

TSSD WATER RECLAMATION FACILITY
Pleasant Grove, Utah

PROJECT MANUAL

FOR

TP-4 East Facility Utilities and Clarifiers Rehabilitation Project

BC PROJECT NO. 157492

PREPARED FOR

Timpanogos Special Service District Water Reclamation Facility
6400 North 5050 West
Utah County, Utah 84003

PREPARED BY

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VOLUME 1: BIDDING AND CONTRACTING REQUIREMENTS

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**TSSD WATER RECLAMATION FACILITY
6400 N. 5050 W., UTAH COUNTY, UT**

TP-4 EAST FACILITY UTILITIES AND CLARIFIERS REHABILITATION PROJECT

00 11 10

ADVERTISEMENT FOR BIDS

Sealed Bids for the construction of the **East Facility Utilities and Clarifiers Rehabilitation Project** will be received **from prequalified Bidders only**, by **Timpanogos Special Service District (TSSD), Water Reclamation Facility**, at the office of the **TSSD Water Reclamation Facility 6400 N., 5050 W. Utah County, UT 84003** until **2:00 p.m.** local time on **August 29, 2023**, at which time the Bids received will be **publicly** opened and read.

Site dewatering will be required for the east clarifier rehabilitation work. The Owner will drain and clean each clarifier prior to the start of the work. East facility secondary clarifier work is to include the demolition, removal, disposal, and replacement of all the internal carbon steel components at and below the waterline with new components. New skimmers and 4-foot scum beaches, weirs, baffles, and Stamford baffles are to be installed in the three clarifiers. The east clarifier drives are to be removed and replaced. The Contractor is to remove and replace the existing east clarifier walkways. The Contractor is to furnish and install new aluminum and stainless-steel launder covers on the three east clarifiers. Contractor is directed to the Bid Form and Technical Specs for bid alternatives related to materials for the clarifier equipment with one option being stainless and another alternative being carbon coated steel.

The east facility secondary clarifier splitter box work shall consist of the removal, replacement of the existing east clarifier gate operator pedestals and installation of Rotork electric actuators.

East facility electrical work is to consist of the installation of Rotork electric actuators and corresponding electrical service on the new clarifier splitter box gate pedestals. New lighting is to be installed on the top of the east clarifier splitter box. The lighting on the clarifier bridges is to be removed and reinstalled with walkway replacement. The electrical feeds to east clarifiers 1 and 3 are to be replaced. Sidewalks are to be replaced as noted on the plans as part of the electrical refeed work.

East facility pipe lining rehabilitation work is to be conducted on the 30-inch diameter RCP mixed liquor pipes associated with east clarifiers 1 and 2. East facility pipe point repair work is to be conducted on the 16-inch diameter DIP RAS pipe associated with east clarifier 3. Piping is to be investigated prior to work to confirm repair locations, procedure and repaired once the east clarifier center feed pipes have been removed. CCTV inspection video footage of these pipes is provided in the supplementary information.

Bids will be received for a single prime Contract. Bids shall be on a lump sum basis as indicated in the Bid Form.

The Issuing Office for the Bidding Documents is: **Brown and Caldwell, contact Roger Greve, 6975 Union Park Center, Suite 490, Midvale, UT 84047, phone: 410-733-1751 email: rgreve@brwnncald.com.**

Bidding Documents will be provided in electronic portable document format (pdf) to invited Bidders. The Bidding Documents will be provided via email or other large file transfer service. Printed copies will not be provided.

A pre-bid conference will be held **at 2:00 p.m. local time on August 2, 2023 at the Timpanogos Special Service District Water Reclamation Facility, 6400 N., 5050 W. Utah County, Utah 84003.** **Attendance at the pre-bid conference is mandatory.** Invited Bidders not in attendance will be deemed un-responsive and any submitted Bids will be returned un-opened.

Bid security shall be furnished in accordance with the Instructions to Bidders.

Owner: **TSSD Water Reclamation Facility**

By: **Rich Mickelson**

Date: **August 29, 2023**

+ + END OF ADVERTISEMENT FOR BIDS +

INSTRUCTIONS TO BIDDERS

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ARTICLE 1 – DEFINED TERMS

- 1.01 Terms used in these Instructions to Bidders have the meanings indicated in the General Conditions and Supplementary Conditions. Additional terms used in these Instructions to Bidders have the meanings indicated below:
- A. *Issuing Office* – The office from which the Bidding Documents are to be issued.
 - B. *Owner* – Timpanogos Special Service District (TSSD) Water Reclamation Facility.
 - C. *Engineer* – Brown and Caldwell.

ARTICLE 2 – COPIES OF BIDDING DOCUMENTS

- 2.01 Complete sets of the Bidding Documents may be obtained from the Issuing Office in the number and format stated in the advertisement or invitation to bid.
- 2.02 Complete sets of Bidding Documents shall be used in preparing Bids; neither Owner nor Engineer assumes any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.
- 2.03 Owner and Engineer, in making copies of Bidding Documents available on the above terms, do so only for the purpose of obtaining Bids for the Work and do not authorize or confer a license for any other use.

ARTICLE 3 – QUALIFICATIONS OF BIDDERS

- 3.01 In accordance with Owner procurement procedures, Owner has conducted a separate pre-qualification step. Only pre-qualified contractors are allowed to submit bids. Owner has prequalified the following Contractors to bid on the Work:
- A. Alder Construction
 - B. Archer Western Construction
 - C. COP Construction
 - D. Ellsworth Paulsen Construction
 - E. Gerber Construction
- 3.02 No requirement in this Article 3 to submit information will prejudice the right of Owner to seek additional pertinent information regarding Bidder's qualifications.
- 3.03 Bidder is advised to carefully review those portions of the Bid Form requiring Bidder's representations and certifications.

ARTICLE 4 – SITE AND OTHER AREAS; EXISTING SITE CONDITIONS; EXAMINATION OF SITE; OWNER'S SAFETY PROGRAM; OTHER WORK AT THE SITE

- 4.01 *Site and Other Areas*
- A. The Site is identified in the Bidding Documents. By definition, the Site includes rights-of-way, easements, and other lands furnished by Owner for the use of the Contractor. Any additional lands required for temporary construction facilities, construction equipment, or storage of materials and equipment, and any access needed for such additional lands, are to be obtained and paid for by Contractor.

4.02 *Existing Site Conditions*

A. Subsurface and Physical Conditions; Hazardous Environmental Conditions

1. The Supplementary Conditions identify:
 - a. those reports known to Owner of explorations and tests of subsurface conditions at or adjacent to the Site.
 - b. those drawings known to Owner of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities).
 - c. reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site.
 - d. Technical Data contained in such reports and drawings.
 - e. Reference Data contained in such reports and drawings.
2. Owner will make copies of reports and drawings referenced above available to any Bidder on request. These reports and drawings are not part of the Contract Documents, but the Technical Data contained therein upon whose accuracy Bidder is entitled to rely, as provided in the General Conditions, has been identified and established in the Supplementary Conditions. Bidder is responsible for any interpretation or conclusion Bidder draws from any Technical Data or any other data, interpretations, opinions, or information contained in such reports or shown or indicated in such drawings.
3. If the Supplementary Conditions do not identify Technical Data, the default definition of Technical Data set forth in Article 1 of the General Conditions will apply.

B. Underground Facilities: Information and data shown or indicated in the Bidding Documents with respect to existing Underground Facilities at or contiguous to the Site are set forth in the Contract Documents and are based upon information and data furnished to Owner and Engineer by owners of such Underground Facilities, including Owner, or others.

C. Adequacy of Data: Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders with respect to existing site conditions, subsurface conditions, other physical conditions, and Underground Facilities, and possible changes in the Bidding Documents due to differing or unanticipated subsurface or physical conditions appear in Paragraphs 5.03, 5.04, and 5.05 of the General Conditions. Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders with respect to a Hazardous Environmental Condition at the Site, if any, and possible changes in the Contract Documents due to any Hazardous Environmental Condition uncovered or revealed at the Site which was not shown or indicated in the Drawings or Specifications or identified in the Contract Documents to be within the scope of the Work, appear in Paragraph 5.06 of the General Conditions.

4.03 *Site Visit and Testing by Bidders*

- A. If Bidder desires a site visit, Bidder shall contact Roger Greve, at 410-733-1751, or rgreve@brwnald.com.
- B. Bidder is not required to conduct any subsurface testing, or exhaustive investigations of Site conditions.
- C. On request, and to the extent Owner has control over the Site, and schedule permitting, the Owner will provide Bidder access to the Site to conduct such additional examinations,

investigations, explorations, tests, and studies as Bidder deems necessary for preparing and submitting a successful Bid. Owner will not have any obligation to grant such access if doing so is not practical because of existing operations, security or safety concerns, or restraints on Owner's authority regarding the Site.

- D. Bidder shall comply with all applicable Laws and Regulations regarding excavation and location of utilities, obtain all permits, and comply with all terms and conditions established by Owner or by property owners or other entities controlling the Site with respect to schedule, access, existing operations, security, liability insurance, and applicable safety programs.
- E. Bidder shall fill all holes and clean up and restore the Site to its former condition upon completion of such explorations, investigations, tests, and studies.

4.04 *Owner's Safety Program*

- A. Site visits and work at the Site is governed by an Owner safety program. Additional information regarding the Owner's safety program is noted in the General and Supplementary Conditions.

4.05 *Other Work at the Site*

- A. Reference is made to Article 8 of the Supplementary Conditions for the identification of the general nature of other work of which Owner is aware (if any) that is to be performed at the Site by Owner or others (such as utilities and other prime contractors) and relates to the Work contemplated by these Bidding Documents. If Owner is party to a written contract for such other work, then on request, Owner will provide to each Bidder access to examine such contracts (other than portions thereof related to price and other confidential matters), if any.

ARTICLE 5 – BIDDER'S REPRESENTATIONS

5.01 It is the responsibility of each Bidder before submitting a Bid to:

- A. examine and carefully study the Bidding Documents, and any data and reference items identified in the Bidding Documents;
- B. visit the Site, conduct a thorough, alert visual examination of the Site and adjacent areas, and become familiar with and satisfy itself as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work;
- C. become familiar with and satisfy itself as to all Laws and Regulations that may affect cost, progress, and performance of the Work;
- D. carefully study all: (1) reports of explorations and tests of subsurface conditions at or adjacent to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings, and (2) reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings;
- E. consider the information known to Bidder itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and the Site-related reports and drawings identified in the Bidding Documents, with respect to the effect of such

information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder; and (3) Bidder's safety precautions and programs;

- F. agree, based on the information and observations referred to in the preceding paragraph, that at the time of submitting its Bid no further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of its Bid for performance of the Work at the price bid and within the times required, and in accordance with the other terms and conditions of the Bidding Documents;
- G. become aware of the general nature of the work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents;
- H. promptly give Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder discovers in the Bidding Documents and confirm that the written resolution thereof by Engineer is acceptable to Bidder;
- I. determine that the Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance and furnishing of the Work; and
- J. agree that the submission of a Bid will constitute an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article, that without exception the Bid and all prices in the Bid are premised upon performing and furnishing the Work required by the Bidding Documents.

ARTICLE 6 – PRE-BID CONFERENCE

- 6.01 A mandatory pre-Bid conference will be held at the time and location stated in the invitation or advertisement to bid. Representatives of Owner and Engineer will be present to discuss the Project. Bidders are required to attend and participate in the conference. Engineer will transmit to all prospective Bidders of record such Addenda as Engineer considers necessary in response to questions arising at the conference. Oral statements may not be relied upon and will not be binding or legally effective. Bidders not in attendance will be deemed un-responsive and any submitted Bids will be returned un-opened.

ARTICLE 7 – INTERPRETATIONS AND ADDENDA

- 7.01 All questions about the meaning or intent of the Bidding Documents are to be submitted to Engineer in writing. Interpretations or clarifications considered necessary by Engineer in response to such questions will be issued by Addenda delivered to all parties recorded as having received the Bidding Documents. Questions received less than seven days prior to the date for opening of Bids may not be answered. Only questions answered by Addenda will be binding. Oral and other interpretations or clarifications will be without legal effect.
- 7.02 Addenda may be issued to clarify, correct, supplement, or change the Bidding Documents.

ARTICLE 8 – BID SECURITY

- 8.01 A Bid must be accompanied by Bid security made payable to Owner in an amount of [5] percent of Bidder's maximum Bid price (determined by adding the base bid and all alternates) and in the form of a certified check, bank money order, or a Bid bond (on the form included in the Bidding Documents) issued by a surety meeting the requirements of Paragraphs 6.01 and 6.02 of the General Conditions.

- 8.02 The Bid security of the apparent Successful Bidder will be retained until Owner awards the contract to such Bidder, and such Bidder has executed the Contract Documents, furnished the required contract security, and met the other conditions of the Notice of Award, whereupon the Bid security will be released. If the Successful Bidder fails to execute and deliver the Contract Documents and furnish the required contract security within 15 days after the Notice of Award, Owner may consider Bidder to be in default, annul the Notice of Award, and the Bid security of that Bidder will be forfeited. Such forfeiture shall be Owner's exclusive remedy if Bidder defaults.
- 8.03 The Bid security of other Bidders that Owner believes to have a reasonable chance of receiving the award may be retained by Owner until the earlier of seven days after the Effective Date of the Contract or 61 days after the Bid opening, whereupon Bid security furnished by such Bidders will be released.
- 8.04 Bid security of other Bidders that Owner believes do not have a reasonable chance of receiving the award will be released within seven days after the Bid opening.

ARTICLE 9 – CONTRACT TIMES

- 9.01 The number of days within which, or the dates by which, the Work is to be substantially completed and ready for final payment are set forth in the Agreement.

ARTICLE 10 – LIQUIDATED DAMAGES

- 10.01 Provisions for liquidated damages, if any, for failure to timely attain a Milestone, Substantial Completion, or completion of the Work in readiness for final payment, are set forth in the Agreement.

ARTICLE 11 – SUBSTITUTE AND "OR-EQUAL" ITEMS

- 11.01 The Contract for the Work, as awarded, will be on the basis of materials and equipment specified or described in the Bidding Documents without consideration during the bidding and Contract award process of possible substitute or "or-equal" items. In cases in which the Contract allows the Contractor to request that Engineer authorize the use of a substitute or "or-equal" item of material or equipment, application for such acceptance may not be made to and will not be considered by Engineer until after the Effective Date of the Contract.
- 11.02 All prices that Bidder sets forth in its Bid shall be based on the presumption that the Contractor will furnish the materials and equipment specified or described in the Bidding Documents, as supplemented by Addenda. Any assumptions regarding the possibility of post-Bid approvals of "or-equal" or substitution requests are made at Bidder's sole risk.

ARTICLE 12 – SUBCONTRACTORS, SUPPLIERS, AND OTHERS

- 12.01 A Bidder shall be prepared to retain specific Subcontractors, Suppliers, or other individuals or entities for the performance of the Work if required by the Bidding Documents (most commonly in the Specifications) to do so. If a prospective Bidder objects to retaining any such Subcontractor, Supplier, or other individual or entity, and the concern is not relieved by an Addendum, then the prospective Bidder should refrain from submitting a Bid.
- 12.02 Subsequent to the submittal of the Bid, Owner may not require the Successful Bidder or Contractor to retain any Subcontractor, Supplier, or other individual or entity against which Contractor has reasonable objection.

- 12.03 The apparent Successful Bidder, and any other Bidder so requested, shall within five days after Bid opening, submit to Owner a list of the Subcontractors or Suppliers proposed along with their qualifications for the following portions of the Work: Any Subcontractors whose subcontract exceeds 5 percent of the Work.

Such list shall be accompanied by an experience statement with pertinent information regarding similar projects and other evidence of qualification for each such Subcontractor, Supplier, or other individual or entity. If Owner or Engineer, after due investigation, has reasonable objection to any proposed Subcontractor, Supplier, individual, or entity, Owner may, before the Notice of Award is given, request apparent Successful Bidder to submit an acceptable substitute, in which case apparent Successful Bidder shall submit a substitute, Bidder's Bid price will be increased (or decreased) by the difference in cost occasioned by such substitution, and Owner may consider such price adjustment in evaluating Bids and making the Contract award.

- 12.04 If apparent Successful Bidder declines to make any such substitution, Owner may award the Contract to the next lowest Bidder that proposes to use acceptable Subcontractors, Suppliers, or other individuals or entities. Declining to make requested substitutions will constitute grounds for forfeiture of the Bid security of any Bidder. Any Subcontractor, Supplier, individual, or entity so listed and against which Owner or Engineer makes no written objection prior to the giving of the Notice of Award will be deemed acceptable to Owner and Engineer subject to subsequent revocation of such acceptance as provided in Paragraph 7.06 of the General Conditions.

ARTICLE 13 – PREPARATION OF BID

- 13.01 The Bid Form is included with the Bidding Documents.

- A. All blanks on the Bid Form shall be completed in ink and the Bid Form signed in ink. Erasures or alterations shall be initialed in ink by the person signing the Bid Form. A Bid price shall be indicated for each section, Bid item, alternate, adjustment unit price item, and unit price item listed therein.
- B. If the Bid Form expressly indicates that submitting pricing on a specific alternate item is optional, and Bidder elects to not furnish pricing for such optional alternate item, then Bidder may enter the words "No Bid" or "Not Applicable."

- 13.02 A Bid by a corporation shall be executed in the corporate name by a corporate officer (whose title must appear under the signature), accompanied by evidence of authority to sign. The corporate address and state of incorporation shall be shown.

- 13.03 A Bid by a limited liability company shall be executed in the name of the firm by a member or other authorized person and accompanied by evidence of authority to sign. The state of formation of the firm and the official address of the firm shall be shown.

- 13.04 A Bid by an individual shall show the Bidder's name and official address.

- 13.05 A Bid by a joint venture shall be executed by an authorized representative of each joint venturer in the manner indicated on the Bid Form. The official address of the joint venture shall be shown.

- 13.06 All names shall be printed in ink below the signatures.

- 13.07 The Bid shall contain an acknowledgment of receipt of all Addenda, the numbers of which shall be filled in on the Bid Form.

- 13.08 Postal and e-mail addresses and telephone number for communications regarding the Bid shall be shown.

- 13.09 The Bid shall contain evidence of Bidder's authority and qualification to do business in the state where the Project is located, or Bidder shall covenant in writing to obtain such authority and qualification prior to award of the Contract and attach such covenant to the Bid. Bidder's state contractor license number, if any, shall also be shown on the Bid Form.

ARTICLE 14 – BASIS OF BID

14.01 *Lump Sum*

- A. Bidders shall submit a Bid on a lump sum basis as set forth in the Bid Form.

14.02 Base Bid with Alternates

- A. Bidders shall submit a Bid on a lump sum basis for the base Bid and include a separate price for each alternate described in the Bidding Documents and as provided for in the Bid Form. After the bid's have been reviewed and a Notice of Award has been issued, and at the Owner's discretion, Owner may elect to include the bid alternates for the Work. Owner may elect to include some, all or none of the bid alternate items. The price for each alternate will be the amount added to or deleted from the base Bid if Owner selects the alternate.

ARTICLE 15 – SUBMITTAL OF BID

- 15.01 With each copy of the Bidding Documents, a Bidder is furnished one separate unbound copy of the Bid Form, and, if required, the Bid Bond Form. The unbound copy of the Bid Form is to be completed and submitted with the Bid security and the other documents required to be submitted under the terms of Article 7 of the Bid Form.
- 15.02 A Bid shall be received no later than the date and time prescribed and at the place indicated in the advertisement or invitation to bid and shall be enclosed in a plainly marked package with the Project title (and, if applicable, the designated portion of the Project for which the Bid is submitted), the name and address of Bidder, and shall be accompanied by the Bid security and other required documents. If a Bid is sent by mail or other delivery system, the sealed envelope containing the Bid shall be enclosed in a separate package plainly marked on the outside with the notation "BID ENCLOSED." A mailed Bid shall be addressed to the Timpanogos Special Service District Reclamation Facility, Attention: Rich Mickelson, 6400 N. 5050 W., American Fork, UT 84003.
- 15.03 Bids received after the date and time prescribed for the opening of bids, or not submitted at the correct location or in the designated manner, will not be accepted and will be returned to the Bidder unopened.

ARTICLE 16 – MODIFICATION AND WITHDRAWAL OF BID

- 16.01 A Bid may be withdrawn by an appropriate document duly executed in the same manner that a Bid must be executed and delivered to the place where Bids are to be submitted prior to the date and time for the opening of Bids. Upon receipt of such notice, the unopened Bid will be returned to the Bidder.
- 16.02 If a Bidder wishes to modify its Bid prior to Bid opening, Bidder must withdraw its initial Bid in the manner specified in Paragraph 16.01 and submit a new Bid prior to the date and time for the opening of Bids.
- 16.03 If within 24 hours after Bids are opened any Bidder files a duly signed written notice with Owner and promptly thereafter demonstrates to the reasonable satisfaction of Owner that there was a

material and substantial mistake in the preparation of its Bid, that Bidder may withdraw its Bid, and the Bid security will be returned. Thereafter, if the Work is rebid, that Bidder will be disqualified from further bidding on the Work.

ARTICLE 17 – OPENING OF BIDS

- 17.01 Bids will be opened at the time and place indicated in the advertisement or invitation to bid and, unless obviously non-responsive, read aloud publicly. An abstract of the amounts of the base Bids and major alternates, if any, will be made available to Bidders after the opening of Bids.

ARTICLE 18 – BIDS TO REMAIN SUBJECT TO ACCEPTANCE

- 18.01 All Bids will remain subject to acceptance for the period of time stated in the Bid Form, but Owner may, in its sole discretion, release any Bid and return the Bid security prior to the end of this period.

ARTICLE 19 – EVALUATION OF BIDS AND AWARD OF CONTRACT

- 19.01 Owner reserves the right to reject any or all Bids, including without limitation, nonconforming, nonresponsive, unbalanced, or conditional Bids. Owner will reject the Bid of any Bidder that Owner finds, after reasonable inquiry and evaluation, to not be responsible. If Bidder purports to add terms or conditions to its Bid, takes exception to any provision of the Bidding Documents, or attempts to alter the contents of the Contract Documents for purposes of the Bid, then the Owner will reject the Bid as nonresponsive; provided that Owner also reserves the right to waive all minor informalities not involving price, time, or changes in the Work.
- 19.02 If Owner awards the contract for the Work, such award shall be to the responsible Bidder submitting the lowest responsive Bid.
- 19.03 Evaluation of Bids
- A. In evaluating Bids, Owner will consider whether or not the Bids comply with the prescribed requirements, and such alternates, required bid attachments, and other data, as may be requested in the Bid Form or prior to the Notice of Award.
 - B. Items on the Bid Form marked with an * are to note that these items could potentially be substituted for a bid alternate item, or deleted from the Work after the NOA has been issued.
- 19.04 In evaluating whether a Bidder is responsible, Owner will consider the qualifications of the Bidder and may consider the qualifications and experience of Subcontractors and Suppliers proposed for those portions of the Work for which the identity of Subcontractors and Suppliers must be submitted as provided in the Bidding Documents.
- 19.05 Owner may conduct such investigations as Owner deems necessary to establish the responsibility, qualifications, and financial ability of Bidders and any proposed Subcontractors or Suppliers.

ARTICLE 20 – BONDS AND INSURANCE

- 20.01 Article 6 of the General Conditions, as may be modified by the Supplementary Conditions, sets forth Owner's requirements as to performance and payment bonds and insurance. When the Successful Bidder delivers the Agreement (executed by Successful Bidder) to Owner, it shall be accompanied by required bonds and insurance documentation.

ARTICLE 21 – SIGNING OF AGREEMENT

21.01 When Owner issues a Notice of Award to the Successful Bidder, it shall be accompanied by the unexecuted counterparts of the Agreement along with the other Contract Documents as identified in the Agreement. Within 15 days thereafter, Successful Bidder shall execute and deliver the required number of counterparts of the Agreement (and any bonds and insurance documentation required to be delivered by the Contract Documents) to Owner. Within ten days thereafter, Owner shall deliver one fully executed counterpart of the Agreement to Successful Bidder, together with printed and electronic copies of the Contract Documents as stated in Paragraph 2.02 of the General Conditions.

ARTICLE 22 – SALES AND USE TAXES

Owner is not exempt from state sales and use taxes on materials and equipment to be incorporated in the Work. Contractor shall include sales and use tax in the bid.

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00 41 00
BID FORM

Timpanogos Special Service District Water Reclamation Facility
6400 N., 5050 W. Utah County, UT 84119

TP-4 EAST FACILITY UTILITIES AND CLARIFIERS REHABILITATION PROJECT

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ARTICLE 1 – BID RECIPIENT

1.01 This Bid is submitted to:

Timpanogos Special Service District Water Reclamation Facility, 6400 N. 5050 W., Utah County, UT 84003

1.02 The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into an Agreement with Owner in the form included in the Bidding Documents to perform all Work as specified or indicated in the Bidding Documents for the prices and within the times indicated in this Bid and in accordance with the other terms and conditions of the Bidding Documents.

ARTICLE 2 – BIDDER’S ACKNOWLEDGEMENTS

2.01 Bidder accepts all of the terms and conditions of the Instructions to Bidders, including without limitation those dealing with the disposition of Bid security. This Bid will remain subject to acceptance for 90 days after the Bid opening, or for such longer period of time that Bidder may agree to in writing upon request of Owner.

ARTICLE 3 – BIDDER’S REPRESENTATIONS

3.01 In submitting this Bid, Bidder represents that:

- A. Bidder has examined and carefully studied the Bidding Documents, and any data and reference items identified in the Bidding Documents, and hereby acknowledges receipt of the following Addenda:

Addendum No.

Addendum, Date

_____	_____
_____	_____
_____	_____
_____	_____

- B. Bidder has visited the Site, conducted a thorough, alert visual examination of the Site and adjacent areas, and become familiar with and satisfied itself as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
- C. Bidder is familiar with and has satisfied itself as to all Laws and Regulations that may affect cost, progress, and performance of the Work.
- D. Bidder has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or adjacent to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings, and (2) reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings.
- E. Bidder has considered the information known to Bidder itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and any Site-related reports and drawings identified in the Bidding Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and

performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder; and (3) Bidder's safety precautions and programs.

- F. Bidder agrees, based on the information and observations referred to in the preceding paragraph, that no further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of this Bid for performance of the Work at the price bid and within the times required, and in accordance with the other terms and conditions of the Bidding Documents.
- G. Bidder is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents.
- H. Bidder has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Bidding Documents, and confirms that the written resolution thereof by Engineer is acceptable to Bidder.
- I. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance and furnishing of the Work.
- J. The submission of this Bid constitutes an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article, and that without exception the Bid and all prices in the Bid are premised upon performing and furnishing the Work required by the Bidding Documents.

ARTICLE 4 – BIDDER'S CERTIFICATION

4.01 Bidder certifies that:

- A. This Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any collusive agreement or rules of any group, association, organization, or corporation;
- B. Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid;
- C. Bidder has not solicited or induced any individual or entity to refrain from bidding; and
- D. Bidder has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract. For the purposes of this Paragraph 4.01.D:
 - 1. "corrupt practice" means the offering, giving, receiving, or soliciting of any thing of value likely to influence the action of a public official in the bidding process;
 - 2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process to the detriment of Owner, (b) to establish bid prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;
 - 3. "collusive practice" means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish bid prices at artificial, non-competitive levels; and
 - 4. "coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

ARTICLE 5 – BASIS OF BID

5.01 Bidder will complete the Work in accordance with the Contract Documents for the following price(s):

East Clarifier Splitter Box:		
Item No.	Description*	Lump Sum Bid Price (numerals)
1*	Remove, dispose of the three existing lift gate pedestals and gear boxes. Furnish and install three new lift gate pedestals and gear boxes that accommodate electrical Rotork actuators and PVC rising gate stem (clear) tubes. Furnish and install three new electrical Rotork actuators.	
2*	Install power supply for and to the new lift gate electric actuators.	
3*	Furnish and install new lighting, light posts and power supply on the top of the east clarifier splitter box (2 lights total)	
East Clarifiers E-1, E-2, E-3:		
Item No.	Description*	Lump Sum Bid Price (numerals)
4*	Remove and dispose of the following: EIMCO C40HT/LT clarifier drives on clarifiers 1, 2 and 3; all carbon steel clarifier components at and below the waterline; FRP weirs and baffles; current density (Stamford) baffles and supports; ducking skimmer systems; scum spray system piping and sprayers along walkways; corrugated FRP panels and clarifier feed well sidewall frames; walkways	
5	Furnish and install new clarifier drives for clarifiers 1, 2, and 3.	
6	Electrical re-feed of East Clarifiers 1 and 3.	

7*	Furnish and install new clarifier mechanism. All material 1'-0 above or below the water line shall be 304 stainless steel. (excluding walkways, weirs, baffles and current density (Stamford) baffles, and scum collection and spray systems)	
8*	Furnish and Install 304 stainless steel weirs and baffles.	
9*	Furnish and Install 304 stainless steel current density (Stamford) baffles and supports.	
10*	Furnish and install traditional scum beach (4'-0" radial scum beach) with supports, skimmer blade from feed well, skimming device support arm, flush valve assembly, scum discharge piping, and hinged skimmer assembly. Materials shall be 304 stainless steel. Pipe to be Schedule 10, 304 stainless steel, pipe supports to be 316 stainless steel.	
11*	Furnish and install new scum spray piping with manually controlled anti-rotation, full cone jet spray nozzle system. Piping 304 stainless steel with 316 hangers.	
12	Furnish and install 304 stainless steel feedwell frames with corrugated FRP panels. Sidewall panel profile to be 4.2x1-1/16" with stainless steel (316) self-driving screws with neoprene washers.	
13	Furnish and install painted carbon steel walkways. Walkways to have an 8'x7'-4" drive maintenance platform, 1-1/2" aluminum 3 rail mechanical handrail system, and 1-1-1/4" rectangular aluminum serrated bar grating (non-slip).	
14*	Remove and reinstall existing walkway lighting, light posts, and local lighting controls.	

15*	Furnish and install aluminum laundry covers with 304 stainless steel supports.	
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East Facility Pipe Repairs		
Item No.	Description*	Lump Sum Bid Price (numerals)
16	East Clarifier 1: 30-inch RCP Center Liquor Pipe: CFRP lining repair.	
17	East Clarifier 2: 30-inch RCP Mixed Liquor Pipe: CFRP lining repair.	
18	East Clarifier 3: 16-inch RAS pipe joint repair.	
Balance of Remaining Work		
19	Balance of remaining work: (i.e.: dewatering, excavation, concrete sidewalk section removal/ replacement, concrete duct bank installation, pipe disassembly / reassembly in the Clarifier 3 valve vault building, etc.)	
Base Bid Total (Items 1 – 19)		

Note: Item numbers with an * are to note that these items could potentially be changed out for a bid alternate item or deleted from the Work after the NOA is issued.

