disclose or otherwise reveal such Confidential Information in any manner inconsistent with the NDA.

I will not perform any illegal acts with respect to the Confidential Information, and I will not share the password or account access provided exclusively to me. When leaving a workstation unattended, or out of sight, I will save my work and log off or lock the workstation to prevent unauthorized access. I will make no attempt to circumvent access codes or information protection schemes or uncover security loopholes or attempt to break authentication procedures or encryption protocols. I will make no attempts to increase the level of access to which I have been authorized. I will not attempt to use or obtain access codes in an unauthorized manner or from another user. I will not allow non-employees to access Valley Water computer systems.

I acknowledge that my faithful compliance with this NDA is necessary to protect Valley Water and that any action on my part that is inconsistent with this NDA will cause Valley Water irreparable and continuing harm. If I violate this NDA, I understand and agree that Valley Water may take action against me personally, including but not limited to, instituting a legal proceeding and seeking any court relief.

PLEASE COMPLETE THE FOLLOWING SECTION (PLEASE PRINT):

Full Name:	
Receiving Person's Name:	
Receiving Person's Employer, Agent or Contractor:	
Phone No.:	Fax No.:
Email Address:	
What District units/department(s) do you work with?	
Signature:	Date:

1. PURPOSE AND SCOPE

This defines District policies and procedures for pesticide approval, purchasing, acquisition, handling, use, storage, transportation, disposal, and reporting in a manner consistent with all Districts' permits, the California Environmental Quality Act (CEQA), and the California Department of Pesticide Regulation. These policies and procedures do not replace the need for regulatory permits and only apply to District work activities once these permits are in place.

These policies and procedures apply to all District-owned or operated facilities and staff, contractors, permittees, and suppliers. The District goal is to minimize the environmental risk and exposure resulting from its pesticide use by employing Best Management Practices (BMPs) and alternatives to their use to the maximum extent practicable and to facilitate the safe use of pesticide by qualified staff and contractors.

2. POLICY

1. Only pesticides included on W751D01 Pesticides Products Approved for District Use (Product List) are allowed to be used, in the appropriate categories for product application on District facilities.

   1.1. District staff is prohibited from purchasing over the counter pesticides

   1.2. The product lists will be updated, as needed, by the Pesticide Review Team to ensure compliance with these practices.

   1.3. All pesticide products not on the approved list that are desired to be used on District facilities (by employees, contractors, or permittees) will need first to be reviewed and approved by the Pesticide Review Team (PRT) prior to their use in accordance with Section 8 of this document and be verified as being in accordance with any relevant regulatory agency review.

2. **State-certified Qualified Applicator** (see definition in Section 4) with the appropriate current certification categories must be onsite for entire application of all pesticides.

3. Products listed on the State Department of Pesticide Regulation (DPR) "A" list of known groundwater contaminants will not be used. Detailed information on DPR regulations can be found on their web site at http://www.cdpr.ca.gov/docs/legbills/calcode/040101.htm#a6800

4. Category I and II pesticides will not be used for routine projects without prior review and approval by the Pesticide Review Team and per regulatory authorizations.

5. To minimize the use of pesticides in the work place, pesticides derived from non-toxic natural ingredients should be used as repellants when appropriate.

6. Insecticides are used after other methods, such as prevention or natural nontoxic control methods, have been shown to be ineffective in similar situations. Where use is needed, the product with the lowest toxicity is used in accordance with the manufacturer's label.

7. Herbicides are used only when alternatives use such as mowing, hand removal, disking, or grazing, has been shown to be ineffective or inefficient to meet the needs and requirements of this program.

   7.1. No herbicide shall be used by District staff without a written recommendation from a Pest Control Advisor in accordance with State Department of Pesticide Regulation (DPR) www.cdpr.ca.gov

8. Rodenticides are used only after trapping to control burrowing rodents has been shown to be ineffective in similar situations or deemed impractical, unless regulatory permits are required.

9. Pesticides containing the following are prohibited without exception:
   9.1. Copper based products on or around any body of water.
   9.2. Organophosphate or Carbamate products.