ALTERNATES

5.02 The Basis of Bid and Notice of Award is shown in 5.01. After the bid's have been reviewed and a Notice of Award has been issued, and at Owner's discretion, Owner may elect to add or remove the following items from the Work. Owner may elect to add or deduct some, all or none of the items shown in the schedule below.

Item No.	Description*	Bid Price (Deduct – negative Add – positive)
East Clarifier Splitter Box:		

1	Do not remove, dispose of the three existing lift gate pedestals and gear boxes. Do not furnish and install three new lift gate pedestals and gear boxes that accommodate electrical Rotork actuators and PVC rising gate stem (clear) tubes. Do not furnish and install three new electrical Rotork actuators.	
2	Do not Install power supply for and to the new lift gate electric actuators.	
3	Do not furnish and install new lighting, light posts and power supply on the top of the east clarifier splitter box (2 lights total)	
East Clarifiers E-1, E-2, E-3:		
4	Rebuild and reinstall EIMCO C40HT/LT clarifier drives on clarifiers 1, 2 and 3, and system balancing in lieu of new clarifier drive units (base bid line item 5).	
5	Remove and dispose of existing conduit rack, relocate existing generator building conduit (1 total), electrical refeed of East Clarifiers 1, 2 and 3.	
6	Furnish and install painted carbon steel clarifier components 1'-0" above and below the waterline in lieu of 304 stainless steel materials (base bid line item 7). (excluding walkways, weirs and baffles)	
7	Furnish and install FRP weirs and baffles in lieu of 304 stainless steel (base bid line item 8)	
8	Furnish and Install current density (Stamford) baffles with FRP and 304 stainless steel supports in lieu of all 304 stainless steel materials (base bid line item 9.)	
9	Furnish and install traditional scum beach (4'-0" radial scum beach) with supports, skimmer blade from feed	

	well, skimming device support arm, flush valve assembly, scum discharge piping, and Aluminum hinged skimmer. Materials shall be painted carbon steel in lieu of 304 stainless (base bid line item 10).	
10	Furnish and install new scum spray piping as polyurethane coating Schedule 40 carbon steel with galvanized carbon steel hangers in lieu of stainless steel (base bid line item 11), with manually controlled anti-rotation, full cone jet spray nozzle system.	
11	Remove, dispose of existing walkway lighting, light posts, and local lighting controls. Furnish and install new walkway lighting, light posts, and local lighting controls in lieu of reinstalling existing lighting (Base bid line item 14).	
12	Do not furnish and install aluminum launder covers and 304 stainless steel supports.	

ARTICLE 6 - TIME OF COMPLETION

- 6.01 Bidder agrees that the Work will be substantially complete within 365 days from the date the Contract times commence to run and will be completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions within 425 days from the date the Contract times commence to run.
- 6.02 Bidder accepts the provisions of the Agreement as to liquidated damages.

ARTICLE 7 – ATTACHMENTS TO THIS BID

- 7.01 The following documents are submitted with and made a condition of this Bid:
- A. Required Bid security;
 - B. List of Proposed Subcontractors;
 - C. List of Proposed Suppliers;
 - D. List of Project References;
 - E. Single Entity Unit Team (SEU) submittal information as outlined in specification section 33 39 30 for pipe rehabilitation work;
 - F. Evidence of authority to do business in the state of the Project; or a written covenant to obtain such license within the time for acceptance of Bids;

- G. Contractor's License No.: [or] Evidence of Bidder's ability to obtain a State Contractor's License and a covenant by Bidder to obtain said license within the time for acceptance of Bids;
- H. Required Bidder Qualification Statement with supporting data;
- I. Within 24 hours of Bid Opening, the Bidder with the lowest Bid shall submit a Schedule of Values for further review by the Owner. The Schedule of Values shall include at a minimum the following Work allocations: Mobilization/demobilization and related General Requirements, Civil Site Work, Structural, Electrical, Process Piping and Related Process Work

ARTICLE 8 – DEFINED TERMS

8.01 The terms used in this Bid with initial capital letters have the meanings stated in the Instructions to Bidders, the General Conditions, and the Supplementary Conditions.

ARTICLE 9 – BID SUBMITTAL

BIDDER: *[Indicate correct name of bidding entity]*

By:

[Signature] _____

[Printed name] _____

(If Bidder is a corporation, a limited liability company, a partnership, or a joint venture, attach evidence of authority to sign.)

Attest:

[Signature] _____

[Printed name] _____

Title: _____

Submittal Date: _____

Address for giving notices:

Telephone Number: _____

Fax Number: _____

Contact Name and e-mail address: _____

Bidder's License No.: _____

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00 43 00
BID BOND

Any singular reference to Bidder, Surety, Owner or other party shall be considered plural where applicable.

BIDDER (*Name and Address*):

SURETY (*Name, and Address of Principal Place of Business*):

OWNER (*Name and Address*):

BID

Bid Due Date:

Description (*Project Name— Include Location*):

BOND

Bond Number:

Date:

Penal sum _____ \$ _____
(Words) (Figures)

Surety and Bidder, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Bid Bond to be duly executed by an authorized officer, agent, or representative.

BIDDER

SURETY

Bidder's Name and Corporate Seal

Surety's Name and Corporate Seal

By: _____
Signature

By: _____
Signature (Attach Power of Attorney)

Print Name

Print Name

Title

Title

Attest: _____
Signature

Attest: _____
Signature

Title

Title

Note: Addresses are to be used for giving any required notice.

Provide execution by any additional parties, such as joint venturers, if necessary.

1. Bidder and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to pay to Owner upon default of Bidder the penal sum set forth on the face of this Bond. Payment of the penal sum is the extent of Bidder's and Surety's liability. Recovery of such penal sum under the terms of this Bond shall be Owner's sole and exclusive remedy upon default of Bidder.
2. Default of Bidder shall occur upon the failure of Bidder to deliver within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents.
3. This obligation shall be null and void if:
 - 3.1 Owner accepts Bidder's Bid and Bidder delivers within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents, or
 - 3.2 All Bids are rejected by Owner, or
 - 3.3 Owner fails to issue a Notice of Award to Bidder within the time specified in the Bidding Documents (or any extension thereof agreed to in writing by Bidder and, if applicable, consented to by Surety when required by Paragraph 5 hereof).
4. Payment under this Bond will be due and payable upon default of Bidder and within 30 calendar days after receipt by Bidder and Surety of written notice of default from Owner, which notice will be given with reasonable promptness, identifying this Bond and the Project and including a statement of the amount due.
5. Surety waives notice of any and all defenses based on or arising out of any time extension to issue Notice of Award agreed to in writing by Owner and Bidder, provided that the total time for issuing Notice of Award including extensions shall not in the aggregate exceed 120 days from the Bid due date without Surety's written consent.
6. No suit or action shall be commenced under this Bond prior to 30 calendar days after the notice of default required in Paragraph 4 above is received by Bidder and Surety and in no case later than one year after the Bid due date.
7. Any suit or action under this Bond shall be commenced only in a court of competent jurisdiction located in the state in which the Project is located.
8. Notices required hereunder shall be in writing and sent to Bidder and Surety at their respective addresses shown on the face of this Bond. Such notices may be sent by personal delivery, commercial courier, or by United States Registered or Certified Mail, return receipt requested, postage pre-paid, and shall be deemed to be effective upon receipt by the party concerned.
9. Surety shall cause to be attached to this Bond a current and effective Power of Attorney evidencing the authority of the officer, agent, or representative who executed this Bond on behalf of Surety to execute, seal, and deliver such Bond and bind the Surety thereby.
10. This Bond is intended to conform to all applicable statutory requirements. Any applicable requirement of any applicable statute that has been omitted from this Bond shall be deemed to be included herein as if set forth at length. If any provision of this Bond conflicts with any applicable statute, then the provision of said statute shall govern and the remainder of this Bond that is not in conflict therewith shall continue in full force and effect.
11. The term "Bid" as used herein includes a Bid, offer, or proposal as applicable.

00 51 00

NOTICE OF AWARD

Date of Issuance:

Owner:	Timpanogos Special Service District Water Reclamation Facility	Owner's Contract No.: NA
Engineer:	Brown and Caldwell	Engineer's Project No.: 157492
Project:	TP-4 East Facility Utilities and Clarifiers Rehabilitation Project	Contract Name: TP-4 East Facility Utilities and Clarifiers Rehabilitation Project

Bidder:

Bidder's Address:

TO BIDDER:

You are notified that Owner has accepted your Bid dated [] for the above Contract, and that you are the Successful Bidder and are awarded a Contract for:

[describe Work, alternates, or sections of Work awarded]

The Contract Price of the awarded Contract is: \$ [] *[note if subject to unit prices, or cost-plus]*

[] unexecuted counterparts of the Agreement accompany this Notice of Award, and one copy of the Contract Documents accompanies this Notice of Award, or has been transmitted or made available to Bidder electronically. *[revise if multiple copies accompany the Notice of Award]*

☐ a set of the Drawings will be delivered separately from the other Contract Documents.

You must comply with the following conditions precedent within 15 days of the date of receipt of this Notice of Award:

1. Deliver to Owner [] counterparts of the Agreement, fully executed by Bidder.
2. Deliver with the executed Agreement(s) the Contract security *[e.g., performance and payment bonds]* and insurance documentation as specified in the Instructions to Bidders and General Conditions, Articles 2 and 6.
3. Other conditions precedent (if any): Proof of Utah General Contractor's license.

Failure to comply with these conditions within the time specified will entitle Owner to consider you in default, annul this Notice of Award, and declare your Bid security forfeited.

Within ten days after you comply with the above conditions, Owner will return to you one fully executed counterpart of the Agreement, together with any additional copies of the Contract Documents as indicated in Paragraph 2.02 of the General Conditions.

Owner:

Authorized Signature

By:

Title:

Copy: Engineer

00 52 00
AGREEMENT
BETWEEN OWNER AND CONTRACTOR
FOR CONSTRUCTION CONTRACT

THIS AGREEMENT is by and between Timpanogos Special Service District Water Reclamation Facility ("Owner") and _____ ("Contractor").

Owner and Contractor hereby agree as follows:

ARTICLE 1 – WORK

1.01 Contractor shall complete all Work as specified or indicated in the Contract Documents. The Work is generally described as follows:

A. East Clarifier Splitter Box

1. Remove and dispose of the existing manual lift gate operators (pedestals and gear boxes).
2. Furnish and install new gate operators (pedestals and gear boxes) to fit electric actuators.
3. Furnish and install new locally controlled Rotork electric actuators and corresponding electrical power feed system.
4. Furnish and install new lighting, corresponding light posts and corresponding power supply on the top of the East Clarifier Splitter Box (2 lights total).

B. East Clarifiers 1, 2 and 3

1. Dewater east facility clarifier site to prevent clarifier floating.
2. Remove and replace the three EIMCO C40HT/LT clarifier drives, conduct drive system balancing.
3. Electrical re-feed of East Clarifiers 1 and 3.
4. Removal and disposal of all carbon steel clarifier components at and below the waterline.
5. Remove and dispose of the existing clarifier duck skimmer systems.
6. Removal and disposal of existing FRP weirs, baffles, Current Density (Stamford) Baffles.
7. Furnish and install 304 stainless steel clarifier components (center feed pipe, torque cage, energy dissipation stilling well, influent well frame with sidewalls to be corrugated FRP, rake arms, scrapers, squeegees).
8. Furnish and install 304 stainless steel weirs, baffles, and Stamford baffles.
9. Furnish and install corrugated FRP material on (as) sidewalls of influent well frame. FRP panel profile to be 4.2x1-1/16. Stainless steel (316) self-driving screws with neoprene washers to be used to install panels.
10. Removal and replacement of clarifier walkways with painted carbon steel, with 8' x 7'-4" maintenance platform for drive mechanisms, 1-1/2" aluminum 3 rail handrail system,

1-1-1/4" rectangular aluminum bar grating (non-slip). Remove and reinstall walkway lighting and controls once walkways are replaced.

11. Furnish and install 304 stainless steel traditional scum beach (4'-0" radial scum beach with supports, skimmer blade from feed well (both rake arms), skimming device support arm (both rake arms), flush valve assembly.
 12. Remove and dispose of scum spray system piping and sprayers along clarifier walkways. Install new scum spray piping with manually controlled anti-rotation spray system.
 13. Furnish and install 6-inch Schedule 10, 304 stainless steel piping from scum beach discharge.
 14. Furnish and install aluminum and 304 stainless steel component launder covers.
- C. East Facility pipe repairs
1. Removal of clarifiers 1 and 2 center feed columns for access to mixed liquor feed pipes
 2. Pipe lining repairs:
 - a. CFRP lining repair – East Clarifier 1: 30-inch RCP Center Liquor Pipe
 - b. CFRP lining repair – East Clarifier 2: 30-inch RCP Mixed Liquor Pipe
 3. Pipe point repair – East Clarifier 3: 16-inch RAS pipe
- D. Site civil work corresponding to electrical re feed of East Clarifiers 1 and 3 (E-1, E-3), and corresponding sidewalk replacement as noted on the plans.
- E. Restore site disturbed during construction.
- F. Coordinate Work with Owner's operations.
- G. Coordinate Work with other Contractors at the site and with the Construction Manager including requirements for site safety.

ARTICLE 2 – THE PROJECT

- 2.01 The Project, of which the Work under the Contract Documents is a part, is generally described as follows: East Facility Utilities and Clarifiers Rehabilitation Project.

ARTICLE 3 – ENGINEER

- 3.01 The Project has been designed by Brown and Caldwell.
- 3.02 The Owner has retained Brown and Caldwell ("Engineer") to act as Owner's representative, assume all duties and responsibilities, and have the rights and authority assigned to Engineer in the Contract Documents in connection with the completion of the Work in accordance with the Contract Documents.

ARTICLE 4 – CONTRACT TIMES

- 4.01 *Time of the Essence*
- A. All time limits for Milestones, if any, Substantial Completion, and completion and readiness for final payment as stated in the Contract Documents are of the essence of the Contract.

4.02 *Contract Times: Dates*

- A. The Work will be substantially complete within 365 days from the date the Contract times commence to run and completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions within 425 days from the date the Contract times commence to run.

4.03 *Liquidated Damages*

- A. Contractor and Owner recognize that time is of the essence as stated in Paragraph 4.01 above and that Owner will suffer financial and other losses if the Work is not completed and Milestones not achieved within the times specified in Paragraph 4.02 above, plus any extensions thereof allowed in accordance with the Contract. The parties also recognize the delays, expense, and difficulties involved in proving in a legal proceeding the actual loss suffered by Owner if the Work is not completed on time. Accordingly, instead of requiring any such proof, Owner and Contractor agree that as liquidated damages for delay (but not as a penalty):
 - 1. Substantial Completion: Contractor shall pay Owner \$ 1,000 for each day that expires after the time (as duly adjusted pursuant to the Contract) specified in Paragraph 4.02.A above for Substantial Completion until the Work is substantially complete.
 - 2. Completion of Remaining Work: After Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Time (as duly adjusted pursuant to the Contract) for completion and readiness for final payment, Contractor shall pay Owner \$ 1,000 for each day that expires after such time until the Work is completed and ready for final payment.
 - 3. Liquidated damages for failing to timely attain Substantial Completion and final completion are not additive and will not be imposed concurrently.

ARTICLE 5 – CONTRACT PRICE

- 5.01 Owner shall pay Contractor for completion of the Work in accordance with the Contract Documents the amounts that follow, subject to adjustment under the Contract:
 - A. For all Work other than Unit Price Work, a lump sum of: \$.

All specific cash allowances are included in the above price in accordance with Paragraph 13.02 of the General Conditions.
 - B. For all Work, at the prices stated in Contractor's Bid, attached hereto as an exhibit.

ARTICLE 6 – PAYMENT PROCEDURES

6.01 *Submittal and Processing of Payments*

- A. Contractor shall submit Applications for Payment in accordance with Article 15 of the General Conditions. Applications for Payment will be processed by Engineer as provided in the General Conditions.

6.02 *Progress Payments; Retainage*

- A. Owner shall make progress payments within 45 days of receipt of Contractor's Applications for Payment provided that such Applications for Payment have been submitted prior to the 1st of the preceding month as noted in the Contract Documents. All such payments will be measured by the Schedule of Values established as provided in the General Conditions (and

in the case of Unit Price Work based on the number of units completed) or, in the event there is no Schedule of Values, as provided elsewhere in the Contract.

1. Prior to Substantial Completion, progress payments will be made in an amount equal to the percentage indicated below but, in each case, less the aggregate of payments previously made and less such amounts as Owner may withhold, including but not limited to liquidated damages, in accordance with the Contract
 - a. 95 percent of Work completed (with the balance being retainage).; and
 - b. 70 percent of cost of materials and equipment, on site but not incorporated in the Work (with the balance being retainage).
- B. Upon Substantial Completion, Owner shall pay an amount sufficient to increase total payments to Contractor to 95 percent of the Work completed, less such amounts set off by Owner pursuant to Paragraph 15.01.E of the General Conditions.

6.03 *Final Payment*

- A. Upon final completion and acceptance of the Work in accordance with Paragraph 15.06 of the General Conditions, Owner shall pay the remainder of the Contract Price as recommended by Engineer as provided in said Paragraph 15.06.

ARTICLE 7 – INTEREST

- 7.01 All amounts not paid when due shall bear interest at the rate of 8 percent per annum.

ARTICLE 8 – CONTRACTOR’S REPRESENTATIONS

- 8.01 In order to induce Owner to enter into this Contract, Contractor makes the following representations:
- A. Contractor has examined and carefully studied the Contract Documents, and any data and reference items identified in the Contract Documents.
 - B. Contractor has visited the Site, conducted a thorough, alert visual examination of the Site and adjacent areas, and become familiar with and is satisfied as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
 - C. Contractor is familiar with and is satisfied as to all Laws and Regulations that may affect cost, progress, and performance of the Work.
 - D. Contractor has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or adjacent to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings, and (2) reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings.
 - E. Contractor has considered the information known to Contractor itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Contract Documents; and the Site-related reports and drawings identified in the Contract Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor; and (3) Contractor’s safety precautions and programs.

- F. Based on the information and observations referred to in the preceding paragraph, Contractor agrees that no further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract.
- G. Contractor is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Contract Documents.
- H. Contractor has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Contractor has discovered in the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.
- I. The Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.
- J. Contractor's entry into this Contract constitutes an incontrovertible representation by Contractor that without exception all prices in the Agreement are premised upon performing and furnishing the Work required by the Contract Documents.

ARTICLE 9 – CONTRACT DOCUMENTS

9.01 *Contents*

- A. The Contract Documents consist of the following:
 - 1. This Agreement (pages 1 to , inclusive).
 - 2. Performance bond (pages to , inclusive).
 - 3. Payment bond (pages to , inclusive).
 - 4. Other bonds.
 - a. (pages to , inclusive).
 - 5. General Conditions (pages to , inclusive).
 - 6. Supplementary Conditions (pages to , inclusive).
 - 7. Specifications as listed in the table of contents of the Project Manual.
 - 8. Drawings (not attached but incorporated by reference) consisting the Drawings listed on the drawing sheet index.
 - 9. Addenda (numbers to , inclusive).
 - 10. Exhibits to this Agreement (enumerated as follows):
 - a. Contractor's Bid (pages to , inclusive).
 - b. Aqua-Aerobics Procurement Contract for Disc Filter equipment originally executed between Owner and Aqua-Aerobics; to be assigned to Contractor.
 - 11. The following which may be delivered or issued on or after the Effective Date of the Contract and are not attached hereto:
 - a. Notice to Proceed.
 - b. Work Change Directives.
 - c. Change Orders.
 - d. Field Orders.

- B. The documents listed in Paragraph 9.01.A are attached to this Agreement (except as expressly noted otherwise above).
- C. There are no Contract Documents other than those listed above in this Article 9.
- D. The Contract Documents may only be amended, modified, or supplemented as provided in the General Conditions.

ARTICLE 10 – MISCELLANEOUS

10.01 *Terms*

- A. Terms used in this Agreement will have the meanings stated in the General Conditions and the Supplementary Conditions.

10.02 *Assignment of Contract*

- A. This contract is not assignable.

10.03 *Successors and Assigns*

- A. Owner and Contractor each binds itself, its successors, and legal representatives to the other party hereto, its successors, and legal representatives in respect to all covenants, agreements, and obligations contained in the Contract Documents.

10.04 *Severability*

- A. Any provision or part of the Contract Documents held to be void or unenforceable under any Law or Regulation shall be deemed stricken, and all remaining provisions shall continue to be valid and binding upon Owner and Contractor, who agree that the Contract Documents shall be reformed to replace such stricken provision or part thereof with a valid and enforceable provision that comes as close as possible to expressing the intention of the stricken provision.

10.05 *Contractor's Certifications*

- A. Contractor certifies that it has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for or in executing the Contract. For the purposes of this Paragraph 10.05:
 - 1. "corrupt practice" means the offering, giving, receiving, or soliciting of any thing of value likely to influence the action of a public official in the bidding process or in the Contract execution;
 - 2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process or the execution of the Contract to the detriment of Owner, (b) to establish Bid or Contract prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;

3. “collusive practice” means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish Bid prices at artificial, non-competitive levels; and
4. “coercive practice” means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

10.06 *Governing Laws and Jurisdiction*

- A. Agreement is governed by the laws of the State of Utah and contract legal proceedings or disputes or other legal proceedings as defined in the General Conditions will be reviewed in a court of competent jurisdiction whose jurisdiction will be in a Salt Lake County venue.

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IN WITNESS WHEREOF, Owner and Contractor have signed this Agreement.

This Agreement will be effective on _____ (which is the Effective Date of the Contract).

OWNER:

CONTRACTOR:

By: _____

By: _____

Title: _____

Title: _____

(If Contractor is a corporation, a partnership, or a joint venture, attach evidence of authority to sign.)

Attest: _____

Attest: _____

Title: _____

Title: _____

Address for giving notices:

Address for giving notices:

License No.: _____
(where applicable)

(If Owner is a corporation, attach evidence of authority to sign. If Owner is a public body, attach evidence of authority to sign and resolution or other documents authorizing execution of this Agreement.)

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00 55 00

NOTICE TO PROCEED

Owner:	TSSD Water Reclamation	Owner's Contract No.:	NA
Contractor:		Contractor's Project No.:	NA
Engineer:	Brown and Caldwell	Engineer's Project No.:	157492
Project:	TP-4 East Facility Utilities and Clarifiers Rehabilitation Project	Contract Name:	TP-4 East Facility Utilities and Clarifiers Rehabilitation Project
		Effective Date of Contract:	

TO CONTRACTOR:

Owner hereby notifies Contractor that the Contract Times under the above Contract will commence to run on [_____, 2023]. *[see Paragraph 4.01 of the General Conditions]*

On that date, Contractor shall start performing its obligations under the Contract Documents. No Work shall be done at the Site prior to such date. In accordance with the Agreement, [the date of Substantial Completion is _____], and the date of readiness for final payment is.

Before starting any Work at the Site, Contractor must comply with the following:

[Note any access limitations, security procedures, or other restrictions]

Owner:

Authorized Signature

By:

Title:

Date Issued:

Copy: Engineer

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00 61 00 - PERFORMANCE BOND

CONTRACTOR *(name and address):*

SURETY *(name and address of principal place of business):*

OWNER *(name and address):*

CONSTRUCTION CONTRACT

Effective Date of the Agreement:

Amount:

Description *(name and location):*

BOND

Bond Number:

Date *(not earlier than the Effective Date of the Agreement of the Construction Contract):*

Amount:

Modifications to this Bond Form: ☐ None ☐ See Paragraph 16

Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Performance Bond to be duly executed by an authorized officer, agent, or representative.

CONTRACTOR AS PRINCIPAL

SURETY

Contractor's Name and Corporate Seal

Surety's Name and Corporate Seal

By: _____
Signature

By: _____
Signature *(attach power of attorney)*

Print Name

Print Name

Title

Title

Attest: _____
Signature

Attest: _____
Signature

Title

Title

Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party shall be considered plural where applicable.

1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner for the performance of the Construction Contract, which is incorporated herein by reference.

2. If the Contractor performs the Construction Contract, the Surety and the Contractor shall have no obligation under this Bond, except when applicable to participate in a conference as provided in Paragraph 3.

3. If there is no Owner Default under the Construction Contract, the Surety's obligation under this Bond shall arise after:

3.1 The Owner first provides notice to the Contractor and the Surety that the Owner is considering declaring a Contractor Default. Such notice shall indicate whether the Owner is requesting a conference among the Owner, Contractor, and Surety to discuss the Contractor's performance. If the Owner does not request a conference, the Surety may, within five (5) business days after receipt of the Owner's notice, request such a conference. If the Surety timely requests a conference, the Owner shall attend. Unless the Owner agrees otherwise, any conference requested under this Paragraph 3.1 shall be held within ten (10) business days of the Surety's receipt of the Owner's notice. If the Owner, the Contractor, and the Surety agree, the Contractor shall be allowed a reasonable time to perform the Construction Contract, but such an agreement shall not waive the Owner's right, if any, subsequently to declare a Contractor Default;

3.2 The Owner declares a Contractor Default, terminates the Construction Contract and notifies the Surety; and

3.3 The Owner has agreed to pay the Balance of the Contract Price in accordance with the terms of the Construction Contract to the Surety or to a contractor selected to perform the Construction Contract.

4. Failure on the part of the Owner to comply with the notice requirement in Paragraph 3.1 shall not constitute a failure to comply with a condition precedent to the Surety's obligations, or release the Surety from its obligations, except to the extent the Surety demonstrates actual prejudice.

5. When the Owner has satisfied the conditions of Paragraph 3, the Surety shall promptly and at the Surety's expense take one of the following actions:

5.1 Arrange for the Contractor, with the consent of the Owner, to perform and complete the Construction Contract;

5.2 Undertake to perform and complete the Construction Contract itself, through its agents or independent contractors;

5.3 Obtain bids or negotiated proposals from qualified contractors acceptable to the Owner for a contract for performance and completion of the Construction Contract, arrange for a contract to be prepared for execution by the Owner and a contractor selected with the Owners concurrence, to be

secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Construction Contract, and pay to the Owner the amount of damages as described in Paragraph 7 in excess of the Balance of the Contract Price incurred by the Owner as a result of the Contractor Default; or

5.4 Waive its right to perform and complete, arrange for completion, or obtain a new contractor, and with reasonable promptness under the circumstances:

5.4.1 After investigation, determine the amount for which it may be liable to the Owner and, as soon as practicable after the amount is determined, make payment to the Owner; or

5.4.2 Deny liability in whole or in part and notify the Owner, citing the reasons for denial.

6. If the Surety does not proceed as provided in Paragraph 5 with reasonable promptness, the Surety shall be deemed to be in default on this Bond seven days after receipt of an additional written notice from the Owner to the Surety demanding that the Surety perform its obligations under this Bond, and the Owner shall be entitled to enforce any remedy available to the Owner. If the Surety proceeds as provided in Paragraph 5.4, and the Owner refuses the payment or the Surety has denied liability, in whole or in part, without further notice the Owner shall be entitled to enforce any remedy available to the Owner.

7. If the Surety elects to act under Paragraph 5.1, 5.2, or 5.3, then the responsibilities of the Surety to the Owner shall not be greater than those of the Contractor under the Construction Contract, and the responsibilities of the Owner to the Surety shall not be greater than those of the Owner under the Construction Contract. Subject to the commitment by the Owner to pay the Balance of the Contract Price, the Surety is obligated, without duplication for:

7.1 the responsibilities of the Contractor for correction of defective work and completion of the Construction Contract;

7.2 additional legal, design professional, and delay costs resulting from the Contractor's Default, and resulting from the actions or failure to act of the Surety under Paragraph 5; and

7.3 liquidated damages, or if no liquidated damages are specified in the Construction Contract, actual damages caused by delayed performance or non-performance of the Contractor.

8. If the Surety elects to act under Paragraph 5.1, 5.3, or 5.4, the Surety's liability is limited to the amount of this Bond.

9. The Surety shall not be liable to the Owner or others for obligations of the Contractor that are unrelated to the Construction Contract, and the Balance of the Contract Price shall not be reduced or set off on account of any such unrelated obligations. No right of action shall accrue on this Bond to any person or entity other than the Owner or its heirs, executors, administrators, successors, and assigns.

10. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders, and other obligations.

11. Any proceeding, legal or equitable, under this Bond may be instituted in any court of competent jurisdiction in the location in which the work or part of the work is located and shall be instituted within two years after a declaration of Contractor Default or within two years after the Contractor ceased working or within two years after the Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this paragraph are void or prohibited by law, the minimum periods of limitations available to sureties as a defense in the jurisdiction of the suit shall be applicable.

12. Notice to the Surety, the Owner, or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears.

13. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

14. Definitions

14.1 Balance of the Contract Price: The total amount payable by the Owner to the Contractor under the Construction Contract after all proper adjustments have been made including allowance for the Contractor for any amounts received or to be received by the Owner in settlement of insurance or other claims for damages to which the Contractor is entitled, reduced by all valid and proper payments made to or on behalf of the Contractor under the Construction Contract.

14.2 Construction Contract: The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and changes made to the agreement and the Contract Documents.

14.3 Contractor Default: Failure of the Contractor, which has not been remedied or waived, to perform or otherwise to comply with a material term of the Construction Contract.

14.4 Owner Default: Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

14.5 Contract Documents: All the documents that comprise the agreement between the Owner and Contractor.

15. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

16. Modifications to this Bond are as follows:

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00 61 50 - PAYMENT BOND

CONTRACTOR *(name and address):*

SURETY *(name and address of principal place of business):*

OWNER *(name and address):*

CONSTRUCTION CONTRACT

Effective Date of the Agreement:

Amount:

Description *(name and location):*

BOND

Bond Number:

Date *(not earlier than the Effective Date of the Agreement of the Construction Contract):*

Amount:

Modifications to this Bond Form: ☐ None ☐ See Paragraph 18

Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Payment Bond to be duly executed by an authorized officer, agent, or representative.

CONTRACTOR AS PRINCIPAL

SURETY

Contractor's Name and Corporate Seal

Surety's Name and Corporate Seal

By: _____
Signature

By: _____
Signature *(attach power of attorney)*

Print Name

Print Name

Title

Title

Attest: _____
Signature

Attest: _____
Signature

Title

Title

Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party shall be considered plural where applicable.

1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner to pay for labor, materials, and equipment furnished for use in the performance of the Construction Contract, which is incorporated herein by reference, subject to the following terms.
2. If the Contractor promptly makes payment of all sums due to Claimants, and defends, indemnifies, and holds harmless the Owner from claims, demands, liens, or suits by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, then the Surety and the Contractor shall have no obligation under this Bond.
3. If there is no Owner Default under the Construction Contract, the Surety's obligation to the Owner under this Bond shall arise after the Owner has promptly notified the Contractor and the Surety (at the address described in Paragraph 13) of claims, demands, liens, or suits against the Owner or the Owner's property by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, and tendered defense of such claims, demands, liens, or suits to the Contractor and the Surety.
4. When the Owner has satisfied the conditions in Paragraph 3, the Surety shall promptly and at the Surety's expense defend, indemnify, and hold harmless the Owner against a duly tendered claim, demand, lien, or suit.
5. The Surety's obligations to a Claimant under this Bond shall arise after the following:
 - 5.1 Claimants who do not have a direct contract with the Contractor,
 - 5.1.1 have furnished a written notice of non-payment to the Contractor, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were, or equipment was, furnished or supplied or for whom the labor was done or performed, within ninety (90) days after having last performed labor or last furnished materials or equipment included in the Claim; and
 - 5.1.2 have sent a Claim to the Surety (at the address described in Paragraph 13).
 - 5.2 Claimants who are employed by or have a direct contract with the Contractor have sent a Claim to the Surety (at the address described in Paragraph 13).
6. If a notice of non-payment required by Paragraph 5.1.1 is given by the Owner to the Contractor, that is sufficient to satisfy a Claimant's obligation to furnish a written notice of non-payment under Paragraph 5.1.1.
7. When a Claimant has satisfied the conditions of Paragraph 5.1 or 5.2, whichever is applicable, the Surety shall promptly and at the Surety's expense take the following actions:
 - 7.1 Send an answer to the Claimant, with a copy to the Owner, within sixty (60) days after receipt of the Claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed; and
 - 7.2 Pay or arrange for payment of any undisputed amounts.
 - 7.3 The Surety's failure to discharge its obligations under Paragraph 7.1 or 7.2 shall not be deemed to constitute a waiver of defenses the Surety or Contractor may have or acquire as to a Claim, except as to undisputed amounts for which the Surety and Claimant have reached agreement. If, however, the Surety fails to discharge its obligations under Paragraph 7.1 or 7.2, the Surety shall indemnify the Claimant for the reasonable attorney's fees the Claimant incurs thereafter to recover any sums found to be due and owing to the Claimant.
8. The Surety's total obligation shall not exceed the amount of this Bond, plus the amount of reasonable attorney's fees provided under Paragraph 7.3, and the amount of this Bond shall be credited for any payments made in good faith by the Surety.
9. Amounts owed by the Owner to the Contractor under the Construction Contract shall be used for the performance of the Construction Contract and to satisfy claims, if any, under any construction performance bond. By the Contractor furnishing and the Owner accepting this Bond, they agree that all funds earned by the Contractor in the performance of the Construction Contract are dedicated to satisfy obligations of the Contractor and Surety under this Bond, subject to the Owner's priority to use the funds for the completion of the work.
10. The Surety shall not be liable to the Owner, Claimants, or others for obligations of the Contractor that are unrelated to the Construction Contract. The Owner shall not be liable for the payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligation to make payments to or give notice on behalf of Claimants, or otherwise have any obligations to Claimants under this Bond.

11. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders, and other obligations.
12. No suit or action shall be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the state in which the project that is the subject of the Construction Contract is located or after the expiration of one year from the date (1) on which the Claimant sent a Claim to the Surety pursuant to Paragraph 5.1.2 or 5.2, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Construction Contract, whichever of (1) or (2) first occurs. If the provisions of this paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.
13. Notice and Claims to the Surety, the Owner, or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears. Actual receipt of notice or Claims, however accomplished, shall be sufficient compliance as of the date received.
14. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.
15. Upon requests by any person or entity appearing to be a potential beneficiary of this Bond, the Contractor and Owner shall promptly furnish a copy of this Bond or shall permit a copy to be made.
16. **Definitions**
 - 16.1 **Claim:** A written statement by the Claimant including at a minimum:
 1. The name of the Claimant;
 2. The name of the person for whom the labor was done, or materials or equipment furnished;
 3. A copy of the agreement or purchase order pursuant to which labor, materials, or equipment was furnished for use in the performance of the Construction Contract;
 4. A brief description of the labor, materials, or equipment furnished;
 5. The date on which the Claimant last performed labor or last furnished materials or equipment for use in the performance of the Construction Contract;
 - 16.2 **Claimant:** An individual or entity having a direct contract with the Contractor or with a subcontractor of the Contractor to furnish labor, materials, or equipment for use in the performance of the Construction Contract. The term Claimant also includes any individual or entity that has rightfully asserted a claim under an applicable mechanic's lien or similar statute against the real property upon which the Project is located. The intent of this Bond shall be to include without limitation in the terms of "labor, materials, or equipment" that part of the water, gas, power, light, heat, oil, gasoline, telephone service, or rental equipment used in the Construction Contract, architectural and engineering services required for performance of the work of the Contractor and the Contractor's subcontractors, and all other items for which a mechanic's lien may be asserted in the jurisdiction where the labor, materials, or equipment were furnished.
 - 16.3 **Construction Contract:** The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and all changes made to the agreement and the Contract Documents.
 - 16.4 **Owner Default:** Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.
 - 16.5 **Contract Documents:** All the documents that comprise the agreement between the Owner and Contractor.
17. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.
18. Modifications to this Bond are as follows:
 6. The total amount earned by the Claimant for labor, materials, or equipment furnished as of the date of the Claim;
 7. The total amount of previous payments received by the Claimant; and
 8. The total amount due and unpaid to the Claimant for labor, materials, or equipment furnished as of the date of the Claim.

00 62 50
CERTIFICATE OF SUBSTANTIAL COMPLETION

Owner: TSSD Water Reclamation Facility	Owner's Contract No.: NA
Contractor:	Contractor's Project No.: NA
Engineer: Brown and Caldwell	Engineer's Project No.: 157492
Project: TP-4 East Facility Utilities and Clarifiers Rehabilitation Project	Contract Name: TP-4 East Facility Utilities and Clarifiers Rehabilitation Project

This [preliminary] [final] Certificate of Substantial Completion applies to:

☐ All Work ☐ The following specified portions of the Work:

Date of Substantial Completion

The Work to which this Certificate applies has been inspected by authorized representatives of Owner, Contractor, and Engineer, and found to be substantially complete. The Date of Substantial Completion of the Work or portion thereof designated above is hereby established, subject to the provisions of the Contract pertaining to Substantial Completion. The date of Substantial Completion in the final Certificate of Substantial Completion marks the commencement of the contractual correction period and applicable warranties required by the Contract.

A punch list of items to be completed or corrected is attached to this Certificate. This list may not be all-inclusive, and the failure to include any items on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract.

The responsibilities between Owner and Contractor for security, operation, safety, maintenance, heat, utilities, insurance, and warranties upon Owner's use or occupancy of the Work shall be as provided in the Contract, except as amended as follows: *[Note: Amendments of contractual responsibilities recorded in this Certificate should be the product of mutual agreement of Owner and Contractor; see Paragraph 15.03.D of the General Conditions.]*

Amendments to Owner's responsibilities: ☐ None
☐ As follows

Amendments to Contractor's responsibilities: ☐ None
☐ As follows:

The following documents are attached to and made a part of this Certificate: *[punch list; others]*

This Certificate does not constitute an acceptance of Work not in accordance with the Contract Documents, nor is it a release of Contractor's obligation to complete the Work in accordance with the Contract.

EXECUTED BY ENGINEER:	RECEIVED:	RECEIVED:
By: _____ (Authorized signature)	By: _____ Owner (Authorized Signature)	By: _____ Contractor (Authorized Signature)
Title: _____	Title: _____	Title: _____

Date: _____

Date: _____

Date: _____

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STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

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ARTICLE 1 – DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

- A. Wherever used in the Bidding Requirements or Contract Documents, a term printed with initial capital letters, including the term's singular and plural forms, will have the meaning indicated in the definitions below. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.
1. *Addenda*—Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the proposed Contract Documents.
 2. *Agreement*—The written instrument, executed by Owner and Contractor, that sets forth the Contract Price and Contract Times, identifies the parties and the Engineer, and designates the specific items that are Contract Documents.
 3. *Application for Payment*—The form acceptable to Engineer which is to be used by Contractor during the course of the Work in requesting progress or final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.
 4. *Bid*—The offer of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.
 5. *Bidder*—An individual or entity that submits a Bid to Owner.
 6. *Bidding Documents*—The Bidding Requirements, the proposed Contract Documents, and all Addenda.
 7. *Bidding Requirements*—The advertisement or invitation to bid, Instructions to Bidders, Bid Bond or other Bid security, if any, the Bid Form, and the Bid with any attachments.
 8. *Change Order*—A document which is signed by Contractor and Owner and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, or other revision to the Contract, issued on or after the Effective Date of the Contract.
 9. *Change Proposal*—A written request by Contractor, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment in Contract Price or Contract Times, or both; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; challenging a set-off against payments due; or seeking other relief with respect to the terms of the Contract.
 10. *Claim*—(a) A demand or assertion by Owner directly to Contractor, duly submitted in compliance with the procedural requirements set forth herein: seeking an adjustment of Contract Price or Contract Times, or both; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; contesting Engineer's decision regarding a Change Proposal; seeking resolution of a contractual issue that Engineer has declined to address; or seeking other relief with respect to the terms of the Contract; or (b) a demand or assertion by Contractor directly to Owner, duly submitted in compliance with the procedural requirements set forth herein, contesting Engineer's decision regarding a Change Proposal; or seeking resolution of a contractual issue that Engineer

has declined to address. A demand for money or services by a third party is not a Claim.

11. *Constituent of Concern*—Asbestos, petroleum, radioactive materials, polychlorinated biphenyls (PCBs), hazardous waste, and any substance, product, waste, or other material of any nature whatsoever that is or becomes listed, regulated, or addressed pursuant to (a) the Comprehensive Environmental Response, Compensation and Liability Act, 42 U.S.C. §§9601 et seq. (“CERCLA”); (b) the Hazardous Materials Transportation Act, 49 U.S.C. §§5501 et seq.; (c) the Resource Conservation and Recovery Act, 42 U.S.C. §§6901 et seq. (“RCRA”); (d) the Toxic Substances Control Act, 15 U.S.C. §§2601 et seq.; (e) the Clean Water Act, 33 U.S.C. §§1251 et seq.; (f) the Clean Air Act, 42 U.S.C. §§7401 et seq.; or (g) any other federal, state, or local statute, law, rule, regulation, ordinance, resolution, code, order, or decree regulating, relating to, or imposing liability or standards of conduct concerning, any hazardous, toxic, or dangerous waste, substance, or material.
12. *Contract*—The entire and integrated written contract between the Owner and Contractor concerning the Work.
13. *Contract Documents*—Those items so designated in the Agreement, and which together comprise the Contract.
14. *Contract Price*—The money that Owner has agreed to pay Contractor for completion of the Work in accordance with the Contract Documents. .
15. *Contract Times*—The number of days or the dates by which Contractor shall: (a) achieve Milestones, if any; (b) achieve Substantial Completion; and (c) complete the Work.
16. *Contractor*—The individual or entity with which Owner has contracted for performance of the Work.
17. *Cost of the Work*—See Paragraph 13.01 for definition.
18. *Drawings*—The part of the Contract that graphically shows the scope, extent, and character of the Work to be performed by Contractor.
19. *Effective Date of the Contract*—The date, indicated in the Agreement, on which the Contract becomes effective.
20. *Engineer*—The individual or entity named as such in the Agreement.
21. *Field Order*—A written order issued by Engineer which requires minor changes in the Work but does not change the Contract Price or the Contract Times.
22. *Hazardous Environmental Condition*—The presence at the Site of Constituents of Concern in such quantities or circumstances that may present a danger to persons or property exposed thereto. The presence at the Site of materials that are necessary for the execution of the Work, or that are to be incorporated in the Work, and that are controlled and contained pursuant to industry practices, Laws and Regulations, and the requirements of the Contract, does not establish a Hazardous Environmental Condition.
23. *Laws and Regulations; Laws or Regulations*—Any and all applicable laws, statutes, rules, regulations, ordinances, codes, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.

24. *Liens*—Charges, security interests, or encumbrances upon Contract-related funds, real property, or personal property.
25. *Milestone*—A principal event in the performance of the Work that the Contract requires Contractor to achieve by an intermediate completion date or by a time prior to Substantial Completion of all the Work.
26. *Notice of Award*—The written notice by Owner to a Bidder of Owner's acceptance of the Bid.
27. *Notice to Proceed*—A written notice by Owner to Contractor fixing the date on which the Contract Times will commence to run and on which Contractor shall start to perform the Work.
28. *Owner*—The individual or entity with which Contractor has contracted regarding the Work, and which has agreed to pay Contractor for the performance of the Work, pursuant to the terms of the Contract.
29. *Progress Schedule*—A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising the Contractor's plan to accomplish the Work within the Contract Times.
30. *Project*—The total undertaking to be accomplished for Owner by engineers, contractors, and others, including planning, study, design, construction, testing, commissioning, and start-up, and of which the Work to be performed under the Contract Documents is a part.
31. *Project Manual*—The written documents prepared for, or made available for, procuring and constructing the Work, including but not limited to the Bidding Documents or other construction procurement documents, geotechnical and existing conditions information, the Agreement, bond forms, General Conditions, Supplementary Conditions, and Specifications. The contents of the Project Manual may be bound in one or more volumes.
32. *Resident Project Representative*—The authorized representative of Engineer assigned to assist Engineer at the Site. As used herein, the term Resident Project Representative or "RPR" includes any assistants or field staff of Resident Project Representative.
33. *Samples*—Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and that establish the standards by which such portion of the Work will be judged.
34. *Schedule of Submittals*—A schedule, prepared and maintained by Contractor, of required submittals and the time requirements for Engineer's review of the submittals and the performance of related construction activities.
35. *Schedule of Values*—A schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.
36. *Shop Drawings*—All drawings, diagrams, illustrations, schedules, and other data or information that are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work. Shop Drawings, whether approved or not, are not Drawings and are not Contract Documents.

37. *Site*—Lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements, and such other lands furnished by Owner which are designated for the use of Contractor.
38. *Specifications*—The part of the Contract that consists of written requirements for materials, equipment, systems, standards, and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable to the Work.
39. *Subcontractor*—An individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work.
40. *Substantial Completion*—The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms “substantially complete” and “substantially completed” as applied to all or part of the Work refer to Substantial Completion thereof.
41. *Successful Bidder*—The Bidder whose Bid the Owner accepts, and to which the Owner makes an award of contract, subject to stated conditions.
42. *Supplementary Conditions*—The part of the Contract that amends or supplements these General Conditions.
43. *Supplier*—A manufacturer, fabricator, supplier, distributor, materialman, or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or a Subcontractor.
44. *Technical Data*—Those items expressly identified as Technical Data in the Supplementary Conditions, with respect to either (a) subsurface conditions at the Site, or physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities) or (b) Hazardous Environmental Conditions at the Site. If no such express identifications of Technical Data have been made with respect to conditions at the Site, then the data contained in boring logs, recorded measurements of subsurface water levels, laboratory test results, and other factual, objective information regarding conditions at the Site that are set forth in any geotechnical or environmental report prepared for the Project and made available to Contractor are hereby defined as Technical Data with respect to conditions at the Site under Paragraphs 5.03, 5.04, and 5.06.
45. *Underground Facilities*—All underground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments, and any encasements containing such facilities, including but not limited to those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, fiber optic transmissions, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other control systems.
46. *Unit Price Work*—Work to be paid for on the basis of unit prices.
47. *Work*—The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction; furnishing, installing, and incorporating all materials and equipment into such construction; and may include related services such as testing, start-up, and commissioning, all as required by the Contract Documents.

48. *Work Change Directive*—A written directive to Contractor issued on or after the Effective Date of the Contract, signed by Owner and recommended by Engineer, ordering an addition, deletion, or revision in the Work.

1.02 Terminology

- A. The words and terms discussed in the following paragraphs are not defined but, when used in the Bidding Requirements or Contract Documents, have the indicated meaning.
- B. *Intent of Certain Terms or Adjectives:*
1. The Contract Documents include the terms “as allowed,” “as approved,” “as ordered,” “as directed” or terms of like effect or import to authorize an exercise of professional judgment by Engineer. In addition, the adjectives “reasonable,” “suitable,” “acceptable,” “proper,” “satisfactory,” or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Work. It is intended that such exercise of professional judgment, action, or determination will be solely to evaluate, in general, the Work for compliance with the information in the Contract Documents and with the design concept of the Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective is not intended to and shall not be effective to assign to Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility contrary to the provisions of Article 10 or any other provision of the Contract Documents.
- C. *Day:*
1. The word “day” means a calendar day of 24 hours measured from midnight to the next midnight.
- D. *Defective:*
1. The word “defective,” when modifying the word “Work,” refers to Work that is unsatisfactory, faulty, or deficient in that it:
 - a. does not conform to the Contract Documents; or
 - b. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents; or
 - c. has been damaged prior to Engineer’s recommendation of final payment (unless responsibility for the protection thereof has been assumed by Owner at Substantial Completion in accordance with Paragraph 15.03 or 15.04).
- E. *Furnish, Install, Perform, Provide:*
1. The word “furnish,” when used in connection with services, materials, or equipment, shall mean to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.
 2. The word “install,” when used in connection with services, materials, or equipment, shall mean to put into use or place in final position said services, materials, or equipment complete and ready for intended use.

3. The words “perform” or “provide,” when used in connection with services, materials, or equipment, shall mean to furnish and install said services, materials, or equipment complete and ready for intended use.
 4. If the Contract Documents establish an obligation of Contractor with respect to specific services, materials, or equipment, but do not expressly use any of the four words “furnish,” “install,” “perform,” or “provide,” then Contractor shall furnish and install said services, materials, or equipment complete and ready for intended use.
- F. Unless stated otherwise in the Contract Documents, words or phrases that have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

ARTICLE 2 – PRELIMINARY MATTERS

2.01 *Delivery of Bonds and Evidence of Insurance*

- A. *Bonds*: When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner such bonds as Contractor may be required to furnish.
- B. *Evidence of Contractor’s Insurance*: When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner, with copies to each named insured and additional insured (as identified in the Supplementary Conditions or elsewhere in the Contract), the certificates and other evidence of insurance required to be provided by Contractor in accordance with Article 6.
- C. *Evidence of Owner’s Insurance*: After receipt of the executed counterparts of the Agreement and all required bonds and insurance documentation, Owner shall promptly deliver to Contractor, with copies to each named insured and additional insured (as identified in the Supplementary Conditions or otherwise), the certificates and other evidence of insurance required to be provided by Owner under Article 6.

2.02 *Copies of Documents*

- A. Owner shall furnish to Contractor four printed copies of the Contract (including one fully executed counterpart of the Agreement), and one copy in electronic portable document format (PDF). Additional printed copies will be furnished upon request at the cost of reproduction.
- B. Owner shall maintain and safeguard at least one original printed record version of the Contract, including Drawings and Specifications signed and sealed by Engineer and other design professionals. Owner shall make such original printed record version of the Contract available to Contractor for review. Owner may delegate the responsibilities under this provision to Engineer.

2.03 *Before Starting Construction*

- A. *Preliminary Schedules*: Within 10 days after the Effective Date of the Contract (or as otherwise specifically required by the Contract Documents), Contractor shall submit to Engineer for timely review:
 1. a preliminary Progress Schedule indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract;
 2. a preliminary Schedule of Submittals; and

3. a preliminary Schedule of Values for all of the Work which includes quantities and prices of items which when added together equal the Contract Price and subdivides the Work into component parts in sufficient detail to serve as the basis for progress payments during performance of the Work. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work.

2.04 *Preconstruction Conference; Designation of Authorized Representatives*

- A. Before any Work at the Site is started, a conference attended by Owner, Contractor, Engineer, and others as appropriate will be held to establish a working understanding among the parties as to the Work and to discuss the schedules referred to in Paragraph 2.03.A, procedures for handling Shop Drawings, Samples, and other submittals, processing Applications for Payment, electronic or digital transmittals, and maintaining required records.
- B. At this conference Owner and Contractor each shall designate, in writing, a specific individual to act as its authorized representative with respect to the services and responsibilities under the Contract. Such individuals shall have the authority to transmit and receive information, render decisions relative to the Contract, and otherwise act on behalf of each respective party.

2.05 *Initial Acceptance of Schedules*

- A. At least 10 days before submission of the first Application for Payment a conference, attended by Contractor, Engineer, and others as appropriate, will be held to review for acceptability to Engineer as provided below the schedules submitted in accordance with Paragraph 2.03.A. Contractor shall have an additional 10 days to make corrections and adjustments and to complete and resubmit the schedules. No progress payment shall be made to Contractor until acceptable schedules are submitted to Engineer.
 1. The Progress Schedule will be acceptable to Engineer if it provides an orderly progression of the Work to completion within the Contract Times. Such acceptance will not impose on Engineer responsibility for the Progress Schedule, for sequencing, scheduling, or progress of the Work, nor interfere with or relieve Contractor from Contractor's full responsibility therefor.
 2. Contractor's Schedule of Submittals will be acceptable to Engineer if it provides a workable arrangement for reviewing and processing the required submittals.
 3. Contractor's Schedule of Values will be acceptable to Engineer as to form and substance if it provides a reasonable allocation of the Contract Price to the component parts of the Work.

2.06 *Electronic Transmittals*

- A. Except as otherwise stated elsewhere in the Contract, the Owner, Engineer, and Contractor may transmit, and shall accept, Project-related correspondence, text, data, documents, drawings, information, and graphics, including but not limited to Shop Drawings and other submittals, in electronic media or digital format, either directly, or through access to a secure Project website.
- B. If the Contract does not establish protocols for electronic or digital transmittals, then Owner, Engineer, and Contractor shall jointly develop such protocols.
- C. When transmitting items in electronic media or digital format, the transmitting party makes no representations as to long term compatibility, usability, or readability of the items resulting from the recipient's use of software application packages, operating systems, or

computer hardware differing from those used in the drafting or transmittal of the items, or from those established in applicable transmittal protocols.

ARTICLE 3 – DOCUMENTS: INTENT, REQUIREMENTS, REUSE

3.01 *Intent*

- A. The Contract Documents are complementary; what is required by one is as binding as if required by all.
- B. It is the intent of the Contract Documents to describe a functionally complete project (or part thereof) to be constructed in accordance with the Contract Documents.
- C. Unless otherwise stated in the Contract Documents, if there is a discrepancy between the electronic or digital versions of the Contract Documents (including any printed copies derived from such electronic or digital versions) and the printed record version, the printed record version shall govern.
- D. The Contract supersedes prior negotiations, representations, and agreements, whether written or oral.
- E. Engineer will issue clarifications and interpretations of the Contract Documents as provided herein.

3.02 *Reference Standards*

- A. Standards Specifications, Codes, Laws and Regulations
 - 1. Reference in the Contract Documents to standard specifications, manuals, reference standards, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, shall mean the standard specification, manual, reference standard, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Contract if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.
 - 2. No provision of any such standard specification, manual, reference standard, or code, or any instruction of a Supplier, shall be effective to change the duties or responsibilities of Owner, Contractor, or Engineer, or any of their subcontractors, consultants, agents, or employees, from those set forth in the part of the Contract Documents prepared by or for Engineer. No such provision or instruction shall be effective to assign to Owner, Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the part of the Contract Documents prepared by or for Engineer.

3.03 *Reporting and Resolving Discrepancies*

- A. *Reporting Discrepancies:*
 - 1. *Contractor's Verification of Figures and Field Measurements:* Before undertaking each part of the Work, Contractor shall carefully study the Contract Documents, and check and verify pertinent figures and dimensions therein, particularly with respect to applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy that Contractor discovers, or has actual knowledge of, and shall not proceed with any Work affected thereby until the conflict,

error, ambiguity, or discrepancy is resolved, by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract Documents issued pursuant to Paragraph 11.01.

2. *Contractor's Review of Contract Documents:* If, before or during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents, or between the Contract Documents and (a) any applicable Law or Regulation, (b) actual field conditions, (c) any standard specification, manual, reference standard, or code, or (d) any instruction of any Supplier, then Contractor shall promptly report it to Engineer in writing. Contractor shall not proceed with the Work affected thereby (except in an emergency as required by Paragraph 7.15) until the conflict, error, ambiguity, or discrepancy is resolved, by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract Documents issued pursuant to Paragraph 11.01.
3. Contractor shall not be liable to Owner or Engineer for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless Contractor had actual knowledge thereof.

B. *Resolving Discrepancies:*

1. Except as may be otherwise specifically stated in the Contract Documents, the provisions of the part of the Contract Documents prepared by or for Engineer shall take precedence in resolving any conflict, error, ambiguity, or discrepancy between such provisions of the Contract Documents and:
 - a. the provisions of any standard specification, manual, reference standard, or code, or the instruction of any Supplier (whether or not specifically incorporated by reference as a Contract Document); or
 - b. the provisions of any Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

3.04 *Requirements of the Contract Documents*

- A. During the performance of the Work and until final payment, Contractor and Owner shall submit to the Engineer all matters in question concerning the requirements of the Contract Documents (sometimes referred to as requests for information or interpretation—RFIs), or relating to the acceptability of the Work under the Contract Documents, as soon as possible after such matters arise. Engineer will be the initial interpreter of the requirements of the Contract Documents, and judge of the acceptability of the Work thereunder.
- B. Engineer will, with reasonable promptness, render a written clarification, interpretation, or decision on the issue submitted, or initiate an amendment or supplement to the Contract Documents. Engineer's written clarification, interpretation, or decision will be final and binding on Contractor, unless it appeals by submitting a Change Proposal, and on Owner, unless it appeals by filing a Claim.
- C. If a submitted matter in question concerns terms and conditions of the Contract Documents that do not involve (1) the performance or acceptability of the Work under the Contract Documents, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, then Engineer will promptly give written notice to Owner and Contractor that Engineer is unable to provide a decision or interpretation. If Owner and Contractor are unable to agree on resolution of such a matter in question, either party may pursue resolution as provided in Article 12.

3.05 *Reuse of Documents*

- A. Contractor and its Subcontractors and Suppliers shall not:
 - 1. have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or its consultants, including electronic media editions, or reuse any such Drawings, Specifications, other documents, or copies thereof on extensions of the Project or any other project without written consent of Owner and Engineer and specific written verification or adaptation by Engineer; or
 - 2. have or acquire any title or ownership rights in any other Contract Documents, reuse any such Contract Documents for any purpose without Owner's express written consent, or violate any copyrights pertaining to such Contract Documents.
- B. The prohibitions of this Paragraph 3.05 will survive final payment, or termination of the Contract. Nothing herein shall preclude Contractor from retaining copies of the Contract Documents for record purposes.

ARTICLE 4 – COMMENCEMENT AND PROGRESS OF THE WORK

4.01 *Commencement of Contract Times; Notice to Proceed*

- A. The Contract Times will commence to run on the thirtieth day after the Effective Date of the Contract or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within 30 days after the Effective Date of the Contract. In no event will the Contract Times commence to run later than the sixtieth day after the day of Bid opening or the thirtieth day after the Effective Date of the Contract, whichever date is earlier.

4.02 *Starting the Work*

- A. Contractor shall start to perform the Work on the date when the Contract Times commence to run. No Work shall be done at the Site prior to such date.

4.03 *Reference Points*

- A. Owner shall provide engineering surveys to establish reference points for construction which in Engineer's judgment are necessary to enable Contractor to proceed with the Work. Contractor shall be responsible for laying out the Work, shall protect and preserve the established reference points and property monuments, and shall make no changes or relocations without the prior written approval of Owner. Contractor shall report to Engineer whenever any reference point or property monument is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points or property monuments by professionally qualified personnel.

4.04 *Progress Schedule*

- A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.05 as it may be adjusted from time to time as provided below.
 - 1. Contractor shall submit to Engineer for acceptance (to the extent indicated in Paragraph 2.05) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times.

2. Proposed adjustments in the Progress Schedule that will change the Contract Times shall be submitted in accordance with the requirements of Article 11.
- B. Contractor shall carry on the Work and adhere to the Progress Schedule during all disputes or disagreements with Owner. No Work shall be delayed or postponed pending resolution of any disputes or disagreements, or during any appeal process, except as permitted by Paragraph 16.04, or as Owner and Contractor may otherwise agree in writing.

4.05 *Delays in Contractor's Progress*

- A. If Owner, Engineer, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in the Contract Times and Contract Price. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.
- B. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delay, disruption, or interference caused by or within the control of Contractor. Delay, disruption, and interference attributable to and within the control of a Subcontractor or Supplier shall be deemed to be within the control of Contractor.
- C. If Contractor's performance or progress is delayed, disrupted, or interfered with by unanticipated causes not the fault of and beyond the control of Owner, Contractor, and those for which they are responsible, then Contractor shall be entitled to an equitable adjustment in Contract Times. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times. Such an adjustment shall be Contractor's sole and exclusive remedy for the delays, disruption, and interference described in this paragraph. Causes of delay, disruption, or interference that may give rise to an adjustment in Contract Times under this paragraph include but are not limited to the following:
 1. severe and unavoidable natural catastrophes such as fires, floods, epidemics, and earthquakes;
 2. abnormal weather conditions;
 3. acts or failures to act of utility owners (other than those performing other work at or adjacent to the Site by arrangement with the Owner, as contemplated in Article 8); and
 4. acts of war or terrorism.
- D. Delays, disruption, and interference to the performance or progress of the Work resulting from the existence of a differing subsurface or physical condition, an Underground Facility that was not shown or indicated by the Contract Documents, or not shown or indicated with reasonable accuracy, and those resulting from Hazardous Environmental Conditions, are governed by Article 5.
- E. Paragraph 8.03 governs delays, disruption, and interference to the performance or progress of the Work resulting from the performance of certain other work at or adjacent to the Site.
- F. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for any delay, disruption, or interference if such delay is concurrent with a delay, disruption, or interference caused by or within the control of Contractor.

- G. Contractor must submit any Change Proposal seeking an adjustment in Contract Price or Contract Times under this paragraph within 30 days of the commencement of the delaying, disrupting, or interfering event.