3. REFERENCE DOCUMENTS

External Reference Documents

REFERENCE DOCUMENT	DOCUMENT LOCATION(S)
State Department of Pesticide Regulation (DPR)	www.cdpr.ca.gov http://www.cdpr.ca.gov/docs/dept/quicklinks/compliance/lawsregs.htm
State Department of Pesticide Regulation (DPR) - pesticides that are known to cause groundwater contamination	http://www.cdpr.ca.gov/docs/legbills/calcode/040101.htm#a6800
State Department of Pesticide Regulation (DPR) - Keeping Pesticides Out Of Floodwaters – Container Labeling	http://www.cdpr.ca.gov/docs/pressrls/archive/1998/980213.htm
California Environmental Quality Act (CEQA)	http://ceres.ca.gov/ceqa/
California Food and Agricultural Code for Non-Production Agricultural Use	http://www.cdfa.ca.gov/phpps/LBAMeir/CH%207_Public%20Svcs%20&%20Haz%20Resp.pdf http://www.cdpr.ca.gov/docs/enforce/bulletins/ag_nonag.pdf
State Department of Fish and Game Code relative to stream alterations	http://www.dfg.ca.gov/habcon/1600/
Environmental Protection Agency regulations	http://www.epa.gov/pesticides/regulating/laws.htm http://www.epa.gov/pesticides/regulating/containers.htm
Spill Cleanup on The Pesticide Environmental Stewardship (PES) website supported by Center for Integrated Pest Management	http://pesticidestewardship.org/spill/Pages/SpillCleanup.aspx

Internal Reference Documents

REFERENCE DOCUMENT	DOCUMENT LOCATION(S)
Q520D01 Environmental Management System Environmental Planning	District QEMS
Q741D03 Procurement of General Services	District QEMS
Q830D01 HAZMAT Emergency Response Procedures	District QEMS
W751M01 Best Management Practices (BMP) Handbook	District QEMS
W640D07 Contractor Safety Program	District QEMS
W640D36 Chemical Purchasing	District QEMS
W640D23 Personal Protective Equipment	District QEMS

REFERENCE DOCUMENT	DOCUMENT LOCATION(S)
W751D01 Pesticides Products Approved for District Use	District QEMS
F751D01 Pest Control Recommendation & Spray Operators Report	District QEMS
WQ75101 Field Operations Work Order Process	District QEMS - Watersheds
WQ75103 Review of Community Projects	District QEMS - Watersheds
Pesticide Safety Training Record	Process Owner Files
SMP BMPs (Modified by Permit Conditions)	
National Pollutant Discharge Elimination System (NPDES) permit requirements	
Countywide Urban Runoff permit requirements	

4. DEFINITIONS

Integrated Pest Management – Integrated pest management (IPM), is a process that is used at the Santa Clara Valley Water District (District) to solve pest problems through a combination of techniques such as biological control, cultural controls, mechanical and physical controls, and chemical control while minimizing risks to people and the environment. IPM is practiced at the District to manage a variety of pests such as algae, weeds, and squirrels.

Permitting – The process to acquire regulatory permits from state and federal agencies that have legal jurisdiction with the application of pesticides. Permitting and receiving permits allows the District to legally apply pesticides per the directives in the permits. An environmental planner needs to be engaged to discuss the potential permitting issues.

Pest Control Advisor (PCA) – As defined by the State of California, the Pest Control Advisor is an individual who meets the minimum educational requirements to qualify for examination and who passes the State examination in the categories relative to the area of pesticide work for which they will be making written recommendations for pesticide use. Categories relative to this policy include: Insects, Mites and Other Invertebrates, Vertebrate Pests, and Weeds. The licensed Pest Control Advisor is the authority making written recommendations for pesticide use.

Pest Control Operator (PCO) – The Pest Control Operator possesses a valid Qualified Applicator License from the State of California, supervises the pesticide application (restricted use and/or general use) made by a licensed pest control business, and is responsible for the safe and legal operation of that business relative to pesticide use.

Pesticide – A product formulated specifically for the purpose of controlling pests. The generic term "pesticide" refers to a broad spectrum of products, including herbicides, insecticides, algaecide, rodenticides, etc. The following pesticides are used by the District:

- **Algaecide** – Algae control in percolation ponds.
- **Fungicides** – Chemical that controls fungi. The District does not use fungicides
- **Herbicides** – Control of weeds and undesirable vegetation to minimize fire hazards, control invasive species, maintains flood conveyance of waterways, and complies with State and Federal requirements.