ARTICLE 5 – AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS

5.01 *Availability of Lands*

- A. Owner shall furnish the Site. Owner shall notify Contractor of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work.
- B. Upon reasonable written request, Owner shall furnish Contractor with a current statement of record legal title and legal description of the lands upon which permanent improvements are to be made and Owner's interest therein as necessary for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.
- C. Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

5.02 *Use of Site and Other Areas*

A. *Limitation on Use of Site and Other Areas:*

- 1. Contractor shall confine construction equipment, temporary construction facilities, the storage of materials and equipment, and the operations of workers to the Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and such other adjacent areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for (a) damage to the Site; (b) damage to any such other adjacent areas used for Contractor's operations; (c) damage to any other adjacent land or areas; and (d) for injuries and losses sustained by the owners or occupants of any such land or areas; provided that such damage or injuries result from the performance of the Work or from other actions or conduct of the Contractor or those for which Contractor is responsible.
- 2. If a damage or injury claim is made by the owner or occupant of any such land or area because of the performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible, Contractor shall (a) take immediate corrective or remedial action as required by Paragraph 7.12, or otherwise; (b) promptly attempt to settle the claim as to all parties through negotiations with such owner or occupant, or otherwise resolve the claim by arbitration or other dispute resolution proceeding, or at law; and (c) to the fullest extent permitted by Laws and Regulations, indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against any such claim, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against Owner, Engineer, or any other party indemnified hereunder to the extent caused directly or indirectly, in whole or in part

by, or based upon, Contractor's performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible.

- B. *Removal of Debris During Performance of the Work:* During the progress of the Work the Contractor shall keep the Site and other adjacent areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris shall conform to applicable Laws and Regulations.
- C. *Cleaning:* Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the Work Contractor shall remove from the Site and adjacent areas all tools, appliances, construction equipment and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.
- D. *Loading of Structures:* Contractor shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall Contractor subject any part of the Work or adjacent structures or land to stresses or pressures that will endanger them.

5.03 *Subsurface and Physical Conditions*

- A. *Reports and Drawings:* The Supplementary Conditions identify:
 - 1. those reports known to Owner of explorations and tests of subsurface conditions at or adjacent to the Site;
 - 2. those drawings known to Owner of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities); and
 - 3. Technical Data contained in such reports and drawings.
- B. *Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely upon the accuracy of the Technical Data (as defined in Article 1) contained in any geotechnical or environmental report prepared for the Project and made available to Contractor. Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, with respect to:
 - 1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto; or
 - 2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or
 - 3. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions, or information.

5.04 *Differing Subsurface or Physical Conditions*

- A. *Notice by Contractor:* If Contractor believes that any subsurface or physical condition that is uncovered or revealed at the Site either:
1. is of such a nature as to establish that any Technical Data on which Contractor is entitled to rely as provided in Paragraph 5.03 is materially inaccurate; or
 2. is of such a nature as to require a change in the Drawings or Specifications; or
 3. differs materially from that shown or indicated in the Contract Documents; or
 4. is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents;

then Contractor shall, promptly after becoming aware thereof and before further disturbing the subsurface or physical conditions or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), notify Owner and Engineer in writing about such condition. Contractor shall not further disturb such condition or perform any Work in connection therewith (except with respect to an emergency) until receipt of a written statement permitting Contractor to do so.

- B. *Engineer's Review:* After receipt of written notice as required by the preceding paragraph, Engineer will promptly review the subsurface or physical condition in question; determine the necessity of Owner's obtaining additional exploration or tests with respect to the condition; conclude whether the condition falls within any one or more of the differing site condition categories in Paragraph 5.04.A above; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding the Contractor's resumption of Work in connection with the subsurface or physical condition in question and the need for any change in the Drawings or Specifications; and advise Owner in writing of Engineer's findings, conclusions, and recommendations.
- C. *Owner's Statement to Contractor Regarding Site Condition:* After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the subsurface or physical condition in question, addressing the resumption of Work in connection with such condition, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations, in whole or in part.
- D. *Possible Price and Times Adjustments:*
1. Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times, or both, to the extent that the existence of a differing subsurface or physical condition, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:
 - a. such condition must fall within any one or more of the categories described in Paragraph 5.04.A;
 - b. with respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03; and,

- c. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.
- 2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times with respect to a subsurface or physical condition if:
 - a. Contractor knew of the existence of such condition at the time Contractor made a commitment to Owner with respect to Contract Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract, or otherwise; or
 - b. the existence of such condition reasonably could have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas expressly required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such commitment; or
 - c. Contractor failed to give the written notice as required by Paragraph 5.04.A.
- 3. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, or both, then any such adjustment shall be set forth in a Change Order.
- 4. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, or both, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the subsurface or physical condition in question.

5.05 *Underground Facilities*

- A. *Contractor's Responsibilities:* The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or adjacent to the Site is based on information and data furnished to Owner or Engineer by the owners of such Underground Facilities, including Owner, or by others. Unless it is otherwise expressly provided in the Supplementary Conditions:
 - 1. Owner and Engineer do not warrant or guarantee the accuracy or completeness of any such information or data provided by others; and
 - 2. the cost of all of the following will be included in the Contract Price, and Contractor shall have full responsibility for:
 - a. reviewing and checking all information and data regarding existing Underground Facilities at the Site;
 - b. locating all Underground Facilities shown or indicated in the Contract Documents as being at the Site;
 - c. coordination of the Work with the owners (including Owner) of such Underground Facilities, during construction; and
 - d. the safety and protection of all existing Underground Facilities at the Site, and repairing any damage thereto resulting from the Work.
- B. *Notice by Contractor:* If Contractor believes that an Underground Facility that is uncovered or revealed at the Site was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy, then Contractor shall, promptly after

becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), identify the owner of such Underground Facility and give written notice to that owner and to Owner and Engineer.

- C. *Engineer's Review:* Engineer will promptly review the Underground Facility and conclude whether such Underground Facility was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding the Contractor's resumption of Work in connection with the Underground Facility in question; determine the extent, if any, to which a change is required in the Drawings or Specifications to reflect and document the consequences of the existence or location of the Underground Facility; and advise Owner in writing of Engineer's findings, conclusions, and recommendations. During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.
- D. *Owner's Statement to Contractor Regarding Underground Facility:* After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the Underground Facility in question, addressing the resumption of Work in connection with such Underground Facility, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations in whole or in part.
- E. *Possible Price and Times Adjustments:*
 - 1. Contractor shall be entitled to an equitable adjustment in the Contract Price or Contract Times, or both, to the extent that any existing Underground Facility at the Site that was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:
 - a. Contractor did not know of and could not reasonably have been expected to be aware of or to have anticipated the existence or actual location of the Underground Facility in question;
 - b. With respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03;
 - c. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times; and
 - d. Contractor gave the notice required in Paragraph 5.05.B.
 - 2. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, or both, then any such adjustment shall be set forth in a Change Order.
 - 3. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, or both, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the Underground Facility in question.

5.06 *Hazardous Environmental Conditions at Site*

- A. *Reports and Drawings:* The Supplementary Conditions identify:
1. those reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site; and
 2. Technical Data contained in such reports and drawings.
- B. *Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely on the accuracy of the Technical Data (as defined in Article 1) contained in any geotechnical or environmental report prepared for the Project and made available to Contractor. Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors with respect to:
1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures of construction to be employed by Contractor and safety precautions and programs incident thereto; or
 2. other data, interpretations, opinions and information contained in such reports or shown or indicated in such drawings; or
 3. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions or information.
- C. Contractor shall not be responsible for removing or remediating any Hazardous Environmental Condition encountered, uncovered, or revealed at the Site unless such removal or remediation is expressly identified in the Contract Documents to be within the scope of the Work.
- D. Contractor shall be responsible for controlling, containing, and duly removing all Constituents of Concern brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible, and for any associated costs; and for the costs of removing and remediating any Hazardous Environmental Condition created by the presence of any such Constituents of Concern.
- E. If Contractor encounters, uncovers, or reveals a Hazardous Environmental Condition whose removal or remediation is not expressly identified in the Contract Documents as being within the scope of the Work, or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, then Contractor shall immediately: (1) secure or otherwise isolate such condition; (2) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 7.15); and (3) notify Owner and Engineer (and promptly thereafter confirm such notice in writing). Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such condition or take corrective action, if any. Promptly after consulting with Engineer, Owner shall take such actions as are necessary to permit Owner to timely obtain required permits and provide Contractor the written notice required by Paragraph 5.06.F. If Contractor or anyone for whom Contractor is responsible created the Hazardous Environmental Condition in question, then Owner may remove and remediate the Hazardous Environmental Condition, and impose a set-off against payments to account for the associated costs.

- F. Contractor shall not resume Work in connection with such Hazardous Environmental Condition or in any affected area until after Owner has obtained any required permits related thereto, and delivered written notice to Contractor either (1) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work, or (2) specifying any special conditions under which such Work may be resumed safely.
- G. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, or both, as a result of such Work stoppage or such special conditions under which Work is agreed to be resumed by Contractor, then within 30 days of Owner's written notice regarding the resumption of Work, Contractor may submit a Change Proposal, or Owner may impose a set-off.
- H. If after receipt of such written notice Contractor does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special conditions, then Owner may order the portion of the Work that is in the area affected by such condition to be deleted from the Work, following the contractual change procedures in Article 11. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 8.
- I. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition (1) was not shown or indicated in the Drawings, Specifications, or other Contract Documents, identified as Technical Data entitled to limited reliance pursuant to Paragraph 5.06.B, or identified in the Contract Documents to be included within the scope of the Work, and (2) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.H shall obligate Owner to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.
- J. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the failure to control, contain, or remove a Constituent of Concern brought to the Site by Contractor or by anyone for whom Contractor is responsible, or to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.J shall obligate Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.
- K. The provisions of Paragraphs 5.03, 5.04, and 5.05 do not apply to the presence of Constituents of Concern or to a Hazardous Environmental Condition uncovered or revealed at the Site.

ARTICLE 6 – BONDS AND INSURANCE

6.01 *Performance, Payment, and Other Bonds*

- A. Contractor shall furnish a performance bond and a payment bond, each in an amount at least equal to the Contract Price, as security for the faithful performance and payment of all of Contractor's obligations under the Contract. These bonds shall remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 15.08, whichever is later, except as provided otherwise by Laws or Regulations, the Supplementary Conditions, or other specific provisions of the Contract. Contractor shall also furnish such other bonds as are required by the Supplementary Conditions or other specific provisions of the Contract.
- B. All bonds shall be in the form prescribed by the Contract except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (as amended and supplemented) by the Financial Management Service, Surety Bond Branch, U.S. Department of the Treasury. A bond signed by an agent or attorney-in-fact must be accompanied by a certified copy of that individual's authority to bind the surety. The evidence of authority shall show that it is effective on the date the agent or attorney-in-fact signed the accompanying bond.
- C. Contractor shall obtain the required bonds from surety companies that are duly licensed or authorized in the jurisdiction in which the Project is located to issue bonds in the required amounts.
- D. If the surety on a bond furnished by Contractor is declared bankrupt or becomes insolvent, or its right to do business is terminated in any state or jurisdiction where any part of the Project is located, or the surety ceases to meet the requirements above, then Contractor shall promptly notify Owner and Engineer and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which shall comply with the bond and surety requirements above.
- E. If Contractor has failed to obtain a required bond, Owner may exclude the Contractor from the Site and exercise Owner's termination rights under Article 16.
- F. Upon request, Owner shall provide a copy of the payment bond to any Subcontractor, Supplier, or other person or entity claiming to have furnished labor or materials used in the performance of the Work.

6.02 *Insurance—General Provisions*

- A. Owner and Contractor shall obtain and maintain insurance as required in this Article and in the Supplementary Conditions.
- B. All insurance required by the Contract to be purchased and maintained by Owner or Contractor shall be obtained from insurance companies that are duly licensed or authorized, in the state or jurisdiction in which the Project is located, to issue insurance policies for the required limits and coverages. Unless a different standard is indicated in the Supplementary Conditions, all companies that provide insurance policies required under this Contract shall have an A.M. Best rating of A-VII or better.
- C. Contractor shall deliver to Owner, with copies to each named insured and additional insured (as identified in this Article, in the Supplementary Conditions, or elsewhere in the Contract), certificates of insurance establishing that Contractor has obtained and is

maintaining the policies, coverages, and endorsements required by the Contract. Upon request by Owner or any other insured, Contractor shall also furnish other evidence of such required insurance, including but not limited to copies of policies and endorsements, and documentation of applicable self-insured retentions and deductibles. Contractor may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.

- D. Owner shall deliver to Contractor, with copies to each named insured and additional insured (as identified in this Article, the Supplementary Conditions, or elsewhere in the Contract), certificates of insurance establishing that Owner has obtained and is maintaining the policies, coverages, and endorsements required of Owner by the Contract (if any). Upon request by Contractor or any other insured, Owner shall also provide other evidence of such required insurance (if any), including but not limited to copies of policies and endorsements, and documentation of applicable self-insured retentions and deductibles. Owner may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.
- E. Failure of Owner or Contractor to demand such certificates or other evidence of the other party's full compliance with these insurance requirements, or failure of Owner or Contractor to identify a deficiency in compliance from the evidence provided, shall not be construed as a waiver of the other party's obligation to obtain and maintain such insurance.
- F. If either party does not purchase or maintain all of the insurance required of such party by the Contract, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage.
- G. If Contractor has failed to obtain and maintain required insurance, Owner may exclude the Contractor from the Site, impose an appropriate set-off against payment, and exercise Owner's termination rights under Article 16.
- H. Without prejudice to any other right or remedy, if a party has failed to obtain required insurance, the other party may elect to obtain equivalent insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and the Contract Price shall be adjusted accordingly.
- I. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor or Contractor's interests.
- J. The insurance and insurance limits required herein shall not be deemed as a limitation on Contractor's liability under the indemnities granted to Owner and other individuals and entities in the Contract.

6.03 *Contractor's Insurance*

- A. *Workers' Compensation:* Contractor shall purchase and maintain workers' compensation and employer's liability insurance for:
 - 1. claims under workers' compensation, disability benefits, and other similar employee benefit acts.
 - 2. United States Longshoreman and Harbor Workers' Compensation Act and Jones Act coverage (if applicable).
 - 3. claims for damages because of bodily injury, occupational sickness or disease, or death of Contractor's employees (by stop-gap endorsement in monopolist worker's compensation states).

4. Foreign voluntary worker compensation (if applicable).
- B. *Commercial General Liability—Claims Covered:* Contractor shall purchase and maintain commercial general liability insurance, covering all operations by or on behalf of Contractor, on an occurrence basis, against:
1. claims for damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees.
 2. claims for damages insured by reasonably available personal injury liability coverage.
 3. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom.
- C. *Commercial General Liability—Form and Content:* Contractor's commercial liability policy shall be written on a 1996 (or later) ISO commercial general liability form (occurrence form) and include the following coverages and endorsements:
1. Products and completed operations coverage:
 - a. Such insurance shall be maintained for three years after final payment.
 - b. Contractor shall furnish Owner and each other additional insured (as identified in the Supplementary Conditions or elsewhere in the Contract) evidence of continuation of such insurance at final payment and three years thereafter.
 2. Blanket contractual liability coverage, to the extent permitted by law, including but not limited to coverage of Contractor's contractual indemnity obligations in Paragraph 7.18.
 3. Broad form property damage coverage.
 4. Severability of interest.
 5. Underground, explosion, and collapse coverage.
 6. Personal injury coverage.
 7. Additional insured endorsements that include both ongoing operations and products and completed operations coverage through ISO Endorsements CG 20 10 10 01 and CG 20 37 10 01 (together); or CG 20 10 07 04 and CG 20 37 07 04 (together); or their equivalent.
 8. For design professional additional insureds, ISO Endorsement CG 20 32 07 04, "Additional Insured—Engineers, Architects or Surveyors Not Engaged by the Named Insured" or its equivalent.
- D. *Automobile liability:* Contractor shall purchase and maintain automobile liability insurance against claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance, or use of any motor vehicle. The automobile liability policy shall be written on an occurrence basis.
- E. *Umbrella or excess liability:* Contractor shall purchase and maintain umbrella or excess liability insurance written over the underlying employer's liability, commercial general liability, and automobile liability insurance described in the paragraphs above. Subject to industry-standard exclusions, the coverage afforded shall follow form as to each and every one of the underlying policies.
- F. *Contractor's pollution liability insurance:* Contractor shall purchase and maintain a policy covering third-party injury and property damage claims, including clean-up costs, as a result

of pollution conditions arising from Contractor's operations and completed operations. This insurance shall be maintained for no less than three years after final completion.

- G. *Additional insureds*: The Contractor's commercial general liability, automobile liability, umbrella or excess, and pollution liability policies shall include and list as additional insureds Owner and Engineer, and any individuals or entities identified in the Supplementary Conditions; include coverage for the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of all such additional insureds; and the insurance afforded to these additional insureds shall provide primary coverage for all claims covered thereby (including as applicable those arising from both ongoing and completed operations) on a non-contributory basis. Contractor shall obtain all necessary endorsements to support these requirements.
- H. *Contractor's professional liability insurance*: If Contractor will provide or furnish professional services under this Contract, through a delegation of professional design services or otherwise, then Contractor shall be responsible for purchasing and maintaining applicable professional liability insurance. This insurance shall provide protection against claims arising out of performance of professional design or related services, and caused by a negligent error, omission, or act for which the insured party is legally liable. It shall be maintained throughout the duration of the Contract and for a minimum of two years after Substantial Completion. If such professional design services are performed by a Subcontractor, and not by Contractor itself, then the requirements of this paragraph may be satisfied through the purchasing and maintenance of such insurance by such Subcontractor.
- I. *General provisions*: The policies of insurance required by this Paragraph 6.03 shall:
 - 1. include at least the specific coverages provided in this Article.
 - 2. be written for not less than the limits of liability provided in this Article and in the Supplementary Conditions, or required by Laws or Regulations, whichever is greater.
 - 3. contain a provision or endorsement that the coverage afforded will not be canceled, materially changed, or renewal refused until at least 10 days prior written notice has been given to Contractor. Within three days of receipt of any such written notice, Contractor shall provide a copy of the notice to Owner, Engineer, and each other insured under the policy.
 - 4. remain in effect at least until final payment (and longer if expressly required in this Article) and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work as a warranty or correction obligation, or otherwise, or returning to the Site to conduct other tasks arising from the Contract Documents.
 - 5. be appropriate for the Work being performed and provide protection from claims that may arise out of or result from Contractor's performance of the Work and Contractor's other obligations under the Contract Documents, whether it is to be performed by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable.
- J. The coverage requirements for specific policies of insurance must be met by such policies, and not by reference to excess or umbrella insurance provided in other policies.

6.04 *Owner's Liability Insurance*

- A. In addition to the insurance required to be provided by Contractor under Paragraph 6.03, Owner, at Owner's option, may purchase and maintain at Owner's expense Owner's own liability insurance as will protect Owner against claims which may arise from operations under the Contract Documents.
- B. Owner's liability policies, if any, operate separately and independently from policies required to be provided by Contractor, and Contractor cannot rely upon Owner's liability policies for any of Contractor's obligations to the Owner, Engineer, or third parties.

6.05 *Property Insurance*

- A. *Builder's Risk:* Unless otherwise provided in the Supplementary Conditions, Contractor shall purchase and maintain builder's risk insurance upon the Work on a completed value basis, in the amount of the full insurable replacement cost thereof (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). This insurance shall:
 - 1. include the Owner and Contractor as named insureds, and all Subcontractors, and any individuals or entities required by the Supplementary Conditions to be insured under such builder's risk policy, as insureds or named insureds. For purposes of the remainder of this Paragraph 6.05, Paragraphs 6.06 and 6.07, and any corresponding Supplementary Conditions, the parties required to be insured shall collectively be referred to as "insureds."
 - 2. be written on a builder's risk "all risk" policy form that shall at least include insurance for physical loss or damage to the Work, temporary buildings, falsework, and materials and equipment in transit, and shall insure against at least the following perils or causes of loss: fire; lightning; windstorm; riot; civil commotion; terrorism; vehicle impact; aircraft; smoke; theft; vandalism and malicious mischief; mechanical breakdown, boiler explosion, and artificially generated electric current; earthquake; volcanic activity, and other earth movement; flood; collapse; explosion; debris removal; demolition occasioned by enforcement of Laws and Regulations; water damage (other than that caused by flood); and such other perils or causes of loss as may be specifically required by the Supplementary Conditions. If insurance against mechanical breakdown, boiler explosion, and artificially generated electric current; earthquake; volcanic activity, and other earth movement; or flood, are not commercially available under builder's risk policies, by endorsement or otherwise, such insurance may be provided through other insurance policies acceptable to Owner and Contractor.
 - 3. cover, as insured property, at least the following: (a) the Work and all materials, supplies, machinery, apparatus, equipment, fixtures, and other property of a similar nature that are to be incorporated into or used in the preparation, fabrication, construction, erection, or completion of the Work, including Owner-furnished or assigned property; (b) spare parts inventory required within the scope of the Contract; and (c) temporary works which are not intended to form part of the permanent constructed Work but which are intended to provide working access to the Site, or to the Work under construction, or which are intended to provide temporary support for the Work under construction, including scaffolding, form work, fences, shoring, falsework, and temporary structures.
 - 4. cover expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects).

5. extend to cover damage or loss to insured property while in temporary storage at the Site or in a storage location outside the Site (but not including property stored at the premises of a manufacturer or Supplier).
 6. extend to cover damage or loss to insured property while in transit.
 7. allow for partial occupation or use of the Work by Owner, such that those portions of the Work that are not yet occupied or used by Owner shall remain covered by the builder's risk insurance.
 8. allow for the waiver of the insurer's subrogation rights, as set forth below.
 9. provide primary coverage for all losses and damages caused by the perils or causes of loss covered.
 10. not include a co-insurance clause.
 11. include an exception for ensuing losses from physical damage or loss with respect to any defective workmanship, design, or materials exclusions.
 12. include performance/hot testing and start-up.
 13. be maintained in effect, subject to the provisions herein regarding Substantial Completion and partial occupancy or use of the Work by Owner, until the Work is complete.
- B. *Notice of Cancellation or Change:* All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained in accordance with this Paragraph 6.05 will contain a provision or endorsement that the coverage afforded will not be canceled or materially changed or renewal refused until at least 10 days prior written notice has been given to the purchasing policyholder. Within three days of receipt of any such written notice, the purchasing policyholder shall provide a copy of the notice to each other insured.
- C. *Deductibles:* The purchaser of any required builder's risk or property insurance shall pay for costs not covered because of the application of a policy deductible.
- D. *Partial Occupancy or Use by Owner:* If Owner will occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work as provided in Paragraph 15.04, then Owner (directly, if it is the purchaser of the builder's risk policy, or through Contractor) will provide notice of such occupancy or use to the builder's risk insurer. The builder's risk insurance shall not be canceled or permitted to lapse on account of any such partial use or occupancy; rather, those portions of the Work that are occupied or used by Owner may come off the builder's risk policy, while those portions of the Work not yet occupied or used by Owner shall remain covered by the builder's risk insurance.
- E. *Additional Insurance:* If Contractor elects to obtain other special insurance to be included in or supplement the builder's risk or property insurance policies provided under this Paragraph 6.05, it may do so at Contractor's expense.
- F. *Insurance of Other Property:* If the express insurance provisions of the Contract do not require or address the insurance of a property item or interest, such as tools, construction equipment, or other personal property owned by Contractor, a Subcontractor, or an employee of Contractor or a Subcontractor, then the entity or individual owning such property item will be responsible for deciding whether to insure it, and if so in what amount.

6.06 *Waiver of Rights*

- A. All policies purchased in accordance with Paragraph 6.05, expressly including the builder's risk policy, shall contain provisions to the effect that in the event of payment of any loss or damage the insurers will have no rights of recovery against any insureds thereunder, or against Engineer or its consultants, or their officers, directors, members, partners, employees, agents, consultants, or subcontractors. Owner and Contractor waive all rights against each other and the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work; and, in addition, waive all such rights against Engineer, its consultants, all Subcontractors, all individuals or entities identified in the Supplementary Conditions as insureds, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, under such policies for losses and damages so caused. None of the above waivers shall extend to the rights that any party making such waiver may have to the proceeds of insurance held by Owner or Contractor as trustee or fiduciary, or otherwise payable under any policy so issued.
- B. Owner waives all rights against Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, for:
 - 1. loss due to business interruption, loss of use, or other consequential loss extending beyond direct physical loss or damage to Owner's property or the Work caused by, arising out of, or resulting from fire or other perils whether or not insured by Owner; and
 - 2. loss or damage to the completed Project or part thereof caused by, arising out of, or resulting from fire or other insured peril or cause of loss covered by any property insurance maintained on the completed Project or part thereof by Owner during partial occupancy or use pursuant to Paragraph 15.04, after Substantial Completion pursuant to Paragraph 15.03, or after final payment pursuant to Paragraph 15.06.
- C. Any insurance policy maintained by Owner covering any loss, damage or consequential loss referred to in Paragraph 6.06.B shall contain provisions to the effect that in the event of payment of any such loss, damage, or consequential loss, the insurers will have no rights of recovery against Contractor, Subcontractors, or Engineer, or the officers, directors, members, partners, employees, agents, consultants, or subcontractors of each and any of them.
- D. Contractor shall be responsible for assuring that the agreement under which a Subcontractor performs a portion of the Work contains provisions whereby the Subcontractor waives all rights against Owner, Contractor, all individuals or entities identified in the Supplementary Conditions as insureds, the Engineer and its consultants, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, relating to, or resulting from any of the perils or causes of loss covered by builder's risk insurance and any other property insurance applicable to the Work.

6.07 *Receipt and Application of Property Insurance Proceeds*

- A. Any insured loss under the builder's risk and other policies of insurance required by Paragraph 6.05 will be adjusted and settled with the named insured that purchased the

policy. Such named insured shall act as fiduciary for the other insureds, and give notice to such other insureds that adjustment and settlement of a claim is in progress. Any other insured may state its position regarding a claim for insured loss in writing within 15 days after notice of such claim.

- B. Proceeds for such insured losses may be made payable by the insurer either jointly to multiple insureds, or to the named insured that purchased the policy in its own right and as fiduciary for other insureds, subject to the requirements of any applicable mortgage clause. A named insured receiving insurance proceeds under the builder's risk and other policies of insurance required by Paragraph 6.05 shall distribute such proceeds in accordance with such agreement as the parties in interest may reach, or as otherwise required under the dispute resolution provisions of this Contract or applicable Laws and Regulations.
- C. If no other special agreement is reached, the damaged Work shall be repaired or replaced, the money so received applied on account thereof, and the Work and the cost thereof covered by Change Order, if needed.

ARTICLE 7 – CONTRACTOR'S RESPONSIBILITIES

7.01 *Supervision and Superintendence*

- A. Contractor shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction.
- B. At all times during the progress of the Work, Contractor shall assign a competent resident superintendent who shall not be replaced without written notice to Owner and Engineer except under extraordinary circumstances.

7.02 *Labor; Working Hours*

- A. Contractor shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. Contractor shall at all times maintain good discipline and order at the Site.
- B. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site shall be performed during regular working hours, Monday through Friday. Contractor will not perform Work on a Saturday, Sunday, or any legal holiday. Contractor may perform Work outside regular working hours or on Saturdays, Sundays, or legal holidays only with Owner's written consent, which will not be unreasonably withheld.

7.03 *Services, Materials, and Equipment*

- A. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start up, and completion of the Work, whether or not such items are specifically called for in the Contract Documents.
- B. All materials and equipment incorporated into the Work shall be of good quality and new, except as otherwise provided in the Contract Documents. All special warranties and

guarantees required by the Specifications shall expressly run to the benefit of Owner. If required by Engineer, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment.

- C. All materials and equipment shall be stored, applied, installed, connected, erected, protected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise may be provided in the Contract Documents.

7.04 "Or Equals"

- A. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the Contract Price has been based upon Contractor furnishing such item as specified. The specification or description of such an item is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or equal" item is permitted, Contractor may request that Engineer authorize the use of other items of material or equipment, or items from other proposed suppliers under the circumstances described below.
 - 1. If Engineer in its sole discretion determines that an item of material or equipment proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, Engineer shall deem it an "or equal" item. For the purposes of this paragraph, a proposed item of material or equipment will be considered functionally equal to an item so named if:
 - a. in the exercise of reasonable judgment Engineer determines that:
 - 1) it is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;
 - 2) it will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole;
 - 3) it has a proven record of performance and availability of responsive service; and
 - 4) it is not objectionable to Owner.
 - b. Contractor certifies that, if approved and incorporated into the Work:
 - 1) there will be no increase in cost to the Owner or increase in Contract Times; and
 - 2) it will conform substantially to the detailed requirements of the item named in the Contract Documents.
- B. *Contractor's Expense:* Contractor shall provide all data in support of any proposed "or equal" item at Contractor's expense.
- C. *Engineer's Evaluation and Determination:* Engineer will be allowed a reasonable time to evaluate each "or-equal" request. Engineer may require Contractor to furnish additional data about the proposed "or-equal" item. Engineer will be the sole judge of acceptability. No "or-equal" item will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an "or-equal", which will be evidenced by an approved Shop Drawing or other written communication. Engineer will advise Contractor in writing of any negative determination.

- D. *Effect of Engineer's Determination:* Neither approval nor denial of an "or-equal" request shall result in any change in Contract Price. The Engineer's denial of an "or-equal" request shall be final and binding, and may not be reversed through an appeal under any provision of the Contract Documents.
- E. *Treatment as a Substitution Request:* If Engineer determines that an item of material or equipment proposed by Contractor does not qualify as an "or-equal" item, Contractor may request that Engineer consider the proposed item as a substitute pursuant to Paragraph 7.05.

7.05 Substitutes

- A. Unless the specification or description of an item of material or equipment required to be furnished under the Contract Documents contains or is followed by words reading that no substitution is permitted, Contractor may request that Engineer authorize the use of other items of material or equipment under the circumstances described below. To the extent possible such requests shall be made before commencement of related construction at the Site.
 - 1. Contractor shall submit sufficient information as provided below to allow Engineer to determine if the item of material or equipment proposed is functionally equivalent to that named and an acceptable substitute therefor. Engineer will not accept requests for review of proposed substitute items of material or equipment from anyone other than Contractor.
 - 2. The requirements for review by Engineer will be as set forth in Paragraph 7.05.B, as supplemented by the Specifications, and as Engineer may decide is appropriate under the circumstances.
 - 3. Contractor shall make written application to Engineer for review of a proposed substitute item of material or equipment that Contractor seeks to furnish or use. The application:
 - a. shall certify that the proposed substitute item will:
 - 1) perform adequately the functions and achieve the results called for by the general design,
 - 2) be similar in substance to that specified, and
 - 3) be suited to the same use as that specified.
 - b. will state:
 - 1) the extent, if any, to which the use of the proposed substitute item will necessitate a change in Contract Times,
 - 2) whether use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for other work on the Project) to adapt the design to the proposed substitute item, and
 - 3) whether incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty.
 - c. will identify:
 - 1) all variations of the proposed substitute item from that specified, and

- 2) available engineering, sales, maintenance, repair, and replacement services.
- d. shall contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including but not limited to changes in Contract Price, shared savings, costs of redesign, and claims of other contractors affected by any resulting change.
- B. *Engineer's Evaluation and Determination:* Engineer will be allowed a reasonable time to evaluate each substitute request, and to obtain comments and direction from Owner. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No substitute will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an acceptable substitute. Engineer's determination will be evidenced by a Field Order or a proposed Change Order accounting for the substitution itself and all related impacts, including changes in Contract Price or Contract Times. Engineer will advise Contractor in writing of any negative determination.
- C. *Special Guarantee:* Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any substitute.
- D. *Reimbursement of Engineer's Cost:* Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor. Whether or not Engineer approves a substitute so proposed or submitted by Contractor, Contractor shall reimburse Owner for the reasonable charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the reasonable charges of Engineer for making changes in the Contract Documents (or in the provisions of any other direct contract with Owner) resulting from the acceptance of each proposed substitute.
- E. *Contractor's Expense:* Contractor shall provide all data in support of any proposed substitute at Contractor's expense.
- F. *Effect of Engineer's Determination:* If Engineer approves the substitution request, Contractor shall execute the proposed Change Order and proceed with the substitution. The Engineer's denial of a substitution request shall be final and binding, and may not be reversed through an appeal under any provision of the Contract Documents. Contractor may challenge the scope of reimbursement costs imposed under Paragraph 7.05.D, by timely submittal of a Change Proposal.

7.06 *Concerning Subcontractors, Suppliers, and Others*

- A. Contractor may retain Subcontractors and Suppliers for the performance of parts of the Work. Such Subcontractors and Suppliers must be acceptable to Owner.
- B. Contractor shall retain specific Subcontractors, Suppliers, or other individuals or entities for the performance of designated parts of the Work if required by the Contract to do so.
- C. Subsequent to the submittal of Contractor's Bid or final negotiation of the terms of the Contract, Owner may not require Contractor to retain any Subcontractor, Supplier, or other individual or entity to furnish or perform any of the Work against which Contractor has reasonable objection.
- D. Prior to entry into any binding subcontract or purchase order, Contractor shall submit to Owner the identity of the proposed Subcontractor or Supplier (unless Owner has already deemed such proposed Subcontractor or Supplier acceptable, during the bidding process or otherwise). Such proposed Subcontractor or Supplier shall be deemed acceptable to Owner unless Owner raises a substantive, reasonable objection within five days.

- E. Owner may require the replacement of any Subcontractor, Supplier, or other individual or entity retained by Contractor to perform any part of the Work. Owner also may require Contractor to retain specific replacements; provided, however, that Owner may not require a replacement to which Contractor has a reasonable objection. If Contractor has submitted the identity of certain Subcontractors, Suppliers, or other individuals or entities for acceptance by Owner, and Owner has accepted it (either in writing or by failing to make written objection thereto), then Owner may subsequently revoke the acceptance of any such Subcontractor, Supplier, or other individual or entity so identified solely on the basis of substantive, reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor, Supplier, or other individual or entity.
- F. If Owner requires the replacement of any Subcontractor, Supplier, or other individual or entity retained by Contractor to perform any part of the Work, then Contractor shall be entitled to an adjustment in Contract Price or Contract Times, or both, with respect to the replacement; and Contractor shall initiate a Change Proposal for such adjustment within 30 days of Owner's requirement of replacement.
- G. No acceptance by Owner of any such Subcontractor, Supplier, or other individual or entity, whether initially or as a replacement, shall constitute a waiver of the right of Owner to the completion of the Work in accordance with the Contract Documents.
- H. On a monthly basis Contractor shall submit to Engineer a complete list of all Subcontractors and Suppliers having a direct contract with Contractor, and of all other Subcontractors and Suppliers known to Contractor at the time of submittal.
- I. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of the Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work just as Contractor is responsible for Contractor's own acts and omissions.
- J. Contractor shall be solely responsible for scheduling and coordinating the work of Subcontractors, Suppliers, and all other individuals or entities performing or furnishing any of the Work.
- K. Contractor shall restrict all Subcontractors, Suppliers, and such other individuals or entities performing or furnishing any of the Work from communicating with Engineer or Owner, except through Contractor or in case of an emergency, or as otherwise expressly allowed herein.
- L. The divisions and sections of the Specifications and the identifications of any Drawings shall not control Contractor in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.
- M. All Work performed for Contractor by a Subcontractor or Supplier shall be pursuant to an appropriate contractual agreement that specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of Owner and Engineer.
- N. Owner may furnish to any Subcontractor or Supplier, to the extent practicable, information about amounts paid to Contractor on account of Work performed for Contractor by the particular Subcontractor or Supplier.

O. Nothing in the Contract Documents:

1. shall create for the benefit of any such Subcontractor, Supplier, or other individual or entity any contractual relationship between Owner or Engineer and any such Subcontractor, Supplier, or other individual or entity; nor
2. shall create any obligation on the part of Owner or Engineer to pay or to see to the payment of any money due any such Subcontractor, Supplier, or other individual or entity except as may otherwise be required by Laws and Regulations.

7.07 *Patent Fees and Royalties*

- A. Contractor shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product, or device which is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product, or device is specified in the Contract Documents for use in the performance of the Work and if, to the actual knowledge of Owner or Engineer, its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by Owner in the Contract Documents.
- B. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, and its officers, directors, members, partners, employees, agents, consultants, and subcontractors from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device specified in the Contract Documents, but not identified as being subject to payment of any license fee or royalty to others required by patent rights or copyrights.
- C. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device not specified in the Contract Documents.

7.08 *Permits*

- A. Unless otherwise provided in the Contract Documents, Contractor shall obtain and pay for all construction permits and licenses. Owner shall assist Contractor, when necessary, in obtaining such permits and licenses. Contractor shall pay all governmental charges and inspection fees necessary for the prosecution of the Work which are applicable at the time of the submission of Contractor's Bid (or when Contractor became bound under a negotiated contract). Owner shall pay all charges of utility owners for connections for providing permanent service to the Work

7.09 *Taxes*

- A. Contractor shall pay all sales, consumer, use, and other similar taxes required to be paid by Contractor in accordance with the Laws and Regulations of the place of the Project which are applicable during the performance of the Work.

7.10 *Laws and Regulations*

- A. Contractor shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither Owner nor Engineer shall be responsible for monitoring Contractor's compliance with any Laws or Regulations.
- B. If Contractor performs any Work or takes any other action knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all resulting costs and losses, and shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work or other action. It shall not be Contractor's responsibility to make certain that the Work described in the Contract Documents is in accordance with Laws and Regulations, but this shall not relieve Contractor of Contractor's obligations under Paragraph 3.03.
- C. Owner or Contractor may give notice to the other party of any changes after the submission of Contractor's Bid (or after the date when Contractor became bound under a negotiated contract) in Laws or Regulations having an effect on the cost or time of performance of the Work, including but not limited to changes in Laws or Regulations having an effect on procuring permits and on sales, use, value-added, consumption, and other similar taxes. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times resulting from such changes, then within 30 days of such notice Contractor may submit a Change Proposal, or Owner may initiate a Claim.

7.11 *Record Documents*

- A. Contractor shall maintain in a safe place at the Site one printed record copy of all Drawings, Specifications, Addenda, Change Orders, Work Change Directives, Field Orders, written interpretations and clarifications, and approved Shop Drawings. Contractor shall keep such record documents in good order and annotate them to show changes made during construction. These record documents, together with all approved Samples, will be available to Engineer for reference. Upon completion of the Work, Contractor shall deliver these record documents to Engineer.

7.12 *Safety and Protection*

- A. Contractor shall be solely responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the Work. Such responsibility does not relieve Subcontractors of their responsibility for the safety of persons or property in the performance of their work, nor for compliance with applicable safety Laws and Regulations. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury, or loss to:
 - 1. all persons on the Site or who may be affected by the Work;

2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and
 3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, other work in progress, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.
- B. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection. Contractor shall notify Owner; the owners of adjacent property, Underground Facilities, and other utilities; and other contractors and utility owners performing work at or adjacent to the Site, when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property or work in progress.
 - C. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. The Supplementary Conditions identify any Owner's safety programs that are applicable to the Work.
 - D. Contractor shall inform Owner and Engineer of the specific requirements of Contractor's safety program with which Owner's and Engineer's employees and representatives must comply while at the Site.
 - E. All damage, injury, or loss to any property referred to in Paragraph 7.12.A.2 or 7.12.A.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor at its expense (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).
 - F. Contractor's duties and responsibilities for safety and protection shall continue until such time as all the Work is completed and Engineer has issued a notice to Owner and Contractor in accordance with Paragraph 15.06.B that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).
 - G. Contractor's duties and responsibilities for safety and protection shall resume whenever Contractor or any Subcontractor or Supplier returns to the Site to fulfill warranty or correction obligations, or to conduct other tasks arising from the Contract Documents.

7.13 *Safety Representative*

- A. Contractor shall designate a qualified and experienced safety representative at the Site whose duties and responsibilities shall be the prevention of accidents and the maintaining and supervising of safety precautions and programs.

7.14 *Hazard Communication Programs*

- A. Contractor shall be responsible for coordinating any exchange of material safety data sheets or other hazard communication information required to be made available to or

exchanged between or among employers at the Site in accordance with Laws or Regulations.

7.15 *Emergencies*

- A. In emergencies affecting the safety or protection of persons or the Work or property at the Site or adjacent thereto, Contractor is obligated to act to prevent threatened damage, injury, or loss. Contractor shall give Engineer prompt written notice if Contractor believes that any significant changes in the Work or variations from the Contract Documents have been caused thereby or are required as a result thereof. If Engineer determines that a change in the Contract Documents is required because of the action taken by Contractor in response to such an emergency, a Work Change Directive or Change Order will be issued.

7.16 *Shop Drawings, Samples, and Other Submittals*

A. *Shop Drawing and Sample Submittal Requirements:*

- 1. Before submitting a Shop Drawing or Sample, Contractor shall have:
 - a. reviewed and coordinated the Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;
 - b. determined and verified all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;
 - c. determined and verified the suitability of all materials and equipment offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and
 - d. determined and verified all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto.
- 2. Each submittal shall bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review of that submittal, and that Contractor approves the submittal.
- 3. With each submittal, Contractor shall give Engineer specific written notice of any variations that the Shop Drawing or Sample may have from the requirements of the Contract Documents. This notice shall be set forth in a written communication separate from the Shop Drawings or Sample submittal; and, in addition, in the case of Shop Drawings by a specific notation made on each Shop Drawing submitted to Engineer for review and approval of each such variation.

- B. *Submittal Procedures for Shop Drawings and Samples:* Contractor shall submit Shop Drawings and Samples to Engineer for review and approval in accordance with the accepted Schedule of Submittals. Each submittal will be identified as Engineer may require.

1. *Shop Drawings:*

- a. Contractor shall submit the number of copies required in the Specifications.
- b. Data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Contractor proposes to

provide and to enable Engineer to review the information for the limited purposes required by Paragraph 7.16.D.

2. *Samples:*

- a. Contractor shall submit the number of Samples required in the Specifications.
- b. Contractor shall clearly identify each Sample as to material, Supplier, pertinent data such as catalog numbers, the use for which intended and other data as Engineer may require to enable Engineer to review the submittal for the limited purposes required by Paragraph 7.16.D.

3. Where a Shop Drawing or Sample is required by the Contract Documents or the Schedule of Submittals, any related Work performed prior to Engineer's review and approval of the pertinent submittal will be at the sole expense and responsibility of Contractor.

C. *Other Submittals:* Contractor shall submit other submittals to Engineer in accordance with the accepted Schedule of Submittals, and pursuant to the applicable terms of the Specifications.

D. *Engineer's Review:*

1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the Schedule of Submittals acceptable to Engineer. Engineer's review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.
2. Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction or to safety precautions or programs incident thereto.
3. Engineer's review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.
4. Engineer's review and approval of a Shop Drawing or Sample shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 7.16.A.3 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer will document any such approved variation from the requirements of the Contract Documents in a Field Order.
5. Engineer's review and approval of a Shop Drawing or Sample shall not relieve Contractor from responsibility for complying with the requirements of Paragraph 7.16.A and B.
6. Engineer's review and approval of a Shop Drawing or Sample, or of a variation from the requirements of the Contract Documents, shall not, under any circumstances, change the Contract Times or Contract Price, unless such changes are included in a Change Order.
7. Neither Engineer's receipt, review, acceptance or approval of a Shop Drawing, Sample, or other submittal shall result in such item becoming a Contract Document.

8. Contractor shall perform the Work in compliance with the requirements and commitments set forth in approved Shop Drawings and Samples, subject to the provisions of Paragraph 7.16.D.4.

E. *Resubmittal Procedures:*

1. Contractor shall make corrections required by Engineer and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review and approval. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Engineer on previous submittals.
2. Contractor shall furnish required submittals with sufficient information and accuracy to obtain required approval of an item with no more than three submittals. Engineer will record Engineer's time for reviewing a fourth or subsequent submittal of a Shop Drawings, sample, or other item requiring approval, and Contractor shall be responsible for Engineer's charges to Owner for such time. Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges.
3. If Contractor requests a change of a previously approved submittal item, Contractor shall be responsible for Engineer's charges to Owner for its review time, and Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges, unless the need for such change is beyond the control of Contractor.

7.17 *Contractor's General Warranty and Guarantee*

- A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective. Engineer and its officers, directors, members, partners, employees, agents, consultants, and subcontractors shall be entitled to rely on Contractor's warranty and guarantee.
- B. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:
 1. abuse, modification, or improper maintenance or operation by persons other than Contractor, Subcontractors, Suppliers, or any other individual or entity for whom Contractor is responsible; or
 2. normal wear and tear under normal usage.
- C. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents or a release of Contractor's obligation to perform the Work in accordance with the Contract Documents:
 1. observations by Engineer;
 2. recommendation by Engineer or payment by Owner of any progress or final payment;
 3. the issuance of a certificate of Substantial Completion by Engineer or any payment related thereto by Owner;
 4. use or occupancy of the Work or any part thereof by Owner;
 5. any review and approval of a Shop Drawing or Sample submittal;
 6. the issuance of a notice of acceptability by Engineer;
 7. any inspection, test, or approval by others; or
 8. any correction of defective Work by Owner.

- D. If the Contract requires the Contractor to accept the assignment of a contract entered into by Owner, then the specific warranties, guarantees, and correction obligations contained in the assigned contract shall govern with respect to Contractor's performance obligations to Owner for the Work described in the assigned contract.

7.18 *Indemnification*

- A. To the fullest extent permitted by Laws and Regulations, and in addition to any other obligations of Contractor under the Contract or otherwise, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the performance of the Work, provided that any such claim, cost, loss, or damage is attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom but only to the extent caused by any negligent act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work or anyone for whose acts any of them may be liable.
- B. In any and all claims against Owner or Engineer or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 7.18.A shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.
- C. The indemnification obligations of Contractor under Paragraph 7.18.A shall not extend to the liability of Engineer and Engineer's officers, directors, members, partners, employees, agents, consultants and subcontractors arising out of:
 - 1. the preparation or approval of, or the failure to prepare or approve maps, Drawings, opinions, reports, surveys, Change Orders, designs, or Specifications; or
 - 2. giving directions or instructions, or failing to give them, if that is the primary cause of the injury or damage.

7.19 *Delegation of Professional Design Services*

- A. Contractor will not be required to provide professional design services unless such services are specifically required by the Contract Documents for a portion of the Work or unless such services are required to carry out Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. Contractor shall not be required to provide professional services in violation of applicable Laws and Regulations.
- B. If professional design services or certifications by a design professional related to systems, materials, or equipment are specifically required of Contractor by the Contract Documents, Owner and Engineer will specify all performance and design criteria that such services must satisfy. Contractor shall cause such services or certifications to be provided by a properly licensed professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, and other submittals prepared by such professional. Shop

Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to Engineer.

- C. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy, and completeness of the services, certifications, or approvals performed by such design professionals, provided Owner and Engineer have specified to Contractor all performance and design criteria that such services must satisfy.
- D. Pursuant to this paragraph, Engineer's review and approval of design calculations and design drawings will be only for the limited purpose of checking for conformance with performance and design criteria given and the design concept expressed in the Contract Documents. Engineer's review and approval of Shop Drawings and other submittals (except design calculations and design drawings) will be only for the purpose stated in Paragraph 7.16.D.1.
- E. Contractor shall not be responsible for the adequacy of the performance or design criteria specified by Owner or Engineer.

ARTICLE 8 – OTHER WORK AT THE SITE

8.01 *Other Work*

- A. In addition to and apart from the Work under the Contract Documents, the Owner may perform other work at or adjacent to the Site. Such other work may be performed by Owner's employees, or through contracts between the Owner and third parties. Owner may also arrange to have third-party utility owners perform work on their utilities and facilities at or adjacent to the Site.
- B. If Owner performs other work at or adjacent to the Site with Owner's employees, or through contracts for such other work, then Owner shall give Contractor written notice thereof prior to starting any such other work. If Owner has advance information regarding the start of any utility work at or adjacent to the Site, Owner shall provide such information to Contractor.
- C. Contractor shall afford each other contractor that performs such other work, each utility owner performing other work, and Owner, if Owner is performing other work with Owner's employees, proper and safe access to the Site, and provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering such work; provided, however, that Contractor may cut or alter others' work with the written consent of Engineer and the others whose work will be affected.
- D. If the proper execution or results of any part of Contractor's Work depends upon work performed by others under this Article 8, Contractor shall inspect such other work and promptly report to Engineer in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of Contractor's Work. Contractor's failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work.

8.02 *Coordination*

- A. If Owner intends to contract with others for the performance of other work at or adjacent to the Site, to perform other work at or adjacent to the Site with Owner's employees, or to arrange to have utility owners perform work at or adjacent to the Site, the following will be set forth in the Supplementary Conditions or provided to Contractor prior to the start of any such other work:
 - 1. the identity of the individual or entity that will have authority and responsibility for coordination of the activities among the various contractors;
 - 2. an itemization of the specific matters to be covered by such authority and responsibility; and
 - 3. the extent of such authority and responsibilities.
- B. Unless otherwise provided in the Supplementary Conditions, Owner shall have sole authority and responsibility for such coordination.

8.03 *Legal Relationships*

- A. If, in the course of performing other work at or adjacent to the Site for Owner, the Owner's employees, any other contractor working for Owner, or any utility owner causes damage to the Work or to the property of Contractor or its Subcontractors, or delays, disrupts, interferes with, or increases the scope or cost of the performance of the Work, through actions or inaction, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Times, or both. Contractor must submit any Change Proposal seeking an equitable adjustment in the Contract Price or the Contract Times under this paragraph within 30 days of the damaging, delaying, disrupting, or interfering event. The entitlement to, and extent of, any such equitable adjustment shall take into account information (if any) regarding such other work that was provided to Contractor in the Contract Documents prior to the submittal of the Bid or the final negotiation of the terms of the Contract. When applicable, any such equitable adjustment in Contract Price shall be conditioned on Contractor assigning to Owner all Contractor's rights against such other contractor or utility owner with respect to the damage, delay, disruption, or interference that is the subject of the adjustment. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.
- B. Contractor shall take reasonable and customary measures to avoid damaging, delaying, disrupting, or interfering with the work of Owner, any other contractor, or any utility owner performing other work at or adjacent to the Site. If Contractor fails to take such measures and as a result damages, delays, disrupts, or interferes with the work of any such other contractor or utility owner, then Owner may impose a set-off against payments due to Contractor, and assign to such other contractor or utility owner the Owner's contractual rights against Contractor with respect to the breach of the obligations set forth in this paragraph.
- C. When Owner is performing other work at or adjacent to the Site with Owner's employees, Contractor shall be liable to Owner for damage to such other work, and for the reasonable direct delay, disruption, and interference costs incurred by Owner as a result of Contractor's failure to take reasonable and customary measures with respect to Owner's other work. In response to such damage, delay, disruption, or interference, Owner may impose a set-off against payments due to Contractor.

- D. If Contractor damages, delays, disrupts, or interferes with the work of any other contractor, or any utility owner performing other work at or adjacent to the Site, through Contractor's failure to take reasonable and customary measures to avoid such impacts, or if any claim arising out of Contractor's actions, inactions, or negligence in performance of the Work at or adjacent to the Site is made by any such other contractor or utility owner against Contractor, Owner, or Engineer, then Contractor shall (1) promptly attempt to settle the claim as to all parties through negotiations with such other contractor or utility owner, or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law, and (2) indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against any such claims, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such damage, delay, disruption, or interference.

ARTICLE 9 – OWNER'S RESPONSIBILITIES

9.01 *Communications to Contractor*

- A. Except as otherwise provided in these General Conditions, Owner shall issue all communications to Contractor through Engineer.

9.02 *Replacement of Engineer*

- A. Owner may at its discretion appoint an engineer to replace Engineer, provided Contractor makes no reasonable objection to the replacement engineer. The replacement engineer's status under the Contract Documents shall be that of the former Engineer.

9.03 *Furnish Data*

- A. Owner shall promptly furnish the data required of Owner under the Contract Documents.

9.04 *Pay When Due*

- A. Owner shall make payments to Contractor when they are due as provided in the Agreement.

9.05 *Lands and Easements; Reports, Tests, and Drawings*

- A. Owner's duties with respect to providing lands and easements are set forth in Paragraph 5.01.
- B. Owner's duties with respect to providing engineering surveys to establish reference points are set forth in Paragraph 4.03.
- C. Article 5 refers to Owner's identifying and making available to Contractor copies of reports of explorations and tests of conditions at the Site, and drawings of physical conditions relating to existing surface or subsurface structures at the Site.

9.06 *Insurance*

- A. Owner's responsibilities, if any, with respect to purchasing and maintaining liability and property insurance are set forth in Article 6.

9.07 *Change Orders*

- A. Owner's responsibilities with respect to Change Orders are set forth in Article 11.

9.08 *Inspections, Tests, and Approvals*

- A. Owner's responsibility with respect to certain inspections, tests, and approvals is set forth in Paragraph 14.02.B.

9.09 *Limitations on Owner's Responsibilities*

- A. The Owner shall not supervise, direct, or have control or authority over, nor be responsible for, Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Owner will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

9.10 *Undisclosed Hazardous Environmental Condition*

- A. Owner's responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in Paragraph 5.06.

9.11 *Evidence of Financial Arrangements*

- A. Upon request of Contractor, Owner shall furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner's obligations under the Contract Documents (including obligations under proposed changes in the Work).

9.12 *Safety Programs*

- A. While at the Site, Owner's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which Owner has been informed.
- B. Owner shall furnish copies of any applicable Owner safety programs to Contractor.

ARTICLE 10 – ENGINEER'S STATUS DURING CONSTRUCTION

10.01 *Owner's Representative*

- A. Engineer will be Owner's representative during the construction period. The duties and responsibilities and the limitations of authority of Engineer as Owner's representative during construction are set forth in the Contract.

10.02 *Visits to Site*

- A. Engineer will make visits to the Site at intervals appropriate to the various stages of construction as Engineer deems necessary in order to observe as an experienced and qualified design professional the progress that has been made and the quality of the various aspects of Contractor's executed Work. Based on information obtained during such visits and observations, Engineer, for the benefit of Owner, will determine, in general, if the Work is proceeding in accordance with the Contract Documents. Engineer will not be required to make exhaustive or continuous inspections on the Site to check the quality or quantity of the Work. Engineer's efforts will be directed toward providing for Owner a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and observations, Engineer will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work.
- B. Engineer's visits and observations are subject to all the limitations on Engineer's authority and responsibility set forth in Paragraph 10.08. Particularly, but without limitation, during

or as a result of Engineer's visits or observations of Contractor's Work, Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work.

10.03 *Project Representative*

- A. If Owner and Engineer have agreed that Engineer will furnish a Resident Project Representative to represent Engineer at the Site and assist Engineer in observing the progress and quality of the Work, then the authority and responsibilities of any such Resident Project Representative will be as provided in the Supplementary Conditions, and limitations on the responsibilities thereof will be as provided in Paragraph 10.08. If Owner designates another representative or agent to represent Owner at the Site who is not Engineer's consultant, agent, or employee, the responsibilities and authority and limitations thereon of such other individual or entity will be as provided in the Supplementary Conditions.

10.04 *Rejecting Defective Work*

- A. Engineer has the authority to reject Work in accordance with Article 14.

10.05 *Shop Drawings, Change Orders and Payments*

- A. Engineer's authority, and limitations thereof, as to Shop Drawings and Samples, are set forth in Paragraph 7.16.
- B. Engineer's authority, and limitations thereof, as to design calculations and design drawings submitted in response to a delegation of professional design services, if any, are set forth in Paragraph 7.19.
- C. Engineer's authority as to Change Orders is set forth in Article 11.
- D. Engineer's authority as to Applications for Payment is set forth in Article 15.

10.06 *Determinations for Unit Price Work*

- A. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor as set forth in Paragraph 13.03.

10.07 *Decisions on Requirements of Contract Documents and Acceptability of Work*

- A. Engineer will render decisions regarding the requirements of the Contract Documents, and judge the acceptability of the Work, pursuant to the specific procedures set forth herein for initial interpretations, Change Proposals, and acceptance of the Work. In rendering such decisions and judgments, Engineer will not show partiality to Owner or Contractor, and will not be liable to Owner, Contractor, or others in connection with any proceedings, interpretations, decisions, or judgments conducted or rendered in good faith.

10.08 *Limitations on Engineer's Authority and Responsibilities*

- A. Neither Engineer's authority or responsibility under this Article 10 or under any other provision of the Contract, nor any decision made by Engineer in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by Engineer, shall create, impose, or give rise to any duty in contract, tort, or otherwise owed by Engineer to Contractor, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.

- B. Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Engineer will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.
- C. Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.
- D. Engineer's review of the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Paragraph 15.06.A will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals, that the results certified indicate compliance with the Contract Documents.
- E. The limitations upon authority and responsibility set forth in this Paragraph 10.08 shall also apply to the Resident Project Representative, if any.

10.09 *Compliance with Safety Program*

- A. While at the Site, Engineer's employees and representatives will comply with the specific applicable requirements of Owner's and Contractor's safety programs (if any) of which Engineer has been informed.

ARTICLE 11 – AMENDING THE CONTRACT DOCUMENTS; CHANGES IN THE WORK

11.01 *Amending and Supplementing Contract Documents*

- A. The Contract Documents may be amended or supplemented by a Change Order, a Work Change Directive, or a Field Order.
 - 1. *Change Orders:*
 - a. If an amendment or supplement to the Contract Documents includes a change in the Contract Price or the Contract Times, such amendment or supplement must be set forth in a Change Order. A Change Order also may be used to establish amendments and supplements of the Contract Documents that do not affect the Contract Price or Contract Times.
 - b. Owner and Contractor may amend those terms and conditions of the Contract Documents that do not involve (1) the performance or acceptability of the Work, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, without the recommendation of the Engineer. Such an amendment shall be set forth in a Change Order.
 - 2. *Work Change Directives:* A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the modification ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order, following negotiations by the parties as to the Work Change Directive's effect, if any, on the Contract Price and Contract Times; or, if negotiations are unsuccessful, by a determination under the terms of the Contract Documents governing adjustments, expressly including Paragraph 11.04 regarding change of Contract Price. Contractor must submit any Change Proposal seeking an

adjustment of the Contract Price or the Contract Times, or both, no later than 30 days after the completion of the Work set out in the Work Change Directive. Owner must submit any Claim seeking an adjustment of the Contract Price or the Contract Times, or both, no later than 60 days after issuance of the Work Change Directive.

3. *Field Orders*: Engineer may authorize minor changes in the Work if the changes do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Such changes will be accomplished by a Field Order and will be binding on Owner and also on Contractor, which shall perform the Work involved promptly. If Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, or both, then before proceeding with the Work at issue, Contractor shall submit a Change Proposal as provided herein.

11.02 *Owner-Authorized Changes in the Work*

- A. Without invalidating the Contract and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work. Such changes shall be supported by Engineer's recommendation, to the extent the change involves the design (as set forth in the Drawings, Specifications, or otherwise), or other engineering or technical matters. Such changes may be accomplished by a Change Order, if Owner and Contractor have agreed as to the effect, if any, of the changes on Contract Times or Contract Price; or by a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved; or, in the case of a deletion in the Work, promptly cease construction activities with respect to such deleted Work. Added or revised Work shall be performed under the applicable conditions of the Contract Documents. Nothing in this paragraph shall obligate Contractor to undertake work that Contractor reasonably concludes cannot be performed in a manner consistent with Contractor's safety obligations under the Contract Documents or Laws and Regulations.

11.03 *Unauthorized Changes in the Work*

- A. Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents, as amended, modified, or supplemented, except in the case of an emergency as provided in Paragraph 7.15 or in the case of uncovering Work as provided in Paragraph 14.05.

11.04 *Change of Contract Price*

- A. The Contract Price may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Price shall comply with the provisions of Paragraph 11.06. Any Claim for an adjustment of Contract Price shall comply with the provisions of Article 12.
- B. An adjustment in the Contract Price will be determined as follows:
 1. where the Work involved is covered by unit prices contained in the Contract Documents, then by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 13.03); or
 2. where the Work involved is not covered by unit prices contained in the Contract Documents, then by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 11.04.C.2); or
 3. where the Work involved is not covered by unit prices contained in the Contract Documents and the parties do not reach mutual agreement to a lump sum, then on

the basis of the Cost of the Work (determined as provided in Paragraph 13.01) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 11.04.C).

- C. *Contractor's Fee*: When applicable, the Contractor's fee for overhead and profit shall be determined as follows:
1. a mutually acceptable fixed fee; or
 2. if a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:
 - a. for costs incurred under Paragraphs 13.01.B.1 and 13.01.B.2, the Contractor's fee shall be 15 percent;
 - b. for costs incurred under Paragraph 13.01.B.3, the Contractor's fee shall be five percent;
 - c. where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Paragraphs 11.01.C.2.a and 11.01.C.2.b is that the Contractor's fee shall be based on: (1) a fee of 15 percent of the costs incurred under Paragraphs 13.01.A.1 and 13.01.A.2 by the Subcontractor that actually performs the Work, at whatever tier, and (2) with respect to Contractor itself and to any Subcontractors of a tier higher than that of the Subcontractor that actually performs the Work, a fee of five percent of the amount (fee plus underlying costs incurred) attributable to the next lower tier Subcontractor; provided, however, that for any such subcontracted work the maximum total fee to be paid by Owner shall be no greater than 27 percent of the costs incurred by the Subcontractor that actually performs the work;
 - d. no fee shall be payable on the basis of costs itemized under Paragraphs 13.01.B.4, 13.01.B.5, and 13.01.C;
 - e. the amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in cost will be the amount of the actual net decrease in cost plus a deduction in Contractor's fee by an amount equal to five percent of such net decrease; and
 - f. when both additions and credits are involved in any one change, the adjustment in Contractor's fee shall be computed on the basis of the net change in accordance with Paragraphs 11.04.C.2.a through 11.04.C.2.e, inclusive.