- **Insecticides** – Control of insects in and around District buildings or worksites, or in the case of a serious pest outbreak,

- **Rodenticides** – Control of rodents on flood control levees, dams, and other facilities.

Pesticide Review Team (PRT) –is a five member committee consisting of the following functional roles: District PCA, Health and Safety Program Administrator, Watershed Biologist, Water Utility Support Program Administrator, and Facilities Maintenance Administrator.

Product Lists – W751D01 Pesticides Products Approved for District Use approved by Pesticide Review Team

Qualified Applicator – As defined by the State of California is an individual who has passed the State examination for application of various pesticide products and is certified to do so. A Qualified Applicator must be certified in the appropriate certification categories to perform the pesticide application. Categories relative to this policy include: Landscape Maintenance, Right of Way, Aquatic, and Residential, Industrial and Institutional.

Toxicity – The Environmental Protection Agency and the State Department of Pesticide Regulation define pesticides in the following categories:

- **Category I** – highest pesticide toxicity, or poses specific health hazards such as a severe eye hazard.
  - Signal Word(s) - ***Danger/Poison; Skull & Crossbones***

- **Category II** – Moderate toxicity pesticides 1-10 times less toxic than Category I.
  - Signal word ***- Warning***

- **Categories III and IV** – least toxic, 1-10 times less toxic than Category II, and Category IV is considered practically non-toxic.
  - Signal word – **Caution**

5. ROLES AND RESPONSIBILITIES

District's Pest Control Adviser (PCA): Is responsible for coordinating, reviewing, tracking, documenting and reporting pest control practices at the District. Additionally, the PCA provides updates on policy changes and modifications to all District staff. The PCA works with the Watersheds Environmental Health and Safety Program Administrator on the aspects of employee training. This role is filled by the Vegetation Program Senior Field Operations Administrators and the Vegetation Program Specialist II's in the Vegetation Management Unit.

Pesticide Policy Process Owner: Is responsible for resolving any issues with related pesticide use that could not be resolved by working with the PRT and Management. This role is filled by the Vegetation Unit Manager.

Pesticide Review Team (PRT): The purpose of this operational team is to oversee compliance to the pesticide program. The team will also be responsible for meeting on an as needed basis to determine the following:~~Meeting annually and as-needed which will be decided by the Team~~

- Evaluating the District's pesticide use
- Revision, as needed, of the Pesticides Products Approved for District Use list.

- Responding to issues relative to the use of pesticides
- Recommending changes to the pesticide program including training and procedures
- Reviewing, evaluating, and approving the use of new products including those to be used by contractors and permittees. These approvals do not override the legal requirements for CEQA compliance
- Researching alternatives to pesticides using staff and consultant services

Unit Manager of Units with Oversight of the Use of Pesticides - these units include, but are not limited to: Vegetation Management Unit, Facilities, Watershed Field Operations Units, Water Utility Raw Water Field Operations and Pipeline Maintenance Unit, and Watershed Stream Stewardship

- Provide training on pesticide use, MSDS labeling, and BMPs relating to pesticide use
- Maintaining original training records in accordance with District Record Retention Policy
- Sending copies of training records to the Training Unit

Unit Manager with Oversight of Pesticide Contractors – these units include: Vegetation Management Unit, Facilities, and Watershed Stream Stewardship are responsible for

- Ensuring that any contracts involving pesticides comply with this document and contain all project specific requests, restrictions, and BMPs for limitation on pesticide use prior to signing contract
- Ensuring that any contractors using pesticides have immediate oversight by a State-Certified Qualified Applicator
- Oversight of the pesticide contractor from the time the contract is in effect to the end of the contract service
- Training contractors on District BMPs, District Environmental Management System including Policy and aspects, Pesticide Policies (this document), and W751D01 Pesticide Products Approved for District Use
- Acquiring the appropriate approvals, permits, any environmental reviews, biological surveys, and clearances before beginning work
- Providing a report after the use of pesticides back to the Vegetation Management Unit Manager with the exact names of pesticides applied and the amounts used

Qualified Applicator* – Is responsible for:

- Being certified by the State of California with the appropriate certification categories (see definition, section 4)
- Annual training of District BMPs, Pesticide Policies (this document), and W751D01 Pesticide Products Approved for District Use.
- Must be onsite for entire application “immediate oversight” of all pesticide use.
- Responsible for the storage, handling, transportation, labeling, disposal, and clean up of spills according to State Department of Pesticide Regulation, District standards, and Hazardous Materials regulations.
- Posting on the project site and notifying the appropriate parties of the pesticide use
- Completing a Spray Operators Report (F751D01) for each pesticide application and then submitting report to the appropriate review body of by the applicable due dates.
  *The following classifications in Unit 295 are required to be Qualified Applicators:
  - Maintenance Worker Series (MW II, III, Senior)
  - Senior Field Operations Administrators
  - Vegetation Program Specialists
  - Vegetation Unit Manager

Vegetation Unit Manager:

- Is the Pesticide Policy Process Owner
- Is responsible for resolving any issues with related pesticide use that could not be resolved by working with the PRT and Management.
- Is responsible for monthly reporting to the Agricultural Commissioner

6. REQUIREMENTS

6.1 ISO Requirements

- **ISO 9001 Quality Management System Requirements**
  - 7.5.1 Control of Production and Service Provision
- **ISO 14001 Environmental Management System**
  - 4.4.6 Operational Control

6.2 Other Requirements

- California Environmental Quality Act (CEQA) and other applicable Federal and State Regulations
- Board Governance Policies and Executive Limitations
- Best Management Practices of the various environmental documents covering the District's work on streams, water utility facilities, buildings, and grounds

7. MONITORING AND MEASUREMENT

The Pesticide Review Team will review and report on this process annually.

8. PROCEDURE

ACTION STATEMENT & ROLE	DETAILS (DESCRIBE STEPS)	QUALITY RECORDS (OUTPUT FROM STEP)
(1) Review of Pesticide Use (Pesticide Review Team)	• The Team will meet annually in January and as-needed to: ○ Evaluate the District's pesticide use. ○ Revise, as needed, the W751D01 Pesticide Products Approved for District Use list. ○ Respond to requests to add pesticides to W751D01 Pesticide Products Approved for District Use list. ○ Respond to issues relative to the use of pesticides. ○ Recommend changes to the pesticide program including training and procedures. ○ Review, evaluate, and approve the use of new products including those to be used by contractors and permittees. ○ Research alternatives to pesticides. • W751D01 Pesticide Products Approved for District Use will be released in accordance with Q423D01 District Document Control Process ○ Release announcement will be sent to all District Staff	W751D01 Pesticide Products Approved for District Use

ACTION STATEMENT & ROLE	DETAILS (DESCRIBE STEPS)	QUALITY RECORDS (OUTPUT FROM STEP)
(2) Purchase of Pesticides (District Staff)	• District Staff is prohibited from purchasing pesticides over the counter, as these are designated for home use only • See W751D01 Pesticide Products Approved for District Use for acquiring pesticides • If a pesticide is not listed on W751D01 Pesticide Products Approved for District Use, a request may be made to the PRT ○ Send the request through Access Valley Water to PCA ○ PCA will review the request and forward to PRT ○ Requestor will be notified of decision	Request using Access Valley Water
(3) Certification Requirements for Using Pesticides (District Staff, Contractors, Permittees)	• All applicable District staff, contractors, and permittees shall provide proof of State Certification performing pesticide applications. • As defined by the State of California, **State-certified Qualified Applicator** is an individual who has passed the State examination for application of various pesticide categories and is certified to do so. Categories relative to this policy include: Landscape Maintenance, Right of Way, Aquatic, and Residential, Industrial and Institutional. • Any pesticide use by District Staff, contractors, or permittees in the course of District business must be done with immediate oversight by a **State-certified Qualified Applicator with the appropriate certification categories**. ○ Only pesticides listed on W751D01 Pesticide Products Approved for District Use list can be used. • There is an exemption of Aerosol for Yellow Jackets and Spiders. See step 8.	Contractors and Permittee Proof of State Certification
(4) Pesticide Use with Permits, Agreements, or Licenses (Community Review Projects Unit (CPRU))	• Permits, agreements, and licenses will be issued by CPRU in accordance with WQ75103 Review of Community Projects. CPRU will work with Vegetation Management Unit on any pesticide request. ○ Any pesticide use by District Staff, contractors, or permittees in the course of District business must be done with immediate oversight by a **State-certified Qualified Applicator with the appropriate certification categories**. • Only pesticides listed on W751D01 Pesticide Products Approved for District Use list can be used. • If a pesticide is not listed on W751D01 Pesticide Products Approved for District Use, CPRU can make a request to add the product to the PRT by sending the request to the PCA using Access Valley Water	