11.05 *Change of Contract Times*

- A. The Contract Times may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Times shall comply with the provisions of Paragraph 11.06. Any Claim for an adjustment in the Contract Times shall comply with the provisions of Article 12.
- B. An adjustment of the Contract Times shall be subject to the limitations set forth in Paragraph 4.05, concerning delays in Contractor's progress.

11.06 *Change Proposals*

- A. Contractor shall submit a Change Proposal to Engineer to request an adjustment in the Contract Times or Contract Price; appeal an initial decision by Engineer concerning the requirements of the Contract Documents or relating to the acceptability of the Work under the Contract Documents; contest a set-off against payment due; or seek other relief under

the Contract. The Change Proposal shall specify any proposed change in Contract Times or Contract Price, or both, or other proposed relief, and explain the reason for the proposed change, with citations to any governing or applicable provisions of the Contract Documents.

1. *Procedures:* Contractor shall submit each Change Proposal to Engineer promptly (but in no event later than 30 days) after the start of the event giving rise thereto, or after such initial decision. The Contractor shall submit supporting data, including the proposed change in Contract Price or Contract Time (if any), to the Engineer and Owner within 15 days after the submittal of the Change Proposal. The supporting data shall be accompanied by a written statement that the supporting data are accurate and complete, and that any requested time or price adjustment is the entire adjustment to which Contractor believes it is entitled as a result of said event. Engineer will advise Owner regarding the Change Proposal, and consider any comments or response from Owner regarding the Change Proposal.
 2. *Engineer's Action:* Engineer will review each Change Proposal and, within 30 days after receipt of the Contractor's supporting data, either deny the Change Proposal in whole, approve it in whole, or deny it in part and approve it in part. Such actions shall be in writing, with a copy provided to Owner and Contractor. If Engineer does not take action on the Change Proposal within 30 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of Engineer's inaction the Change Proposal is deemed denied, thereby commencing the time for appeal of the denial under Article 12.
 3. *Binding Decision:* Engineer's decision will be final and binding upon Owner and Contractor, unless Owner or Contractor appeals the decision by filing a Claim under Article 12.
- B. *Resolution of Certain Change Proposals:* If the Change Proposal does not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters, then Engineer will notify the parties that the Engineer is unable to resolve the Change Proposal. For purposes of further resolution of such a Change Proposal, such notice shall be deemed a denial, and Contractor may choose to seek resolution under the terms of Article 12.

11.07 *Execution of Change Orders*

- A. Owner and Contractor shall execute appropriate Change Orders covering:
1. changes in the Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive;
 2. changes in Contract Price resulting from an Owner set-off, unless Contractor has duly contested such set-off;
 3. changes in the Work which are: (a) ordered by Owner pursuant to Paragraph 11.02, (b) required because of Owner's acceptance of defective Work under Paragraph 14.04 or Owner's correction of defective Work under Paragraph 14.07, or (c) agreed to by the parties, subject to the need for Engineer's recommendation if the change in the Work involves the design (as set forth in the Drawings, Specifications, or otherwise), or other engineering or technical matters; and
 4. changes in the Contract Price or Contract Times, or other changes, which embody the substance of any final and binding results under Paragraph 11.06, or Article 12.

- B. If Owner or Contractor refuses to execute a Change Order that is required to be executed under the terms of this Paragraph 11.07, it shall be deemed to be of full force and effect, as if fully executed.

11.08 *Notification to Surety*

- A. If the provisions of any bond require notice to be given to a surety of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Times), the giving of any such notice will be Contractor's responsibility. The amount of each applicable bond will be adjusted to reflect the effect of any such change.

ARTICLE 12 – CLAIMS

12.01 *Claims*

- A. *Claims Process:* The following disputes between Owner and Contractor shall be submitted to the Claims process set forth in this Article:
 - 1. Appeals by Owner or Contractor of Engineer's decisions regarding Change Proposals;
 - 2. Owner demands for adjustments in the Contract Price or Contract Times, or other relief under the Contract Documents; and
 - 3. Disputes that Engineer has been unable to address because they do not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters.
- B. *Submittal of Claim:* The party submitting a Claim shall deliver it directly to the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto; in the case of appeals regarding Change Proposals within 30 days of the decision under appeal. The party submitting the Claim shall also furnish a copy to the Engineer, for its information only. The responsibility to substantiate a Claim shall rest with the party making the Claim. In the case of a Claim by Contractor seeking an increase in the Contract Times or Contract Price, or both, Contractor shall certify that the Claim is made in good faith, that the supporting data are accurate and complete, and that to the best of Contractor's knowledge and belief the amount of time or money requested accurately reflects the full amount to which Contractor is entitled.
- C. *Review and Resolution:* The party receiving a Claim shall review it thoroughly, giving full consideration to its merits. The two parties shall seek to resolve the Claim through the exchange of information and direct negotiations. The parties may extend the time for resolving the Claim by mutual agreement. All actions taken on a Claim shall be stated in writing and submitted to the other party, with a copy to Engineer.
- D. *Mediation:*
 - 1. At any time after initiation of a Claim, Owner and Contractor may mutually agree to mediation of the underlying dispute. The agreement to mediate shall stay the Claim submittal and response process.
 - 2. If Owner and Contractor agree to mediation, then after 60 days from such agreement, either Owner or Contractor may unilaterally terminate the mediation process, and the Claim submittal and decision process shall resume as of the date of the termination. If the mediation proceeds but is unsuccessful in resolving the dispute, the Claim

submittal and decision process shall resume as of the date of the conclusion of the mediation, as determined by the mediator.

3. Owner and Contractor shall each pay one-half of the mediator's fees and costs.
- E. *Partial Approval*: If the party receiving a Claim approves the Claim in part and denies it in part, such action shall be final and binding unless within 30 days of such action the other party invokes the procedure set forth in Article 17 for final resolution of disputes.
- F. *Denial of Claim*: If efforts to resolve a Claim are not successful, the party receiving the Claim may deny it by giving written notice of denial to the other party. If the receiving party does not take action on the Claim within 90 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of the inaction, the Claim is deemed denied, thereby commencing the time for appeal of the denial. A denial of the Claim shall be final and binding unless within 30 days of the denial the other party invokes the procedure set forth in Article 17 for the final resolution of disputes.
- G. *Final and Binding Results*: If the parties reach a mutual agreement regarding a Claim, whether through approval of the Claim, direct negotiations, mediation, or otherwise; or if a Claim is approved in part and denied in part, or denied in full, and such actions become final and binding; then the results of the agreement or action on the Claim shall be incorporated in a Change Order to the extent they affect the Contract, including the Work, the Contract Times, or the Contract Price.

ARTICLE 13 – COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

13.01 Cost of the Work

- A. *Purposes for Determination of Cost of the Work*: The term Cost of the Work means the sum of all costs necessary for the proper performance of the Work at issue, as further defined below. The provisions of this Paragraph 13.01 are used for two distinct purposes:
 1. To determine Cost of the Work when Cost of the Work is a component of the Contract Price, under cost-plus-fee, time-and-materials, or other cost-based terms; or
 2. To determine the value of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price. When the value of any such adjustment is determined on the basis of Cost of the Work, Contractor is entitled only to those additional or incremental costs required because of the change in the Work or because of the event giving rise to the adjustment.
- B. *Costs Included*: Except as otherwise may be agreed to in writing by Owner, costs included in the Cost of the Work shall be in amounts no higher than those prevailing in the locality of the Project, shall not include any of the costs itemized in Paragraph 13.01.C, and shall include only the following items:
 1. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor. Such employees shall include, without limitation, superintendents, foremen, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits, which shall include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, bonuses, sick leave, and vacation and holiday pay applicable

thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, shall be included in the above to the extent authorized by Owner.

2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts shall accrue to Owner. All trade discounts, rebates, and refunds and returns from sale of surplus materials and equipment shall accrue to Owner, and Contractor shall make provisions so that they may be obtained.
3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and Contractor and shall deliver such bids to Owner, who will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee shall be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 13.01.
4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed for services specifically related to the Work.
5. Supplemental costs including the following:
 - a. The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.
 - b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Contractor.
 - c. Rentals of all construction equipment and machinery, and the parts thereof, whether rented from Contractor or others in accordance with rental agreements approved by Owner with the advice of Engineer, and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs shall be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts shall cease when the use thereof is no longer necessary for the Work.
 - d. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, as imposed by Laws and Regulations.
 - e. Deposits lost for causes other than negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.
 - f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of property insurance established in accordance with Paragraph 6.05), provided such losses and damages have resulted from causes

other than the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses shall be included in the Cost of the Work for the purpose of determining Contractor's fee.

- g. The cost of utilities, fuel, and sanitary facilities at the Site.
- h. Minor expenses such as communication service at the Site, express and courier services, and similar petty cash items in connection with the Work.
- i. The costs of premiums for all bonds and insurance that Contractor is required by the Contract Documents to purchase and maintain.

C. *Costs Excluded:* The term Cost of the Work shall not include any of the following items:

- 1. Payroll costs and other compensation of Contractor's officers, executives, principals (of partnerships and sole proprietorships), general managers, safety managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expeditors, timekeepers, clerks, and other personnel employed by Contractor, whether at the Site or in Contractor's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in Paragraph 13.01.B.1 or specifically covered by Paragraph 13.01.B.4. The payroll costs and other compensation excluded here are to be considered administrative costs covered by the Contractor's fee.
- 2. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.
- 3. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.
- 4. Costs due to the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.
- 5. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraph 13.01.B.

D. *Contractor's Fee:* When the Work as a whole is performed on the basis of cost-plus, Contractor's fee shall be determined as set forth in the Agreement. When the value of any Work covered by a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price is determined on the basis of Cost of the Work, Contractor's fee shall be determined as set forth in Paragraph 11.04.C.

E. *Documentation:* Whenever the Cost of the Work for any purpose is to be determined pursuant to this Article 13, Contractor will establish and maintain records thereof in accordance with generally accepted accounting practices and submit in a form acceptable to Engineer an itemized cost breakdown together with supporting data.

13.02 Allowances

- A. It is understood that Contractor has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be performed for such sums and by such persons or entities as may be acceptable to Owner and Engineer.

- B. *Cash Allowances*: Contractor agrees that:
 - 1. the cash allowances include the cost to Contractor (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and
 - 2. Contractor's costs for unloading and handling on the Site, labor, installation, overhead, profit, and other expenses contemplated for the cash allowances have been included in the Contract Price and not in the allowances, and no demand for additional payment on account of any of the foregoing will be valid.
- C. *Contingency Allowance*: Contractor agrees that a contingency allowance, if any, is for the sole use of Owner to cover unanticipated costs.
- D. Prior to final payment, an appropriate Change Order will be issued as recommended by Engineer to reflect actual amounts due Contractor on account of Work covered by allowances, and the Contract Price shall be correspondingly adjusted.

13.03 *Unit Price Work*

- A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement.
- B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Payments to Contractor for Unit Price Work will be based on actual quantities.
- C. Each unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.
- D. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review with Contractor the Engineer's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). Engineer's written decision thereon will be final and binding (except as modified by Engineer to reflect changed factual conditions or more accurate data) upon Owner and Contractor, subject to the provisions of the following paragraph.
- E. Within 30 days of Engineer's written decision under the preceding paragraph, Contractor may submit a Change Proposal, or Owner may file a Claim, seeking an adjustment in the Contract Price if:
 - 1. the quantity of any item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement;
 - 2. there is no corresponding adjustment with respect to any other item of Work; and
 - 3. Contractor believes that it is entitled to an increase in Contract Price as a result of having incurred additional expense or Owner believes that Owner is entitled to a decrease in Contract Price, and the parties are unable to agree as to the amount of any such increase or decrease.

ARTICLE 14 – TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

14.01 *Access to Work*

- A. Owner, Engineer, their consultants and other representatives and personnel of Owner, independent testing laboratories, and authorities having jurisdiction will have access to the Site and the Work at reasonable times for their observation, inspection, and testing. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's safety procedures and programs so that they may comply therewith as applicable.

14.02 *Tests, Inspections, and Approvals*

- A. Contractor shall give Engineer timely notice of readiness of the Work (or specific parts thereof) for all required inspections and tests, and shall cooperate with inspection and testing personnel to facilitate required inspections and tests.
- B. Owner shall retain and pay for the services of an independent inspector, testing laboratory, or other qualified individual or entity to perform all inspections and tests expressly required by the Contract Documents to be furnished and paid for by Owner, except that costs incurred in connection with tests or inspections of covered Work shall be governed by the provisions of Paragraph 14.05.
- C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.
- D. Contractor shall be responsible for arranging, obtaining, and paying for all inspections and tests required:
 - 1. by the Contract Documents, unless the Contract Documents expressly allocate responsibility for a specific inspection or test to Owner;
 - 2. to attain Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work;
 - 3. by manufacturers of equipment furnished under the Contract Documents;
 - 4. for testing, adjusting, and balancing of mechanical, electrical, and other equipment to be incorporated into the Work; and
 - 5. for acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work.

Such inspections and tests shall be performed by independent inspectors, testing laboratories, or other qualified individuals or entities acceptable to Owner and Engineer.

- E. If the Contract Documents require the Work (or part thereof) to be approved by Owner, Engineer, or another designated individual or entity, then Contractor shall assume full responsibility for arranging and obtaining such approvals.
- F. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Engineer, Contractor shall, if requested by Engineer, uncover such Work for observation. Such uncovering shall be at Contractor's expense unless Contractor had given Engineer timely notice of Contractor's intention to

cover the same and Engineer had not acted with reasonable promptness in response to such notice.

14.03 *Defective Work*

- A. *Contractor's Obligation:* It is Contractor's obligation to assure that the Work is not defective.
- B. *Engineer's Authority:* Engineer has the authority to determine whether Work is defective, and to reject defective Work.
- C. *Notice of Defects:* Prompt notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor.
- D. *Correction, or Removal and Replacement:* Promptly after receipt of written notice of defective Work, Contractor shall correct all such defective Work, whether or not fabricated, installed, or completed, or, if Engineer has rejected the defective Work, remove it from the Project and replace it with Work that is not defective.
- E. *Preservation of Warranties:* When correcting defective Work, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.
- F. *Costs and Damages:* In addition to its correction, removal, and replacement obligations with respect to defective Work, Contractor shall pay all claims, costs, losses, and damages arising out of or relating to defective Work, including but not limited to the cost of the inspection, testing, correction, removal, replacement, or reconstruction of such defective Work, fines levied against Owner by governmental authorities because the Work is defective, and the costs of repair or replacement of work of others resulting from defective Work. Prior to final payment, if Owner and Contractor are unable to agree as to the measure of such claims, costs, losses, and damages resulting from defective Work, then Owner may impose a reasonable set-off against payments due under Article 15.

14.04 *Acceptance of Defective Work*

- A. If, instead of requiring correction or removal and replacement of defective Work, Owner prefers to accept it, Owner may do so (subject, if such acceptance occurs prior to final payment, to Engineer's confirmation that such acceptance is in general accord with the design intent and applicable engineering principles, and will not endanger public safety). Contractor shall pay all claims, costs, losses, and damages attributable to Owner's evaluation of and determination to accept such defective Work (such costs to be approved by Engineer as to reasonableness), and for the diminished value of the Work to the extent not otherwise paid by Contractor. If any such acceptance occurs prior to final payment, the necessary revisions in the Contract Documents with respect to the Work shall be incorporated in a Change Order. If the parties are unable to agree as to the decrease in the Contract Price, reflecting the diminished value of Work so accepted, then Owner may impose a reasonable set-off against payments due under Article 15. If the acceptance of defective Work occurs after final payment, Contractor shall pay an appropriate amount to Owner.

14.05 *Uncovering Work*

- A. Engineer has the authority to require special inspection or testing of the Work, whether or not the Work is fabricated, installed, or completed.

- B. If any Work is covered contrary to the written request of Engineer, then Contractor shall, if requested by Engineer, uncover such Work for Engineer's observation, and then replace the covering, all at Contractor's expense.
- C. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, then Contractor, at Engineer's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as Engineer may require, that portion of the Work in question, and provide all necessary labor, material, and equipment.
 - 1. If it is found that the uncovered Work is defective, Contractor shall be responsible for all claims, costs, losses, and damages arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and pending Contractor's full discharge of this responsibility the Owner shall be entitled to impose a reasonable set-off against payments due under Article 15.
 - 2. If the uncovered Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, or both, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, then Contractor may submit a Change Proposal within 30 days of the determination that the Work is not defective.

14.06 *Owner May Stop the Work*

- A. If the Work is defective, or Contractor fails to supply sufficient skilled workers or suitable materials or equipment, or fails to perform the Work in such a way that the completed Work will conform to the Contract Documents, then Owner may order Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of Owner to stop the Work shall not give rise to any duty on the part of Owner to exercise this right for the benefit of Contractor, any Subcontractor, any Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

14.07 *Owner May Correct Defective Work*

- A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work, or to remove and replace rejected Work as required by Engineer, or if Contractor fails to perform the Work in accordance with the Contract Documents, or if Contractor fails to comply with any other provision of the Contract Documents, then Owner may, after seven days written notice to Contractor, correct or remedy any such deficiency.
- B. In exercising the rights and remedies under this Paragraph 14.07, Owner shall proceed expeditiously. In connection with such corrective or remedial action, Owner may exclude Contractor from all or part of the Site, take possession of all or part of the Work and suspend Contractor's services related thereto, and incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's representatives, agents and employees, Owner's other contractors, and Engineer and Engineer's consultants access to the Site to enable Owner to exercise the rights and remedies under this paragraph.
- C. All claims, costs, losses, and damages incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 14.07 will be charged against Contractor as set-offs against payments due under Article 15. Such claims, costs, losses and damages will

include but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of Contractor's defective Work.

- D. Contractor shall not be allowed an extension of the Contract Times because of any delay in the performance of the Work attributable to the exercise by Owner of Owner's rights and remedies under this Paragraph 14.07.

ARTICLE 15 – PAYMENTS TO CONTRACTOR; SET-OFFS; COMPLETION; CORRECTION PERIOD

15.01 Progress Payments

- A. *Basis for Progress Payments:* The Schedule of Values established as provided in Article 2 will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to Engineer. Progress payments on account of Unit Price Work will be based on the number of units completed during the pay period, as determined under the provisions of Paragraph 13.03. Progress payments for cost-based Work will be based on Cost of the Work completed by Contractor during the pay period.
- B. *Applications for Payments:*
 - 1. At least 20 days before the date established in the Agreement for each progress payment (but not more often than once a month), Contractor shall submit to Engineer for review an Application for Payment filled out and signed by Contractor covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment shall also be accompanied by a bill of sale, invoice, or other documentation warranting that Owner has received the materials and equipment free and clear of all Liens, and evidence that the materials and equipment are covered by appropriate property insurance, a warehouse bond, or other arrangements to protect Owner's interest therein, all of which must be satisfactory to Owner.
 - 2. Beginning with the second Application for Payment, each Application shall include an affidavit of Contractor stating that all previous progress payments received on account of the Work have been applied on account to discharge Contractor's legitimate obligations associated with prior Applications for Payment.
 - 3. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.
- C. *Review of Applications:*
 - 1. Engineer will, within 10 days after receipt of each Application for Payment, including each resubmittal, either indicate in writing a recommendation of payment and present the Application to Owner, or return the Application to Contractor indicating in writing Engineer's reasons for refusing to recommend payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application.
 - 2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's observations of the executed Work as an experienced and qualified design professional, and on Engineer's review of the Application for Payment and the accompanying data and schedules, that to the best of Engineer's knowledge, information and belief:

- a. the Work has progressed to the point indicated;
 - b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, the results of any subsequent tests called for in the Contract Documents, a final determination of quantities and classifications for Unit Price Work under Paragraph 13.03, and any other qualifications stated in the recommendation); and
 - c. the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Work.
3. By recommending any such payment Engineer will not thereby be deemed to have represented that:
- a. inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract; or
 - b. there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner or entitle Owner to withhold payment to Contractor.
4. Neither Engineer's review of Contractor's Work for the purposes of recommending payments nor Engineer's recommendation of any payment, including final payment, will impose responsibility on Engineer:
- a. to supervise, direct, or control the Work, or
 - b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or
 - c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work, or
 - d. to make any examination to ascertain how or for what purposes Contractor has used the money paid on account of the Contract Price, or
 - e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.
5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 15.01.C.2.
6. Engineer will recommend reductions in payment (set-offs) necessary in Engineer's opinion to protect Owner from loss because:
- a. the Work is defective, requiring correction or replacement;
 - b. the Contract Price has been reduced by Change Orders;
 - c. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;
 - d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible; or

- e. Engineer has actual knowledge of the occurrence of any of the events that would constitute a default by Contractor and therefore justify termination for cause under the Contract Documents.

D. *Payment Becomes Due:*

- 1. Ten days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended (subject to any Owner set-offs) will become due, and when due will be paid by Owner to Contractor.

E. *Reductions in Payment by Owner:*

- 1. In addition to any reductions in payment (set-offs) recommended by Engineer, Owner is entitled to impose a set-off against payment based on any of the following:
 - a. claims have been made against Owner on account of Contractor's conduct in the performance or furnishing of the Work, or Owner has incurred costs, losses, or damages on account of Contractor's conduct in the performance or furnishing of the Work, including but not limited to claims, costs, losses, or damages from workplace injuries, adjacent property damage, non-compliance with Laws and Regulations, and patent infringement;
 - b. Contractor has failed to take reasonable and customary measures to avoid damage, delay, disruption, and interference with other work at or adjacent to the Site;
 - c. Contractor has failed to provide and maintain required bonds or insurance;
 - d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible;
 - e. Owner has incurred extra charges or engineering costs related to submittal reviews, evaluations of proposed substitutes, tests and inspections, or return visits to manufacturing or assembly facilities;
 - f. the Work is defective, requiring correction or replacement;
 - g. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;
 - h. the Contract Price has been reduced by Change Orders;
 - i. an event that would constitute a default by Contractor and therefore justify a termination for cause has occurred;
 - j. liquidated damages have accrued as a result of Contractor's failure to achieve Milestones, Substantial Completion, or final completion of the Work;
 - k. Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to Owner to secure the satisfaction and discharge of such Liens;
 - l. there are other items entitling Owner to a set off against the amount recommended.
- 2. If Owner imposes any set-off against payment, whether based on its own knowledge or on the written recommendations of Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action and the specific amount of the reduction, and promptly pay Contractor any amount

remaining after deduction of the amount so withheld. Owner shall promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by Owner and Contractor, if Contractor remedies the reasons for such action. The reduction imposed shall be binding on Contractor unless it duly submits a Change Proposal contesting the reduction.

3. Upon a subsequent determination that Owner's refusal of payment was not justified, the amount wrongfully withheld shall be treated as an amount due as determined by Paragraph 15.01.C.1 and subject to interest as provided in the Agreement.

15.02 *Contractor's Warranty of Title*

- A. Contractor warrants and guarantees that title to all Work, materials, and equipment furnished under the Contract will pass to Owner free and clear of (1) all Liens and other title defects, and (2) all patent, licensing, copyright, or royalty obligations, no later than seven days after the time of payment by Owner.

15.03 *Substantial Completion*

- A. When Contractor considers the entire Work ready for its intended use Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete and request that Engineer issue a certificate of Substantial Completion. Contractor shall at the same time submit to Owner and Engineer an initial draft of punch list items to be completed or corrected before final payment.
- B. Promptly after Contractor's notification, Owner, Contractor, and Engineer shall make an inspection of the Work to determine the status of completion. If Engineer does not consider the Work substantially complete, Engineer will notify Contractor in writing giving the reasons therefor.
- C. If Engineer considers the Work substantially complete, Engineer will deliver to Owner a preliminary certificate of Substantial Completion which shall fix the date of Substantial Completion. Engineer shall attach to the certificate a punch list of items to be completed or corrected before final payment. Owner shall have seven days after receipt of the preliminary certificate during which to make written objection to Engineer as to any provisions of the certificate or attached punch list. If, after considering the objections to the provisions of the preliminary certificate, Engineer concludes that the Work is not substantially complete, Engineer will, within 14 days after submission of the preliminary certificate to Owner, notify Contractor in writing that the Work is not substantially complete, stating the reasons therefor. If Owner does not object to the provisions of the certificate, or if despite consideration of Owner's objections Engineer concludes that the Work is substantially complete, then Engineer will, within said 14 days, execute and deliver to Owner and Contractor a final certificate of Substantial Completion (with a revised punch list of items to be completed or corrected) reflecting such changes from the preliminary certificate as Engineer believes justified after consideration of any objections from Owner.
- D. At the time of receipt of the preliminary certificate of Substantial Completion, Owner and Contractor will confer regarding Owner's use or occupancy of the Work following Substantial Completion, review the builder's risk insurance policy with respect to the end of the builder's risk coverage, and confirm the transition to coverage of the Work under a permanent property insurance policy held by Owner. Unless Owner and Contractor agree otherwise in writing, Owner shall bear responsibility for security, operation, protection of the Work, property insurance, maintenance, heat, and utilities upon Owner's use or occupancy of the Work.

- E. After Substantial Completion the Contractor shall promptly begin work on the punch list of items to be completed or corrected prior to final payment. In appropriate cases Contractor may submit monthly Applications for Payment for completed punch list items, following the progress payment procedures set forth above.
- F. Owner shall have the right to exclude Contractor from the Site after the date of Substantial Completion subject to allowing Contractor reasonable access to remove its property and complete or correct items on the punch list.

15.04 *Partial Use or Occupancy*

- A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which Owner, Engineer, and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by Owner for its intended purpose without significant interference with Contractor's performance of the remainder of the Work, subject to the following conditions:
 - 1. At any time Owner may request in writing that Contractor permit Owner to use or occupy any such part of the Work that Owner believes to be substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor, Owner, and Engineer will follow the procedures of Paragraph 15.03.A through E for that part of the Work.
 - 2. At any time Contractor may notify Owner and Engineer in writing that Contractor considers any such part of the Work substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.
 - 3. Within a reasonable time after either such request, Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify Owner and Contractor in writing giving the reasons therefor. If Engineer considers that part of the Work to be substantially complete, the provisions of Paragraph 15.03 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.
 - 4. No use or occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of Paragraph 6.05 regarding builder's risk or other property insurance.

15.05 *Final Inspection*

- A. Upon written notice from Contractor that the entire Work or an agreed portion thereof is complete, Engineer will promptly make a final inspection with Owner and Contractor and will notify Contractor in writing of all particulars in which this inspection reveals that the Work, or agreed portion thereof, is incomplete or defective. Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

15.06 *Final Payment*

- A. *Application for Payment:*
 - 1. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance, certificates of

inspection, annotated record documents (as provided in Paragraph 7.11), and other documents, Contractor may make application for final payment.

2. The final Application for Payment shall be accompanied (except as previously delivered) by:
 - a. all documentation called for in the Contract Documents;
 - b. consent of the surety, if any, to final payment;
 - c. satisfactory evidence that all title issues have been resolved such that title to all Work, materials, and equipment has passed to Owner free and clear of any Liens or other title defects, or will so pass upon final payment.
 - d. a list of all disputes that Contractor believes are unsettled; and
 - e. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of the Work, and of Liens filed in connection with the Work.
3. In lieu of the releases or waivers of Liens specified in Paragraph 15.06.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (a) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (b) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner might in any way be responsible, or which might in any way result in liens or other burdens on Owner's property, have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien, or Owner at its option may issue joint checks payable to Contractor and specified Subcontractors and Suppliers.

B. *Engineer's Review of Application and Acceptance:*

1. If, on the basis of Engineer's observation of the Work during construction and final inspection, and Engineer's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations under the Contract have been fulfilled, Engineer will, within ten days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of final payment and present the Application for Payment to Owner for payment. Such recommendation shall account for any set-offs against payment that are necessary in Engineer's opinion to protect Owner from loss for the reasons stated above with respect to progress payments. At the same time Engineer will also give written notice to Owner and Contractor that the Work is acceptable, subject to the provisions of Paragraph 15.07. Otherwise, Engineer will return the Application for Payment to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application for Payment.

C. *Completion of Work:* The Work is complete (subject to surviving obligations) when it is ready for final payment as established by the Engineer's written recommendation of final payment.

D. *Payment Becomes Due:* Thirty days after the presentation to Owner of the final Application for Payment and accompanying documentation, the amount recommended by Engineer (less any further sum Owner is entitled to set off against Engineer's recommendation,

including but not limited to set-offs for liquidated damages and set-offs allowed under the provisions above with respect to progress payments) will become due and shall be paid by Owner to Contractor.

15.07 *Waiver of Claims*

- A. The making of final payment will not constitute a waiver by Owner of claims or rights against Contractor. Owner expressly reserves claims and rights arising from unsettled Liens, from defective Work appearing after final inspection pursuant to Paragraph 15.05, from Contractor's failure to comply with the Contract Documents or the terms of any special guarantees specified therein, from outstanding Claims by Owner, or from Contractor's continuing obligations under the Contract Documents.
- B. The acceptance of final payment by Contractor will constitute a waiver by Contractor of all claims and rights against Owner other than those pending matters that have been duly submitted or appealed under the provisions of Article 17.

15.08 *Correction Period*

- A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed by the terms of any applicable special guarantee required by the Contract Documents, or by any specific provision of the Contract Documents), any Work is found to be defective, or if the repair of any damages to the Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas used by Contractor as permitted by Laws and Regulations, is found to be defective, then Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:
 - 1. correct the defective repairs to the Site or such other adjacent areas;
 - 2. correct such defective Work;
 - 3. if the defective Work has been rejected by Owner, remove it from the Project and replace it with Work that is not defective, and
 - 4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others, or to other land or areas resulting therefrom.
- B. If Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others).
- C. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications.
- D. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this paragraph, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.

- E. Contractor's obligations under this paragraph are in addition to all other obligations and warranties. The provisions of this paragraph shall not be construed as a substitute for, or a waiver of, the provisions of any applicable statute of limitation or repose.

ARTICLE 16 – SUSPENSION OF WORK AND TERMINATION

16.01 *Owner May Suspend Work*

- A. At any time and without cause, Owner may suspend the Work or any portion thereof for a period of not more than 90 consecutive days by written notice to Contractor and Engineer. Such notice will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be entitled to an adjustment in the Contract Price or an extension of the Contract Times, or both, directly attributable to any such suspension. Any Change Proposal seeking such adjustments shall be submitted no later than 30 days after the date fixed for resumption of Work.