ACTION STATEMENT & ROLE	DETAILS (DESCRIBE STEPS)	QUALITY RECORDS (OUTPUT FROM STEP)

(5) Training Requirements for Using Pesticides
 	
(Unit Managers of units who use or oversee the use of Pesticides)
	• All Unit Managers of units who use or oversee the use of pesticides will provide trainings on pesticide, MSDS labeling, and BMPs for any staff that use or oversee the use of pesticide in the course of their duties.
	  ○ Optionally, Unit Managers can contract Process Owner for training or alternatives.
	
	• The training shall include:
	  ○ Review of laws and regulations
	  ○ Updates on new products
	  ○ Pesticide Policies (this document)
	  ○ W751D01 Pesticide Products Approved for District Use
	  ○ Review of proper procedures for use and handling
	  ○ Review of W640D23 Personal Protective Equipment
	  ○ Review of impacts of pesticides on the environment
	  ○ Label/MSDS training – Proper reading and use
	  ○ Impacts of pesticides on the environment
	  ○ Updates on project-specific operating procedures and BMPs
	  ○ Process for identifying and responding to potential secondary impacts (carcass discovery)
	  ○ Proper emergency response procedure for accidental ingesting or spilling of pesticides
	
	• The Unit Manager providing the training is responsible for maintaining the original training records and for providing a copy to the Training & Employee Development Unit for entry into the Training Wizard
		Staff Training Records

(6) Contractor Pesticide Use (i.e. landscape, rodent control)
 	
(Unit Manager requesting contracting services)
	• The selection of contractors who use pesticides in the course of the contract will be in accordance with Q741D03 Procurement of General Services, W640D07 Contractor Safety Program, and this document.
	
	• RFP package includes the requirement that only **State-certified Qualified Applicator** with the appropriate current certification categories will provide immediate oversight for application of all pesticides.
	
	• Per Q741D03 Procurement of General Services, Procurement will verify the contractor is a **State-certified Qualified Applicator** with the appropriate current certification categories will provide immediate oversight for application of all pesticides to be used within the contract
	
	• Unit Manager requesting the pesticide contracting services is responsible for:
	  ○ Oversight of the contract from the time the contract is in effect to the end of the contract service
	  ○ Training the contractor on:
		Contractor Training Records

ACTION STATEMENT & ROLE	DETAILS (DESCRIBE STEPS)	QUALITY RECORDS (OUTPUT FROM STEP)
	• The District's environmental policy, environmental management system, and the environmental aspects of the activities • District BMP's • Pesticide Policies (this document) • W751D01 Pesticide Products Approved for District Use • Safety training, see W640D07 Contractor Safety Program ○ Acquiring the appropriate approvals, permits, any environmental reviews, biological surveys, and clearances before beginning work ○ Providing an after use report with the exact pesticides used and amounts back the Vegetation Management Unit Manager within a week of application. This is necessary for tracking District pesticide use.	
(7) Processing Pesticide Use Recommendations for Internal Use (Pest Control Adviser (PCA))	• Staff pesticide requests are initiated, entered, and tracked in Maximo in accordance with WQ75101 Field Operations Work Order Process • The request will be evaluated for: ○ Any questions or issues will be resolved by the Pesticide Review Team ○ Environmental clearances and permits must be obtained, as required ○ Biological Survey and clearance must be obtained before proceeding with application of pesticides, when required by permit or regulation ○ BMPs must be followed • A proposed use is evaluated based on: ○ Regulatory restrictions including CEQA and BMPs ○ Anticipated effectiveness of the proposed methods ○ Public health aspects ○ Long and short term environmental impacts ○ Financial cost ○ Consistency with other District's policies • All herbicide use by District staff require a written recommendation from the PCA in accordance with State Department of Pesticide Regulation (DPR) www.cdpr.ca.gov • PCA develops a written Pest Control Recommendation (F751D01) for use in accordance with requirements of the California Food and Agricultural Code and forwards the request and recommendation to the Qualified Applicator.	F751D01 Pest Control Recommendation & Spray Operators Report

ACTION STATEMENT & ROLE	DETAILS (DESCRIBE STEPS)	QUALITY RECORDS (OUTPUT FROM STEP)
	• The Qualified Applicator reviews the request and recommendation and completes the work.	
(8) Use of Aerosols for Yellow Jackets and Spiders (Staff)	• District Staff is prohibited from purchasing pesticides over the counter as these are designated for home use only • Aerosols for yellow jackets and spiders can be obtained from PCA ○ Contact PCA via email and specify whether the use will be outdoors or indoors, date planned, and if training is needed. ○ Only employees that have been trained on the MSDS and label are allowed to use the aerosols for yellow jackets and spiders. Contact PCA for more details ○ Proper PPE (eye goggles and gloves) is required when handling these pesticides. ○ Aerosol cans will be individually issued. New cans can be issued only after empty cans are returned. • Reporting on the usage of the use of these pesticides: ○ Will be done after each can is emptied and returned to the PCA ○ Report will be submitted to the Agricultural Commissioner. See step 11 of this section.	Request
(9) Handling, Labeling, Storage, Disposal, Transportation, and Spills of Pesticides (Qualified Applicator)	• **Handling.** Mixing and loading should never be done without a full understanding of the pesticide label and with the use of all recommended personal protective equipment (PPEs-See W640D23 Personal Protective Equipment) The label will identify the dangers involved and the precautions to follow, may indicate the signs and symptoms of poisoning and recommend first aid practices, should one be exposed to the product. ○ Pesticide handling includes the following activities: • Mixing, loading transferring, applying or assisting with an application of pesticides, • Servicing, repairing or handling contaminated equipment, • Incorporating pesticides into soil or entering treated area during an application • **Labeling**. Containers containing pesticides will be labeled according to State Department of Pesticide Regulation (DPR) - Keeping Pesticides Out Of Floodwaters – Container Labeling http://www.cdpr.ca.gov/docs/pressrls/archive/1998/980213.htm ○ Each pesticide service container must be labeled with	

ACTION STATEMENT & ROLE	DETAILS (DESCRIBE STEPS)	QUALITY RECORDS (OUTPUT FROM STEP)
	1. Pesticide name 2. Signal word (Danger/Poison, Warning, or Caution) 3. Who the container belongs to (SCVWD) • **Storage.** Pesticides must be stored according to the properties set forth in the MSDS. See http://www.epa.gov/pesticides/regulating/containers.htm This includes: ○ Pesticides must be stored in labeled containers ○ Pesticides should be stored in a designated storage room that has secondary containment on earthquake secured shelves. ○ Pesticides should not be stored in a location that would expose them to direct sunlight. ○ **Disposal** of unused pesticides and associated containers will be handled in compliance with hazardous waste regulations ○ **Transportation** of Pesticides - ○ Never carry pesticides in the passenger compartment of any vehicle. ○ All pesticides containers should be secured in the cargo area of the vehicle. ○ Do not leave pesticides unattended in a vehicle unless they are inside a locked compartment. ○ A current inventory of all pesticides, along with MSDS's for each pesticide to be transported, should be available. ○ **Spills**. Any spilled pesticide will be cleaned up in accordance with Spill Cleanup on The Pesticide Environmental Stewardship (PES) website supported by Center for Integrated Pest Management (http://pesticidestewardship.org/spill/Pages/SpillCleanup.aspx) and Q830D01 HAZMAT Emergency Response Procedures	

(10) Posting, Notification, and Application of Pesticides
 	
(Qualified Applicator)
	• Posting of areas where pesticides are used shall be performed in compliance with this policy as follows:
	  • Posting shall be performed in compliance with the label requirements of the product being applied.
	  • In addition, the District shall provide posting for **any** products applied in areas used by the public for recreational purposes, or those areas readily accessible to the public, regardless of whether the label requires such notification. In doing this, the District ensures that exposure risk is minimized by adopting practices that go beyond the product label requirements.
	  • Sign postings shall include the date and time of application, the product's active ingredients, common name, and the time of allowable re-entry into the treated area. A District staff contact phone number shall be posted on the sign.
	  • Signs shall not be removed until after the end of the specified re-entry interval.
	  • Right-to-know literature on the product shall be made available upon request to anyone in the area of the application.
	