16.02 *Owner May Terminate for Cause*

- A. The occurrence of any one or more of the following events will constitute a default by Contractor and justify termination for cause:
 - 1. Contractor's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the Progress Schedule);
 - 2. Failure of Contractor to perform or otherwise to comply with a material term of the Contract Documents;
 - 3. Contractor's disregard of Laws or Regulations of any public body having jurisdiction; or
 - 4. Contractor's repeated disregard of the authority of Owner or Engineer.
- B. If one or more of the events identified in Paragraph 16.02.A occurs, then after giving Contractor (and any surety) ten days written notice that Owner is considering a declaration that Contractor is in default and termination of the contract, Owner may proceed to:
 - 1. declare Contractor to be in default, and give Contractor (and any surety) notice that the Contract is terminated; and
 - 2. enforce the rights available to Owner under any applicable performance bond.
- C. Subject to the terms and operation of any applicable performance bond, if Owner has terminated the Contract for cause, Owner may exclude Contractor from the Site, take possession of the Work, incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere, and complete the Work as Owner may deem expedient.
- D. Owner may not proceed with termination of the Contract under Paragraph 16.02.B if Contractor within seven days of receipt of notice of intent to terminate begins to correct its failure to perform and proceeds diligently to cure such failure.
- E. If Owner proceeds as provided in Paragraph 16.02.B, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds the cost to complete the Work, including all related claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals) sustained by Owner, such excess will be paid to Contractor. If the cost to complete the Work including such related claims, costs, losses,

and damages exceeds such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, and damages incurred by Owner will be reviewed by Engineer as to their reasonableness and, when so approved by Engineer, incorporated in a Change Order. When exercising any rights or remedies under this paragraph, Owner shall not be required to obtain the lowest price for the Work performed.

- F. Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue, or any rights or remedies of Owner against Contractor or any surety under any payment bond or performance bond. Any retention or payment of money due Contractor by Owner will not release Contractor from liability.
- G. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 6.01.A, the provisions of that bond shall govern over any inconsistent provisions of Paragraphs 16.02.B and 16.02.D.

16.03 *Owner May Terminate For Convenience*

- A. Upon seven days written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):
 - 1. completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;
 - 2. expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses; and
 - 3. other reasonable expenses directly attributable to termination, including costs incurred to prepare a termination for convenience cost proposal.
- B. Contractor shall not be paid on account of loss of anticipated overhead, profits, or revenue, or other economic loss arising out of or resulting from such termination.

16.04 *Contractor May Stop Work or Terminate*

- A. If, through no act or fault of Contractor, (1) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (2) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (3) Owner fails for 30 days to pay Contractor any sum finally determined to be due, then Contractor may, upon seven days written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the contract and recover from Owner payment on the same terms as provided in Paragraph 16.03.
- B. In lieu of terminating the Contract and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within 30 days after it is submitted, or Owner has failed for 30 days to pay Contractor any sum finally determined to be due, Contractor may, seven days after written notice to Owner and Engineer, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The provisions of this paragraph are not intended to preclude Contractor from submitting a Change Proposal for an adjustment in Contract Price or Contract Times or otherwise for

expenses or damage directly attributable to Contractor's stopping the Work as permitted by this paragraph.

ARTICLE 17 – FINAL RESOLUTION OF DISPUTES

17.01 *Methods and Procedures*

- A. *Disputes Subject to Final Resolution:* The following disputed matters are subject to final resolution under the provisions of this Article:
 - 1. A timely appeal of an approval in part and denial in part of a Claim, or of a denial in full; and
 - 2. Disputes between Owner and Contractor concerning the Work or obligations under the Contract Documents, and arising after final payment has been made.
- B. *Final Resolution of Disputes:* For any dispute subject to resolution under this Article, Owner or Contractor may:
 - 1. elect in writing to invoke the dispute resolution process provided for in the Supplementary Conditions; or
 - 2. agree with the other party to submit the dispute to another dispute resolution process; or
 - 3. if no dispute resolution process is provided for in the Supplementary Conditions or mutually agreed to, give written notice to the other party of the intent to submit the dispute to a court of competent jurisdiction.

ARTICLE 18 – MISCELLANEOUS

18.01 *Giving Notice*

- A. Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if:
 - 1. delivered in person, by a commercial courier service or otherwise, to the individual or to a member of the firm or to an officer of the corporation for which it is intended; or
 - 2. delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the sender of the notice.

18.02 *Computation of Times*

- A. When any period of time is referred to in the Contract by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day will be omitted from the computation.

18.03 *Cumulative Remedies*

- A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee, or by other provisions of the Contract. The provisions of this paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right, and remedy to which they apply.

18.04 *Limitation of Damages*

- A. With respect to any and all Change Proposals, Claims, disputes subject to final resolution, and other matters at issue, neither Owner nor Engineer, nor any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, shall be liable to Contractor for any claims, costs, losses, or damages sustained by Contractor on or in connection with any other project or anticipated project.

18.05 *No Waiver*

- A. A party's non-enforcement of any provision shall not constitute a waiver of that provision, nor shall it affect the enforceability of that provision or of the remainder of this Contract.

18.06 *Survival of Obligations*

- A. All representations, indemnifications, warranties, and guarantees made in, required by, or given in accordance with the Contract, as well as all continuing obligations indicated in the Contract, will survive final payment, completion, and acceptance of the Work or termination or completion of the Contract or termination of the services of Contractor.

18.07 *Controlling Law*

- A. This Contract is to be governed by the law of the state in which the Project is located.

18.08 *Headings*

- A. Article and paragraph headings are inserted for convenience only and do not constitute parts of these General Conditions.

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SECTION 0 08 00

SUPPLEMENTARY CONDITIONS

These Supplementary Conditions amend or supplement the Standard General Conditions of the Construction Contract, EJCDC® C-700 (2013 Edition). All provisions that are not so amended or supplemented remain in full force and effect.

The terms used in these Supplementary Conditions have the meanings stated in the General Conditions. Additional terms used in these Supplementary Conditions have the meanings stated below, which are applicable to both the singular and plural thereof.

The address system used in these Supplementary Conditions is the same as the address system used in the General Conditions, with the prefix "SC" added thereto.

ARTICLE 2 – PRELIMINARY MATTERS

SC-1.01 Defined Terms

Add to the list of definitions in Paragraph 1.01.A by inserting the following as numbered items in their proper alphabetical positions:

Construction Manager – The individual or entity with which the Owner has contracted for supervision of the Work. The Construction Manager for the Work will be Brown and Caldwell. The Construction Manager (CM) will not direct means and methods but is provided as a resource to interface with Owner, Contractor, Engineer to ensure the Contract Documents are adhered to and facility can be utilized for the purpose intended.

SC-2.02 Copies of Documents

Amend the first sentence of Paragraph 2.02.A. to read as follows:

- A. The Owner shall furnish to the Contractor three hard copies of the bound reduced (11 by 17 inches) Drawings, three hard copies of the Specifications (Contract Documents), and electronic specification and drawings in .pdf format suitable for printing at reduced or full-scale (22 by 34 inches). Additional quantities of the Contract Documents or full-scale drawings sets will be furnished at reproduction cost plus mailing cost if copies are mailed.

ARTICLE 5 – AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS

SC-5.03 Subsurface and Physical Conditions

Add the following new paragraphs immediately after Paragraph 5.03.B:

- C. The following drawings of physical conditions relating to existing surface or subsurface structures at or adjacent to the Site (except Underground Facilities) are known to Owner:
1. Preliminary Geotechnical Engineering Report (Shannon & Wilson) – June 2022.
 2. East Facility Record Drawing information.
 3. CCTV video inspection footage of east facility piping for east clarifiers 1 and 2.
 4. East Facility Condition Assessment Technical Memo.
 5. TSSD site yard piping drawing.

- E. Contractor may examine copies of reports and drawings identified in SC 5.03.C that were not included with the Bidding Documents at the Issuing Office during regular business hours, or may request copies from Engineer.

Add the following new paragraphs as 5.06.L.

- L. The Work will involve work within and near active, wastewater treatment facilities. Typical conditions anticipated are identified in Specification Section 01 11 80 Environmental Conditions.

ARTICLE 6 – BONDS AND INSURANCE

6.02 Delete Paragraph 6.02, C. in its entirety, and insert the following:

C. Contractor shall deliver to Owner, with copies to each named insured and additional insured (as identified in this Article, in the Supplementary Conditions, or elsewhere in the Contract), certificates of insurance establishing that Contractor has obtained and is maintaining the policies, coverages, and endorsements required by the Contract. Contractor shall also furnish other evidence of such required insurance, including but not limited to copies of policies and endorsements, and documentation of applicable self-insured retentions and deductible. Contractor may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision. Documents provided hereunder shall include endorsements or addenda affirming that name Owner and Engineer as additional insureds under all such policies.

SC 6.03 Add the following new paragraph immediately after Paragraph 6.03. A. 4.:

A. Contractor's Insurance:

5. No owner or officer involved in rendering services under this contract may be excluded from the Contractor's workers' compensation insurance policy.

SC 6.03 Add the following new paragraph immediately after Paragraph 6.03. C. 8.:

C. Commercial General Liability-Form and Content: Contractor's commercial liability policy shall be written on a 1996 (or later) ISO commercial general liability form (occurrence form) and include the following coverages and endorsements:

9. Contractor's Commercial General Liability policy to include a per project aggregate limit of liability endorsement.

SC 6.03 Add the following new paragraph immediately after Paragraph 6.03. J:

K. The limits of liability for the insurance required by Paragraph 6.03 of the General Conditions shall provide coverage for not less than the following amounts or greater where required by Laws and Regulations:

1. Workers' Compensation, and related coverages under Paragraphs 6.03.A.1 and A.2 of the General Conditions:

State:	<u>Statutory</u>
Federal, if applicable (e.g., Longshoreman's):	<u>Statutory</u>

Employer's Liability:

Bodily injury, each accident	\$ <u>1,000,000</u>
Bodily injury by disease, each employee	\$ <u>1,000,000</u>
Bodily injury/disease aggregate	\$ <u>1,000,000</u>
Foreign voluntary worker compensation	<u>Statutory</u>
2. Contractor's Commercial General Liability under Paragraphs 6.03.B and 6.03.C of the General Conditions:	
General Aggregate	\$ <u>2,000,000</u>
Products - Completed Operations Aggregate	\$ <u>2,000,000</u>
Personal and Advertising Injury	\$ <u>1,000,000</u>
Each Occurrence (Bodily Injury and Property Damage)	\$ <u>1,000,000</u>
3. Automobile Liability under Paragraph 6.03.D. of the General Conditions:	
Bodily Injury:	
Each person	\$ <u>1,000,000</u>
Each accident	\$ <u>1,000,000</u>
Property Damage:	
Each accident	\$ <u>1,000,000</u>
<i>[or]</i>	
Combined Single Limit of	\$ <u>1,000,000</u>
4. Excess or Umbrella Liability:	
Per Occurrence	\$ <u>10,000,000</u>
General Aggregate	\$ <u>10,000,000</u>
5. Contractor's Pollution Liability:	
Each Occurrence	\$ <u>5,000,000</u>
General Aggregate	\$ <u>5,000,000</u>

6. Contractor's Professional Liability:

Each Claim	\$ 2,000,000
Annual Aggregate	\$ 2,000,000

SC-6.05 Property Insurance

Delete the first sentence of Paragraph 6.05.A and insert the following sentence in its place:

Owner shall purchase and maintain builder's risk insurance upon the Work on a completed value basis, in the amount of the full insurable replacement cost thereof (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). Contractor shall provide its own insurance for tools and equipment owned or leased by Contractor or its Subcontractors.

ARTICLE 7 – CONTRACTOR'S RESPONSIBILITIES

SC-7.02 Labor; Working Hours

Delete Paragraph 7.02 B. in its entirety, and insert the following:

- B. In the absence of any Laws or Regulations to the contrary, Contractor may perform the Work on holidays, during any or all hours of the day, and on any or all days of the week, at Contractor's sole discretion. All Work to be coordinated with and approved in writing by the Owner. Regular site access is between 6:30 a.m. and 5:00 p.m. Monday through Friday. If Contractor desires access outside regular times and days, Contractor shall provide 48 hours prior written notice to Owner.

SC-7.11 Record Documents

Delete Paragraph 7.11 A. in its entirety, and insert the following:

- A. Contractor shall maintain in a safe place at the Site one printed record copy of all Drawings, Specifications, Addenda, Change Orders, Work Change Directives, Field Orders, written interpretations and clarifications, and approved Shop Drawings. Contractor shall keep such record documents in good order and annotate them at least monthly if not more frequent to show changes made during construction. These record documents, together with all approved Samples, will be available to Engineer and RPR for review upon submittal of the monthly Application for Payment. If in the view of the Engineer or RPR; the record information including changes to drawings are not current or un-satisfactory, the Engineer or RPR can reject the monthly Application for Payment. Upon completion of the Work, Contractor shall deliver these record documents to Engineer. Contractor shall also:
1. Include with the record drawings survey data including GPS point numbers redlined at the approximate location of the actual survey shot on the drawings, GPS point numbers, X, Y and elevation data. This information shall be kept up to date monthly in advance of submitting pay applications. If in the view of the Engineer or Construction Manager; the record information including changes to drawings are not current or un-satisfactory, the RPR can reject the monthly Application for Payment.
 2. Maintain on site the ability to survey installed utilities such as buried and underground piping as required in Section 01 32 23. Prior to burial of any new or reconfigured utilities in this Work, Contractor shall survey key utility features (elbows, valves, inverts, etc.) to

the satisfaction of the RPR. This survey data shall be maintained in a survey file and spreadsheet with tagging to the process area identifier or process ID tag shown in the Work. The format and content of the data shall be coordinated to the satisfaction of the RPR and shall include GPS point numbers, X, Y, and elevation data and tagging to the process number or device tag number where applicable. This survey data shall be kept current on a monthly basis in advance of submitting pay applications and reviewed with the Construction Manager on a monthly basis as part of the Application for Payment. Upon request, the Contractor shall provide this data to the Engineer or RPR at any time during the Contract period. The results and progress of the installed Work surveys will be reviewed monthly by the Engineer or RPR and the satisfactory collection and maintenance of the data is a requirement for the RPR approving monthly Applications for Payment. All survey data shall be delivered to the Engineer at the completion of the Work.

SC-7.12 Safety and Protection

Insert the following after the second sentence of Paragraph 7.12.C:

Prior to Work at the site, Contractor, including each employee at the site, shall attend Owner's safety training and orientation. Contractor shall comply with the information provided in Owner's safety program. The safety training will include discussion of the potential hazards at the site. Owner's safety training and orientation will span a period of not more than one 8-hour day.

SC-7.13 Safety Representative

Insert paragraph B after 7.13.A:

- B. The Safety Representative will be required to attend all periodic plant wide safety meetings. The meetings will be hosted and facilitated by the Owner or Construction Manager. These meetings will be attended by other safety representatives of the Contractors working on the site, Construction Manager or Construction Manager representatives, and Owner representatives. The frequency of the safety meetings may vary but could be as often as weekly throughout the course of the Work.

ARTICLE 8 – OTHER WORK AT THE SITE

SC-8.02 Coordination

Delete Paragraph 8.02.A in its entirety and replace with the following:

- A. Owner intends to contract with others for the performance of other work at or adjacent to the Site and will be performing ongoing operations, and additional construction projects at or adjacent to the Site. Ongoing operations include use of roadways to move trucks and material and entry into facilities by Owner personnel or Engineer. Contracts with others may include work in the vicinity or surrounding facilities of this project. Contractor shall coordinate with Owner regarding access of facilities and Contractor shall coordinate with Owner and other Contractors to ensure access of others around the site.

ARTICLE 9 – OWNER'S RESPONSIBILITIES

Add the following new paragraph immediately after Paragraph 9.12 of the General Conditions:

SC-9.13 Owner will furnish an "Owner's Site Representative" to represent Owner at the Site and assist Owner in observing the progress and quality of the Work. The Owner's Site Representative is not Engineer's consultant, agent, or employee. Owner's Site Representative will be an employee of the Owner.

ARTICLE 11 – AMENDING THE CONTRACT DOCUMENTS; CHANGES IN THE WORK

SC-11.04 Change of Contract Price

Add to the following as Paragraph 11.04.D:

- D. Any Change Order which increases the Contract Price shall be subject to prior written certification by the Owner's General Manager or designated representative that the Contract Price increase is within the project or contract budget and Owner has available funds sufficient to pay the increase. In the alternative, if the Contract Price increase exceeds the budget or if Owner otherwise does not have sufficient funds to pay the Contract Price increase, the scope of the Work shall be adjusted to permit the degree of completion feasible within the total project or contract budget as it existed prior to the Change Order which is under consideration.

ARTICLE 14 – TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

Add the following final sentence to 14.03.F.

The Contractor shall in no way be excused from correcting, removing or replacing Defective Work on the grounds that such correction, replacement or removal would constitute economic waste or subject the Contractor to financial or economic hardship.

ARTICLE 15 – PAYMENTS TO CONTRACTOR; SET-OFFS; COMPLETION; CORRECTION PERIOD

SC-15.01 Progress Payments

Add the following paragraph as 15.01.E

Contractor shall submit proof reasonably acceptable to Owner and Engineer in conjunction with progress payments, the final payment, and the release of retainage funds demonstrating that all claims by suppliers of labor, materials and services incorporated in the Work for which payment is being sought have been satisfied including, but not limited to, lien releases or waivers. Contractor shall defend, indemnify and hold Owner free and harmless from and against any and all claims by the suppliers of labor, materials and services performed and/or provided in connection with the Work except to the extent such claims arise due to the acts or omissions of the Owner or any party for which the Owner is liable.

SC-15.08 Correction Period

Delete Paragraph 15.08. A in its entirety and replace with the following:

If within one year after the date of Final Completion (or such longer period of time as may be prescribed by the terms of any applicable special guarantee required by the Contract Documents, or by any specific provision of the Contract Documents), any Work is found to be defective, or if the repair of any damages to the Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas used by Contractor as permitted by

Laws and Regulations, is found to be defective, then Contractor shall promptly, without cost to the Owner and in accordance with Owner's written instructions:

1. correct the defective repairs to the Site or such other adjacent areas;
2. correct such defective Work;
3. if the defective Work has been rejected by the Owner, remove it from the Project and replace it with Work that is not defective, and
4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others, or to other land or areas resulting therefrom.

PART SC-19--UTAH STATE REQUIREMENTS

Add the new PART SC-19 as follows:

- A. Retainage of Compensation to Contractor: Pursuant to Utah Code Ann. 13-8-5, the 5% retainage of Contractor's compensation hereunder shall be placed in an interest-bearing account and the interest which accrues thereon shall do so for the benefit of Contractor and Subcontractors. Release of the retainage shall be as contemplated by the General Conditions, Article 14 - Payments to Contractor and Completion. Any interest which has accrued on the retainage and which is released to the Contractor shall be promptly disbursed by Contractor to itself and/or to Subcontractors on a pro rata basis.
- B. Project Safety: Contractor shall comply in all respects with the Utah Occupational Safety and Health Act, Utah Code Ann. Sections 34A-6-101 et seq., and the rules, regulations and standards promulgated thereunder by the Division of Occupational Safety and Health, as such act, rules, regulations or standards now exist or may be amended during the term of this agreement.
- C. Protection of Underground Utility Facilities: Contractor shall comply in all respects with Utah Code Ann. Title 54, Chapter 8a and the rules and regulations promulgated thereunder, as it now exists or may be amended during the term of this Agreement, with regard to the protection of underground utility facilities. Specifically, but not in limitation, Contractor shall notify the appropriate public utility(s) when making an excavation. Contractor shall further refrain from proceeding with excavation until such time as the appropriate public utility(s) have advised Contractor of the location of any underground facilities in the area proposed for excavation.
- D. Review of Construction by Owner: Owner may, at its option, assign a field representative to review the construction of the project in progress. Said representative will cooperate with the RPR in attempting to note deviations from, or necessary adjustments to, the Contract Documents or deficiencies or defects in the construction. Said representative's presence on the project, however, shall in no way relieve Contractor of its primary responsibility for construction of the project in accordance with the contract documents.

- E. Code Requirements: The provisions of the latest editions of the International Building Code, National Electric Code, and Utah Plumbing Code, as adopted or followed in Utah, including standards adopted in relation thereto, as supplemented or amended, shall apply to the project except as specific variances may be expressly authorized by the Owner. If the Contract Documents fail to meet the minimum standards of the referenced codes, Contractor shall be responsible to bring such information to the attention of the Construction Manager associated with the project. Subcontractors shall also inform Contractor of any infractions of the above-referenced codes regarding their own particular trades. In the event that workmanship or incidental materials are not specified or indicated, they shall at least conform to the above-referenced codes and shall be incorporated into the work without any additional cost to the Owner. If the Contract Documents call for items or workmanship which exceed code requirements, the Contract Documents shall take precedence over such requirements.
- F. Workers Compensation: Contractor shall comply in all respects with Utah Code Ann. Section 34A-2-101, et seq., and the rules and regulations promulgated thereunder by the Utah State Industrial Commission, as such law, rules or regulations now exist or may be amended during the term of this agreement.
- G. Archaeological, Anthropological, or Paleontological Findings: Contractor shall comply with Utah Code Ann. Section 9-8-301 et seq., with respect to the discovery of archaeological, anthropological, or paleontological findings at or on the project site. Specifically, but not in limitation, Contractor shall promptly notify the Utah Division of State History of any such findings.
- H. Non-Discrimination-Equal Employment Opportunity: Contractor shall comply in all respects with the Utah Antidiscrimination Act, Utah Code Ann. Section 34A-5-101 et seq., and the rules and regulations promulgated thereunder by the Labor Commission and/or the Division of Antidiscrimination and Labor, as such act, rules or regulations now exist or may be amended during the term of this agreement.
- I. Affirmative Action: Contractor shall take affirmative action to insure that applicants are employed and that employees are treated during employment without regard to their race; color; religion; sex; national origin; pregnancy, childbirth, or pregnancy related conditions; age, if the individual is 40 years of age or older; or disability. Such action shall include, but shall not be limited to: employment; upgrading; demotion or transfer; recruitment or recruitment advertising; layout or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship.

ARTICLE 17 – FINAL RESOLUTION OF DISPUTES

SC-17.01B DISPUTES

Delete Paragraph 17.01 B in its entirety, and insert the following:

B. *Final Resolution of Disputes:*

1. Any dispute not resolved through the other processes described in the Contract Documents shall be filed exclusively in the Fourth District Court of the State of Utah or in the United States District Court for the Northern District of Utah.

****END OF SECTION****

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00 94 00
Work Change Directive

Work Change Directive No.

Date of Issuance:

Effective Date:

Owner: TSSD Water Reclamation Facility

Owner's Contract No.: NA

Contractor:

Contractor's Project No.: NA

Engineer: Brown and Caldwell

Engineer's Project No.: 157492

Project: TP-4 East Facility Utilities and
Clarifiers Rehabilitation Project

Contract Name: TP-4 East Facility Utilities and
Clarifiers Rehabilitation Project

Contractor is directed to proceed promptly with the following change(s):

Description:

Attachments: *[List documents supporting change]*

Purpose for Work Change Directive:

Directive to proceed promptly with the Work described herein, prior to agreeing to changes on Contract Price and Contract Time, is issued due to: *[check one or both of the following]*

☐ Non-agreement on pricing of proposed change.

☐ Necessity to proceed for schedule or other Project reasons.

Estimated Change in Contract Price and Contract Times (non-binding, preliminary):

Contract Price \$ [increase] [decrease].

Contract Time days [increase] [decrease].

Basis of estimated change in Contract Price:

☐ Lump Sum

☐ Unit Price

☐ Cost of the Work

☐ Other

RECOMMENDED:

AUTHORIZED BY:

RECEIVED:

By:

Engineer (Authorized Signature)

By:

Owner (Authorized Signature)

By:

Contractor (Authorized Signature)

Title:

Title:

Title:

Date:

Date:

Date:

Approved by Funding Agency (if applicable)

By:

Date:

Title:

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00 94 10
Change Order

Change Order No. _____

Date of Issuance:

Owner: TSSD Water Reclamation Facility

Contractor:

Engineer: Brown and Caldwell

Project: TP-4 East Facility Utilities and
Clarifier Rehabilitation Project

Effective Date:

Owner's Contract No.: NA

Contractor's Project No.:
NA

Engineer's Project No.: 157492

Contract Name: TP-4 East Facility
Utilities and Clarifiers
Rehabilitation Project

The Contract is modified as follows upon execution of this Change Order:

Description:

Attachments: *[List documents supporting change]*

CHANGE IN CONTRACT PRICE	CHANGE IN CONTRACT TIMES <i>[note changes in Milestones if applicable]</i>
Original Contract Price: \$ _____	Original Contract Times: Substantial Completion: _____ Ready for Final Payment: _____ days or dates
[Increase] [Decrease] from previously approved Change Orders No. ____ to No. ____: \$ _____	[Increase] [Decrease] from previously approved Change Orders No. ____ to No. ____: Substantial Completion: _____ Ready for Final Payment: _____ days
Contract Price prior to this Change Order: \$ _____	Contract Times prior to this Change Order: Substantial Completion: _____ Ready for Final Payment: _____ days or dates
[Increase] [Decrease] of this Change Order: \$ _____	[Increase] [Decrease] of this Change Order: Substantial Completion: _____ Ready for Final Payment: _____ days or dates
Contract Price incorporating this Change Order: \$ _____	Contract Times with all approved Change Orders: Substantial Completion: _____ Ready for Final Payment: _____ days or dates

RECOMMENDED:	ACCEPTED:	ACCEPTED:
By: _____ Engineer (if required)	By: _____ Owner (Authorized Signature)	By: _____ Contractor (Authorized Signature)
Title: _____	Title: _____	Title: _____
Date: _____	Date: _____	Date: _____

Approved by Funding Agency (if applicable)

By: _____
Title: _____

Date:

00 94 20
Field Order

Field Order No. _____

Date of Issuance:	Effective Date:
Owner: TSSD Water Reclamation Facility	Owner's Contract No.: NA
Contractor:	Contractor's Project No.: NA
Engineer: Brown and Caldwell	Engineer's Project No.: 157492
Project: TP-4 East Facility Utilities and Clarifier Rehabilitation Project	Contract Name: TP-4 East Facility Utilities and Clarifiers Rehabilitation Project

Contractor is hereby directed to promptly execute this Field Order, issued in accordance with General Conditions Paragraph 11.01, for minor changes in the Work without changes in Contract Price or Contract Times. If Contractor considers that a change in Contract Price or Contract Times is required, submit a Change Proposal before proceeding with this Work.

Reference: _____
Specification(s) Drawing(s) / Detail(s)

Description:

Attachments:

ISSUED:	RECEIVED:
By: _____ Engineer (Authorized Signature)	By: _____ Contractor (Authorized Signature)
Title: _____	Title: _____
Date: _____	Date: _____

Copy to: Owner

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VOLUME 2: SPECIFICATIONS DIVISIONS 1 TO 23

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SECTION 01 11 00
SUMMARY OF WORK

PART 1 GENERAL

1.01 SUMMARY

- A. The work to be performed under this Contract at the Owner's water reclamation plant site shall consist of furnishing tools, equipment, materials, and supplies and furnishing labor, transportation, and performing all work or other operations required for the fulfillment of the Contract in accordance with the Contract Documents. The work shall be complete and all work, materials, and services not expressly indicated or called out in the Contract Documents which may be necessary for the complete and proper construction of the Work in good faith shall be provided at no increase in cost to the OWNER.

1.02 DESCRIPTION OF OWNER'S PROJECT

- A. The overall project will consist of:
- Replacement of the east clarifier gate pedestals (3 total), installation of new electric actuators (3 total) and corresponding power source on the East Clarifier Splitter Box. Installation of new lighting, light poles and corresponding power source on the East Clarifier Splitter Box. Rehabilitation of the east facility clarifiers 1, 2, and 3 consisting of replacement with 304 stainless steel components, clarifier drive replacement; clarifier walkway replacement with painted carbon steel components, walkway lighting system removal and reinstallation. East clarifiers 1 and 3 electrical refeed, and corresponding sidewalk replacement. Furnishment and installation of aluminum and 304-stainless steel component launder covers. Rehabilitation of two 30-inch RCP mixed liquor pipes for East Clarifiers 1 and 2. Rehabilitation of one 16-inch DIP RAS pipe associated with East Clarifier 3.

1.03 CONTRACT

- A. The East Facility Utilities and Clarifiers Rehabilitation project will be performed by
CONTRACTOR INFO

1.04 WORK OF THIS CONTRACT

- A. The work to be performed under this contract includes
1. East Clarifier Splitter Box:
 - a. Removal and disposal of the three clarifier gate operator pedestals.
 - b. Furnishment and installation of three new clarifier gate operator pedestals, with rising stem clear cover, and gear boxes that can be fitted with Rotork electric actuators.
 - c. Furnish and install three Rotork electric actuators on new clarifier gate pedestals.
 - 1) Electric actuators to be locally controlled.
 - 2) Contractor to install power conduit wiring to new electric actuators, and connect to power source.
 - d. Furnish and install new lighting on the top of the East Clarifier Splitter box, 2 lights

total, with corresponding power source feed.

2. East Clarifiers 1, 2 and 3:

- a. Ground water control and site dewatering is required to perform the work and to prevent clarifier uplift or subsidence. Dewater east facility site using groundwater control prior to and during the clarifier and pipe rehabilitation work.
- b. East clarifier drives to be removed and replaced (3 total)
 - 1) Drive conduit and wiring to be temporarily removed and then reinstalled.
- c. Electrical re-feed of East Clarifiers 1 and 3. Sidewalk repairs corresponding to the electrical refeed work as outlined on the plans.
- d. Remove and dispose of east clarifiers carbon steel materials at and below the waterline and replacement with 304 stainless steel materials.
- e. Remove and dispose of FRP weirs, baffles and current density (Stamford) baffles and Furnish and install 304 stainless steel weirs, baffles and current density (Stamford) baffles.
- f. Remove and dispose of east clarifiers duck skimmer scum systems and replace with 4-foot scum beaches. Scum systems to be 304 stainless steel material. Scum systems to be locally controlled.
- g. Replacement of scum piping in east clarifiers with 304 stainless steel materials.
- h. Scum system spray water piping to be removed and replaced along clarifier walkways. Scum spray system to include manually controlled full cone jet spray anti rotation spray system.
- i. Feed well sidewalls on the east clarifiers are to be constructed of corrugated FRP panels.
 - 1) Sidewall panels profile to be 4.2x1-1/16"
 - 2) Sidewall panels to be installed with 316 stainless steel self-driving screws with neoprene washers
- j. East clarifier walkways (3 total):
 - 1. Walkways to be removed and replaced. Walkways to be painted carbon steel materials.
 - 2. Walkways to have 1-1/2" aluminum 3 rail mechanical handrail system.
 - 3. Walkway decking to be 1-1/4" rectangular aluminum serrated bar grating (non-slip).
 - 4. Walkway to have 8' x 7'-4" carbon steel maintenance platform around clarifier drive area with 1-1/2" aluminum 3 rail mechanical handrail system and 1-1/4" and aluminum rectangular serrated bar walkway (non-slip) walkway decking.
 - 5. Walkway lights, light poles and corresponding switches, conduit and wiring to be temporarily removed and reinstalled.
- k. Furnish and install aluminum and 304 stainless steel component launder covers on the east facility clarifiers.