	• The District maintains records of neighbors with specific needs relative to notification prior to treatment of an adjacent area to ensure such needs are accommodated. These records are maintained in Maximo with the pest control recommendation.
	
	• A Spray Operators Report (F751D01) shall be completed for each pesticide application performed by District staff. This report shall be submitted with each daily work order in accordance with WQ75101 Field Operations Work Order Process and include:
	  • Pesticide common name and active ingredient
	  • Method of application
	  • Dilution rate, if applicable
	  • Total amount of product applied, **plus** the total amount of diluted material
	  • For outdoor applications, weather conditions, including temperature and wind speed
	  • Specific pests controlled with each application
	
	• Unit Managers overseeing pesticide contractors must supply a monthly use report with the exact pesticides used and amounts (Spray Operators Report) to the Vegetation Management Unit Manager by the 5th day of the following month. This is necessary for tracking all pesticide use on District facilities. The contractor's use report is an internal document only and will not be submitted to the Agricultural Commissioner.
		Pest Control Recommendation & Spray Operators Report
		
		Pesticide Contractor's Spray Operators Report

ACTION STATEMENT & ROLE	DETAILS (DESCRIBE STEPS)	QUALITY RECORDS (OUTPUT FROM STEP)
	• Contractor is responsible for submitting their monthly use report to the Agricultural commissioner in accordance with the State Certification requirements.	
(11)Reporting (Vegetation Unit Manager)	• A report will be run monthly from Maximo listing the total amount of products used for pest control including the common name. • This listing will be submitted to the Agricultural commissioner no later than the 10th day of each month.	Maximo Report Report send to Agricultural Commissioner

9. QUALITY RECORDS

QUALITY RECORD	LOCATION KEPT	FILING ORDER	RECORDS RETENTION SCHEDULE SERIES NO.	COMMENTS
Pesticide Products Approved for District Use List	District Document Control	Document ID	RS-0226	
Maximo Database Record (including reports)	Network Server	Work Order Number	RS-0052	
Pest Control Recommendation & Report	Work Order	Facility Number & Date	RS-0221	
Report send to Agricultural Commissioner	Process Owner Files	Date	RS-0026	
Original Training Records	Process Owner Files	Date	RS-0076	

10. CHANGE HISTORY

Date	Revision	Comments
02/10/10	A	Initial release into QEMS, effective 1/27/10. Supersedes Administrative Policy and Procedure Ad-8.2 Pesticide Use. This document was sent to be reviewed by: Bill Smith; Geoffrey Weigand; David Matthews; Marc Klemencic; Liang Lee; Mike Martin; Debra Caldon; Mike Cresap; Melanie Richardson (Maryann O'Brien); Ann Draper; Chris Elias; Jim Fiedler; Michael Hamer; Frank Maitski; and Neddal Ali-Adeeb.
04/29/11	B	Major rewrite of document. Document was sent for the first stakeholder review in September 2010 and a second stakeholder review in December 2010. Comments were provided by Michael Sanchez; Jennifer Castillo; David Dunlap; Joe Chavez; Jim Crowley; Jamie McLeod; David Matthews; Bill Smith; Kenneth McKenzie; John Chapman, Sunny Williams, Lisa Porcella, and Nina Merrill. A meeting with held with Larry Lopez, Geoffrey Weigand, Mike Cresap; and Tom Spada to collect comments. Stakeholder comments have been responded to and incorporated into the document where appropriate.
09/21/11	C	Minor editorial changes: incorporated W640D23 Personal Protective Equipment in Procedure Steps 5 and 9 and added a link to Spill Cleanup.
09/13/12	D	Minor editorial changes: added definition of IPM, corrections of spelling and language.
12/23/15	D	Minor editorial change: clarified roles and responsibilities of classifications in Unit 295 and requirements for Licensing and Certifications in the Unit

Date	Revision	Comments
11/17/17	D	Changed document ownership from Mark Wander to Jennifer Codianne.

11. ADDENDA

None