3. East Clarifier 1, 2, and 3 piping:

- a. Carbon fiber lining repairs of 30-inch RCP Mixed Liquor pipe (East Clarifiers 1, 2)
- b. Pipe joint repair in 16-inch DIP RAS pipe, East Clarifier 3

END OF SECTION

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SECTION 01 11 80
ENVIRONMENTAL CONDITIONS

PART 1 GENERAL

1.1 SUMMARY

- A. This Section describes the environmental conditions which have been observed at the site of the work and which may reasonably be anticipated throughout the life of the project.

1.2 CLIMATE CONDITIONS

- A. The site of the Work is at an approximate elevation of 4,496 feet above mean sea level.
- B. Climate conditions are described as follows:

Description	Range of Conditions
Low Winter Temperature	30 degrees F to -20 degrees F
High Summer Temperature	80 degrees F to 110 degrees F

1.3 ADDITIONAL CONDITIONS

- A. Additional conditions which may be applicable are specified in other sections.
1. Pathogens and hydrogen sulfide gas may be present in the wastewater and flow conveying structures.
 2. Flow conditions. Seasonal and daily weather conditions impact flow rates in the influent.

Plant Influent Flow Summary by Season AVG Daily 6-year history

	MGD AVG Daily	MGD Peak 30 Min.	MGD min. Hourly
Winter	16.83	--	--
Spring	17.86	--	--
Summer	18.36	--	--
Fall	17.78	--	--

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

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SECTION 01 12 16

WORK SEQUENCE

PART 1 GENERAL

1.01 CONTINUITY OF PLANT OPERATIONS

- A. The existing wastewater treatment plant is currently and continuously receiving and treating sewage, and those functions shall not be interrupted except as specified herein. The Contractor shall coordinate the work to avoid any interference with normal operation of plant equipment and processes.
- B. The existing wastewater treatment process requires that one of the east facility clarifiers 1, 2 or 3 (E-1, E-2, E-3) to be operational in addition to clarifier East 4 (E-4) when an east clarifier or clarifiers are out of service for rehabilitation for the duration of the project. All of the remaining secondary clarifiers, E-4, W-1, W-2, W-3, W-4, W-5 and corresponding plant systems are to remain in service throughout the duration of the project.
- C. This section specifies some but not all constraints for the performance of, or scheduling of, Work to ensure uncompromised operation of the treatment facilities. The Contractor shall ultimately be responsible for ensuring treatment processes and plant operations are not compromised by Contractor's actions, and shall not schedule any outages or testing and commissioning events without prior approval of the Construction Manager.

1.02 BYPASSING

- A. Bypassing of untreated or partially treated sewage to surface waters or drainage courses is prohibited during construction. In the event accidental bypassing is caused by the Contractor's operations, the Owner shall immediately be entitled to employ others to stop the bypassing without giving written notice to the Contractor.
- B. Penalties imposed on the Owner as a result of any bypass caused by the actions of the Contractor, his employees, or subcontractors, shall be borne in full by the Contractor, including legal fees and other expenses to the Owner resulting directly or indirectly from the bypass. Under the terms of discharge permits issued to the Owner, in the event accidental bypassing occurs, the Owner is liable for the following penalties:

UPDES Permit No. [UT0023639____] \$[10,000] per [day____]

1.03 SUBMITTAL

- A. In accordance with Section 01 33 00, the Contractor shall submit a detailed outage plan (Plan). The Plan shall include a detailed description and time schedule for operations which will make it necessary to remove a tank, pipeline, channel, electrical circuit, equipment, or structure from service. The Plan shall be made to minimize impact of outages and all requested outages shall be coordinated with the Construction Manager at least seven (7) working days in advance. The Plan and time schedule shall be coordinated with the construction schedule specified in the General Conditions of the Contract Documents and shall meet the restrictions and conditions specified in this section. The detailed plan shall describe the Contractor's method for preventing bypassing of other treatment units, the length of time required to complete said

operation, the necessary plant, and equipment which the Contractor shall provide in order to prevent bypassing of associated treatment units.

- B. The Contractor shall observe the following restrictions:
 - 1. Systems or individual equipment items shall be isolated, dewatered, decommissioned, deenergized, or depressurized in accordance with the detailed outage plan and schedule.
 - 2. The Construction Manager shall be notified in writing at least seven (7) working days in advance of the planned operation.

1.04 SEQUENCE AND SCHEDULE OF CONSTRUCTION

- A. To permit continuous treatment of wastewater and compliance with effluent quality requirements, the construction schedule required in in the General Conditions of the Contract Documents shall provide for the following specific conditions:
 - 1. Contractor to conduct all site dewatering operations. The Contractor is responsible for obtaining all required dewatering and discharge permits prior to clarifiers being drained and removed from service. The Contractor is responsible for proper water, sediment debris collection and disposal. Water is not to be disposed of into the facility plant drain system or any other process stream, but may be disposed of into the Owner's storm drain system not connected to the plant process system(s). Contractor to coordinate with the Owner as to disposal location(s) since some of the stormdrain system is connected to the plant drain system.
 - 2. Owner will drain, clean and remove the east facility clarifiers from service in accordance with Contractors submitted schedule and outage Plan as described in this section prior to turning over each to the Contractor for rehabilitation work. The Contractor is to coordinate with the Owner for all planned clarifier service interruptions. Contractor to provide work sequence plan with timeline and an outline specifying specific clarifier out of services times to the Engineer and Owner for review. Contractor allowed to have two of the three east facility clarifiers out of service simultaneously, specifically east clarifiers 1 and 2 (E-1, E-2). Owner to be allowed adequate time to switch, re-route and to stabilize plant flows. The Owner requires **one week per clarifier** to complete flow switches, draining and cleaning activities prior to turning over to the Contractor. The Owner requires 1 day to prepare and to put each clarifier back into service prior to preparing subsequent clarifiers for rehabilitation.
 - 3. One of the east facility clarifiers is to be operational during all (clarifier) electrical refeed activities throughout the duration of the project. If Clarifiers 1 and 2 (E-1, E-2) are out of service simultaneously, Clarifier 3 (E-3) is not to be taken out of service. Clarifier 2 shall be in service to complete the required electrical refeed activities for Clarifiers 1 and 3.
 - 4. The Owner is to operate all clarifier lift gates. Owner shall operate clarifier lift gates for the clarifiers that are to be out of service during each phase of the rehabilitation project. The Contractor is not to remove the existing lift gate pedestals prior to the new pedestals and electrical actuators being delivered to the site. The existing east clarifier lift gates leak, so the Contractor is required to manage existing gate leakage and proper clarifier isolation utilizing the gates and clarifier splitter box for the duration of the project as will be required for clarifier and corresponding pipe rehabilitation.

5. Owner to install a fourth lift gate in the east clarifier splitter box with their operations staff to isolate the 42-inch influent mixed liquor pipe that serves the east clarifier splitter box. Owner to coordinate operations staff installation activities of the fourth gate with the Contractor.
6. Individual clarifier work to be complete, clarifier unit(s) to be properly adjusted, balanced, of proper rotation direction, are to be operational and in service to the satisfaction of the Owner prior to the removal of subsequent clarifiers for additional work. **Owner to be allowed (ONE WEEK) to return completed clarifiers to service prior to preparing subsequent clarifiers for rehabilitation work.**

END OF SECTION

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SECTION 01 14 16
COORDINATION WITH OPERATION OF EXISTING FACILITIES

PART 1 GENERAL

1.01 DESCRIPTION

- A. The existing wastewater treatment works will be in operation throughout the execution of this contract. The Contractor, therefore, shall schedule and conduct his work so as to minimize interference with plant operation and maintenance. It is the intent of this Contract that the construction activity, insofar as possible, shall not interfere with the operation of the plant. Where delays are caused by reason of unexpected operation of the plant, the Contractor will be allowed compensatory time but no change in contract compensation.
- B. In addition to meetings held and required to execute the Work under this Contract. The Contractor shall attend the weekly site wide coordination meeting. The weekly site wide coordination meeting will be hosted and facilitated by the Construction Manager and will be attended by Construction Manager or Construction Manager representatives, Owner, and other Contractors performing work under other Contracts. The purpose of this meeting is to facilitate dialogue and coordination where Work on multiple contracts may overlap spatially or on the schedule.

1.02 OPERATION

- A. Unless otherwise specified, normal daily operation and maintenance of the existing plant will be performed by Owner's personnel. Whenever operational functions are required to permit construction operations, these functions will also be performed by Owner's personnel.

1.03 GENERAL

- A. When modification, addition or connection to existing structures, systems, circuits or equipment is required, the Contractor shall schedule such activities with the Construction Manager. These tie-in activities, shutdown activities, etc. that may impact Owner's operation are to be coordinated and tracked as "Maintenance of Plant Operations" events (MOPOs). The Contractor shall notify the Construction Manager, in writing, a minimum of 14 days in advance of the time when construction operations will require connection to, or modification of, in-service portions of the existing Facility. No system, structure, circuit or individual unit shall be modified, de-watered, de-energized or removed from the Facility unless authorized by the Construction Manager.

1.04 REMOVAL OF EXISTING PIPING AND EQUIPMENT

- A. All existing piping, equipment, fixtures, conduit, wiring, and other appurtenances which are to be removed and are not specified or indicated on the Drawings to be relocated or reused will be designated by the Construction Manager as either salvage or junk. Material designated as salvage shall be cleaned carefully and neatly stored at the plant site as directed by the Construction Manager. Material designated as junk shall become the property of the Contractor and shall be removed from the site and lawfully disposed of by the Contractor.

1.05 MODIFICATION OF STRUCTURES

- A. The Contractor shall connect to the new electrical equipment with a minimum of interruption to plant services. The Contractor shall inform the Construction Manager in writing, of the intention to interrupt any power supply for the purpose of making required connections at least 14 days in advance of such interruption and shall also inform the Construction Manager of the estimated period of interruption.
- B. In no case shall the Contractor cause an intentional power interruption without written authority from the Construction Manager.

1.06 SUBMITTAL OF MOPO PLANNING AND ANTICIPATED MOPOS

- A. The contractor shall review the Contract Documents and submit an initial MOPO tracking list. The MOPO tracking list shall be submitted with the initial schedule submittal. The MOPO tracking list shall include the following:
 - 1. Identify the MOPO with number and name (e.g., MOPO 01 – Electrical actuator electrical Tie In).
 - 2. The time needed by the contractor to conduct the MOPO (e.g., 12 hours).
 - 3. The constraints identified by the Owner such as maximum shut down time allowed during the tie-in.
- B. The MOPO tracking list shall be maintained throughout the contract period. The MOPO tracking list shall be supplemented by specific MOPO Plan for each MOPO. The MOPO Plan shall describe detailed shut down periods, work sequences, tools, staff, and steps to be taken by Contractor and Owner during a given MOPO. Each MOPO Plan shall include signature blocks for the Owner, Contractor and Construction Manager. All three signatures shall be complete prior to executing a MOPO.
- C. The following is an initial list of anticipated MOPOs; contractor shall review the Contract Documents and develop a more detailed MOPO tracking list. The MOPO tracking list will be reviewed periodically and kept current. Anticipated MOPOs include:
 - 1. East clarifier splitter box gate operator electric actuators electrical tie in.
 - 2. Removal and installation of the east clarifier splitter box lighting.
 - 3. Removal and reinstallation of east clarifier lighting, new clarifier drive installation and corresponding electrical items.
 - 4. East clarifiers 1 and 3 (E-1, E-3) electrical refeed work.

1.07 SHUTDOWNS ALLOWED

- 1. The following shut down periods are allowed:
 - a. Clarifiers: Only two of the three east clarifiers can be out of service concurrently during the Contractor's performance of the Work.
 - 1) Only Clarifiers 1 (E-1) and 2 (E-2) to be out of service simultaneously.
 - 2) Clarifier out of service time: Out of service time limited to no more than 90 days.
 - 3) Clarifiers not under construction are to remain in service during the project – no shutdown is allowed.

- 4) Clarifiers where construction is complete are to be back in service prior to others being taken out of service for cleaning and construction activities.
- b. East Clarifier Splitter Box:
 - 1) Structure to remain operational to convey flow to clarifiers not under construction and that are to remain in service
 - 2) Individual splitter box structure sections to be taken out of service are to be isolated by the Contractor as required for gate pedestal, clarifier construction and clarifier piping rehabilitation work
- c. RAS Pump Station No. 1:
 - 1) To remain in service for the duration of the project.
 - 2) Individual systems to be taken out of service that correspond with clarifiers out of service for construction and electrical system connection work.
 - 3) No more than 4 hours for electrical shut down tie in work for individual systems
- d. East Clarifier 3 (E-3) Valve Vault Building:
 - 1) To be taken out of service to complete the pipe point repair of the 16-inch DIP RAS pipe associated with Clarifier 3 (E-3).
 - 2) Valve vault building out of service time limited to no more than 90 days.

PART 2 NOT USED

PART 3 NOT USED

END OF SECTION

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SECTION 01 14 19

USE OF SITE

PART 1 GENERAL

1.01 SUMMARY

- A. The Owner's operating personnel will be responsible for operating the existing treatment plant throughout the execution of this contract. Equipment presently installed in the treatment plant must be available to plant personnel at all times for use, maintenance, and repair. If it is necessary in the course of operating the plant, for the Contractor to move his equipment, materials, or any material included in the work, he shall do so promptly and place that equipment or material in an area which does not interfere with the plant operation. The Contractor shall not adjust or operate serviceable or functioning equipment or systems except as specifically required by this contract.
- B. The existing treatment plant will remain in operation throughout the execution of this contract. The Contractor shall schedule and conduct his work to minimize necessary shutdowns and interference with normal plant operations and maintenance.
- C. The Contractor shall notify the Construction Manager, in accordance with Section 01 12 16, 1 week in advance of the time it is necessary to take out of service any existing tank, pipeline, channel, electrical circuit, equipment or structure. The Contractor shall be responsible for providing whatever temporary piping, pumping, power, and control facilities as are required to maintain continuous plant operation and complete treatment except as otherwise specified. The integrity of existing plant utilities shall be maintained by the Contractor at all times.

END OF SECTION

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SECTION 01 29 00
MEASUREMENT AND PAYMENT

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies requirements for determining Contractor payments.

1.02 SCHEDULE OF VALUES

- A. The Contractor shall submit a detailed Schedule of Values for the Work of the Contract, including quantities and unit prices aggregating the Lump Sum Contract Price, for approval in accordance with Article 14 of the General Conditions - Section 00 72 00.
- B. If any unit price in the approved Schedule of Values requires that the said unit price cover and be considered compensation for certain work or material essential to the item, this same work or material will not also be measured or paid for under any other pay item which may appear elsewhere in the Specifications.
1. Schedule shall be listed in tabular form and include the following:
 - a. Schedule item numbers.
 - b. Schedule item descriptions.
 - c. Unit cost description, bid quantity, bid unit cost, bid total amount per item.
 - d. Estimated quantities for previous period, current application period, and total to date per item.
 - e. Amount previously billed, amount billed this period, total amount billed and percent completion per item.
 2. Include a proportional amount of CONTRACTOR's overhead and profit for each item.
 3. If progress payments will be requested for materials or equipment stored either on or off site, show the following:
 - a. Cost of the materials, delivered and unloaded, with taxes paid.
 - b. Total installed value.
- C. Upon request, submit documentation to support the values assigned to the Work. Sum of all values shall equal the TOTAL BID.
- D. Schedule will be reviewed by the Engineer.
1. Upon approval by the Engineer, the schedule will become the official reporting form upon which Application Payment will be calculated.
 2. Provide additional breakdown of bid item costs if requested by the Engineer.
 3. Failure to submit this schedule or receive approval may result in withholding of approval of Application for Payment.

1.03 MEASUREMENT OF QUANTITIES

- A. [Construction Manager] [Engineer] Work completed under the Contract shall be measured according to the standards of weights and measures recognized by the U.S. Bureau of Standards.

- B. The method of measurement and computations to be used in determination of quantities of material furnished and of work performed under the Contract will be those methods generally recognized as conforming to good engineering practice.
- C. Measurement for area computations will be made on the surface. Pay measurements for area computations will not exceed the neat dimensions indicated on the Contract Drawings, unless otherwise ordered in writing by the [Construction Manager] [Engineer].
- D. Structures will be measured according to neat lines indicated on the Contract Drawings or as altered to fit field conditions. No payment will be made for length, width, or depth, in excess of that indicated on the Contract Drawings or specified for any construction, unless otherwise approved by the [Construction Manager] [Engineer] in writing.
- E. Items which are measured by the linear foot, such as pipe, will be measured parallel to the base or foundation upon which such items are placed.
- F. In computing volumes of excavation (when part of a unit price project component), the average end area method, based on horizontal measurements, or other acceptable methods, will be used. If the excavation is incidental or part of a lump sum bid item, no additional payments will be made.
- G. The term "each", when used as an item of payment, will mean complete payment for the Work described in the payment item in the Contract Documents. The work described is not intended to be exhaustive.
- H. The term "lump sum", when used as an item of payment, will mean complete payment for the Work described in the Contract Documents, including all necessary fittings and accessories, and required testing completed.
- I. The term "complete in place", means the completion of the Contract item or portions thereof as determined by the [Construction Manager] [Engineer] including the furnishing of all materials, equipment, tools, labor, and work incident thereto, unless otherwise specified.
- J. Contingent unit price items work is work not shown on the Contract Drawings and shall be performed only at the direction of the [Construction Manager] [Engineer].

1.04 SCOPE OF PAYMENT

- A. The Contractor will receive and accept compensation provided for in the Contract Documents as full payment for furnishing materials, labor, tools, and equipment and for performing Work under the Contract in a complete and acceptable manner and for all risk, loss, damage, or expense of whatever character arising out of the nature of the Work or the execution thereof, subject to the provisions of the General Conditions.

Mobilization:

- 1. When included in the Contractor's Schedule of Values, mobilization shall consist of the assembling and setting up for the project, permitting including but not limited to State and Utah County entity required permits, the Contractor's necessary general plant, including Contractor's offices, [Construction Manager] [Engineer]'s field office, shops, plants, storage areas, sanitary and any other facilities, as required by the Specifications

and special requirements of the Contract, as well as by local or State law and regulation. The determination of the adequacy of the Contractor's facilities, except as noted above, shall be made by the Contractor. The cost of required insurance and bonds and/or any other initial expense required for the start of Work will be included in this item. The Contractor shall furnish all materials and furnishings required, and these materials and furnishings will not be considered as part of the other various items of the completed Contract.

2. No additional payment will be made for demobilization. Costs for demobilization shall be included in this item.
3. Mobilization will be paid at the approved lump sum price for mobilization and demobilization included in the Contractor's Schedule of Values. The lump sum price for this item shall be payable to the Contractor in accordance with the following schedule:
 - a. On the first monthly application for Progress Payment, the amount approved for mobilization or three percent of the total Contract Price, excluding the price for this item, whichever is less, will be paid.
 - b. Whenever Work performed equals 25 percent of the total Contract Price excluding the approved price for this item, any remaining amount for mobilization, or an additional two percent of the total Contract Price excluding the approved price for this item, whichever is less, will be paid.
 - c. Upon completion of the Project, any remaining amount approved for mobilization will be paid.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

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SECTION 01 32 16
CONSTRUCTION PROGRESS SCHEDULE

PART 1 GENERAL

1.01 SCOPE

- A. This section specifies the procedures for preparing and revising the critical path method construction schedule used for planning and managing construction activities. The schedule provides a basis for determining the progress status of the project relative to specific dates and completion time.

1.02 DESCRIPTION

- A. The Contractor shall provide a graphic construction schedule prepared by the critical path method of analysis. The critical path schedule shall be prepared from estimates of the required duration and sequence for each item of work and function to be performed. A general guide for preparing such a schedule is contained in "The Use of CPM in Construction, A Manual for Contractors," published by the Associated General Contractors of America. Tabulation and analysis of the work schedule shall be performed by computer using a commercially available critical path software program. In addition to the capability to produce tabular reports, the computer software shall plot the construction schedule after the Contractor has produced it in a draft form as required by paragraph 1.03 Submittal Procedures.
- B. The schedule shall depict all significant construction activities and all items of work listed in the breakdown of contract prices submitted by the Contractor in accordance with the General Conditions of the Contract Documents. The dependencies between activities shall be indicated so that it may be established what effect the progress of any one activity has on the schedule.
- C. Time for completion and all specific dates as specified in the Contract Documents and sequencing requirements described in Section 01 12 16 shall be shown on the schedule. Activities making up the critical path shall be identified.
- D. No activity on the schedule shall have a duration longer than 21 days or assigned value greater than \$100,000, except activities comprising only fabrication, and delivery may extend for more than 21 days. Activities which exceed these limits shall be divided into more detailed components. The schedule duration of each activity shall be based on the work being performed during the normal 40-hour workweek with allowances made for legal holidays and normal weather conditions.

1.03 SUBMITTAL PROCEDURES

- A. Within 20 days after the date of Notice to Proceed, the Contractor shall complete a construction schedule conforming to paragraph 1.02 Description and representing in detail all planned procurement and on-site construction activities. The schedule shall be prepared on reproducible paper and may be in draft form with legible freehand lines and lettering. Upon completion of the schedule, the Contractor shall submit the original and two copies to the Construction Manager in accordance with Section 01 33 00.

- B. Within 7 days after receipt of the submittal, the Construction Manager shall review the submitted schedule and return one copy of the marked-up original to the Contractor. If the Construction Manager finds that the submitted schedule does not comply with specified requirements, the corrective revisions will be noted on the submittal copy, returned to the Contractor for corrections and resubmitted as specified in **Section 01 33 00**.

1.04 SCHEDULE REVISIONS

- A. Revisions to the accepted critical path construction schedule may be made only with written approval of the Contractor and Owner. Changes in timing for activities which are not on the critical path may be modified with written agreement of the Contractor and Construction Manager. A change affecting the contract value of any activity, the timing of any activity on the critical path, the completion time and specific dates as specified in the Contract Documents, and work sequencing (**Section 01 12 16**) may be made only in accordance with applicable provisions of the General Conditions of the Contract Documents.

1.05 PROJECT STATUS UPDATE

- A. Project status review and update shall be provided each month as specified in the General Conditions of the Contract Documents.

END OF SECTION

SECTION 01 32 23
PRE- AND POST-CONSTRUCTION SURVEYS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Contractor shall furnish all labor and materials necessary to perform all surveying and staking essential for the completion of construction in conformance with the Drawings, Specifications, and Contract Documents.
- B. The Contractor shall perform all the necessary Work and calculations required to accomplish the Work in accordance with this Division.
- C. This Section establishes a minimum standard of field survey specifications and procedures to properly control the construction project.
- D. The Contractor shall insure that commonly accepted practices of survey methods and procedures are followed.
- E. Survey work shall be performed under the supervision of a licensed land surveyor or registered civil engineer. Contractor shall reestablish reference benchmarks and survey control monuments destroyed by his operations at no cost to the Owner.
- F. Work shall be performed under the direction of a Professional Land Surveyor licensed in the State of Utah.
- G. Errors or damages resulting from the Contractor's survey shall be corrected or made whole at the expense of the Contractor.
- H. The Owner shall not be held liable for any additional expense.
- I. Any method conflicting with these survey specifications must be approved by the Construction Manager prior to its use.
- J. The Contractor shall notify the Construction Manager twenty-four (24) hours in advance prior to beginning Work.
- K. All requests for information or determinations concerning the project shall be directed to the Construction Manager.

1.02 PAYMENT

- A. Payment for this Work incidental with other work in accordance with **Section 01 29 00**.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.01 PROJECT CONTROL

- A. All work shall be performed in accordance with recognized engineering survey practices.

- B. The Owner will provide the locations of the project horizontal and vertical control monuments to facilitate construction staking. Surveyor shall verify locations of survey control points prior to Contractor starting work to exposed existing structures. The Contractor shall recover project survey control monuments shown on the Record Drawings or establish project survey control monuments to ensure the project is properly located and constructed according to the Contract Documents.
- C. The Surveyor shall establish construction control points and benchmarks prior to construction. Establish a minimum of two permanent benchmarks on site, reference to established control points. Record locations, with horizontal and vertical data, on Project Record Drawings.
- D. Survey control monuments may be shown on the existing facility Record Drawings. Prior to construction, the Contractor shall locate these monuments to ensure they have not been destroyed. The Owner or Construction Manager can aid the Contractor in locating these monuments. In the event the Contractor is unable to locate certain monuments, the Contractor shall notify the Construction Manager immediately and provide **[7 calendar days / 5 working days]** for the Construction Manager to reestablish the missing monumentation.
- E. The Contractor shall have no basis for a claim requesting additional compensation for costs incurred due to missing survey control which might be shown on the Record Drawings, unless the Construction Manager fails to reestablish said control within **[7 calendar days / 5 working days]** after written notification from Contractor. The Contractor may be entitled an extension of time as the Construction Manager may determine. Claim for extension of time shall be in accordance with **Section 01 32 16.**
- F. The Contractor shall notify the Construction Manager immediately if a discrepancy exists between the field conditions and the Contract Documents. Project staking, which would be directly affected by the discrepancy, shall cease until further notice by the Construction Manager. Work unaffected by the discrepancy shall continue uninterrupted.
- G. The Contractor is responsible for preserving, protecting, and replacing all monuments and lot corners, line stakes, grade stakes, reference points, and hubs. In the event of their loss or destruction, the Contractor shall pay all costs for their replacement.
- H. Monuments:
 - 1. General Description
 - a. A monument is defined as a material object used to physically identify a measured point on the earth's surface that was determined by a land survey.
 - b. The term "monument" will be deemed generic to identify public land corners, private property corners and public agency vertical and horizontal control monuments.
 - c. If a question arises as to the validity of a found object being a monument, it should be submitted to the Construction Manager for clarification prior to disturbance or removal.
 - 2. Existing Monument Search
 - a. Contractor shall perform a monument search before commencement of construction staking.

- b. Contractor shall locate and verify all project survey control monuments shown on the Drawings to ensure that they have not been disturbed or destroyed.
 - c. In the event the Contractor is unable to locate any survey control monument that is shown on the Drawings, the Contractor shall notify the Construction Manager immediately.
 - d. The Construction Manager shall have **[7 calendar days / 5 working days]** to reestablish the missing monument or make a determination whether the project can be accurately staked without the missing monument.
 - 3. Requirement to Establish Monuments
 - a. The Contractor shall replace any monument that exists within the construction limits if it is disturbed or removed due to project activity.
 - b. All monumentation disturbed or removed shall be replaced with the same type monument or monument approved by the Construction Manager.
 - c. Should a physical impediment prevent a monument from being reestablished at its original location, one or more reference monuments shall be established.
 - d. The establishment of reference marks shall be coordinated with the Construction Manager.
- I. Project Control Accuracy:
- 1. Horizontal Control
 - a. The maximum permissible linear error allowed in establishing horizontal control is 1:10,000 feet.
 - b. The maximum error allowed in unadjusted angular closure shall be calculated by the formula "15 times the square root of N." The term "N" signifies the number of transit setups in a traverse and "15" signifies fifteen seconds.
 - 2. Vertical Control
 - a. Vertical datum shall originate from the established site benchmarks.
 - b. All level circuits run to establish temporary benchmarks shall have an accuracy no less than the value computed by the equation (three-hundredths feet (0.03') times the square root of the distance in miles).
 - c. Foresights and backsights shall be balanced. The maximum sighting distance shall not exceed three hundred feet (300').
 - d. All leveling circuits establishing TBMs will be adjusted utilizing recognized standard surveying adjustment methods.
 - e. Side shots to establish an elevation on TBMs will not be allowed.
 - f. A minimum of two known benchmarks shall be utilized when establishing TBMs to verify correct elevation information.
 - g. A sufficient number of TBMs shall be set to control a project with a maximum spacing of eight hundred feet (800') between marks.
 - h. Typically, a TBM should not be greater than two hundred feet (200') outside the construction limits of the project.
 - i. All TBMs shall be located and be comprised of sufficient materials such that their integrity will not be compromised throughout the life of the project.
 - 3. Construction Centerline
 - a. The construction centerline location and stationing shall conform to that shown on the Drawings.

- b. Any errors found in the line shall be corrected and shown on the specific plan view with reference to the centerline stationing.
 - c. If control points do not exist, they shall be established and referenced so that the line can be readily re-established when required.
 - d. A minimum of two reference points shall be established to reference each project control point or monument. Each reference point shall be visible to the other reference point.
 - e. The method of referencing control points shall be done in accordance with the Standard Details of these specifications.
 - f. Reference points shall be placed at locations where there is the least possibility of their being disturbed during the construction period.
 - g. Measurements and sketches of the reference points shall be kept in the horizontal control survey field book.
4. Check Existing Ground Profile
- a. A centerline profile shall be run prior to establishing construction grade stakes.
 - b. The existing ground elevations shall be checked against the existing profile elevations shown on the Drawings to verify design grade relative to the existing ground conditions.
 - c. The Contractor shall review the centerline profile information and immediately notify the Construction Manager of any elevations that do not match the plan profile information. The Construction Manager will direct the Contractor how to proceed.

3.02 DRAINAGE FACILITIES

- A. Minor changes in locations and grades to meet existing field conditions may be made where necessary, but only with the approval of the Construction Manager.
- B. If the planned design grade is found to be unworkable in the field, the Construction Manager shall be notified immediately, and all grade staking of the facility shall cease until further notice from the Construction Manager.

3.03 MAJOR STRUCTURES

- A. Construction survey procedures shall be reviewed by the Construction Manager prior to commencing any construction staking.
- B. The Construction Manager's review and approval of survey procedures is required prior to commencing construction activities for major structures including but not limited to bridges, docks, piers, piling foundations, drainage control facilities and large buildings.
- C. Horizontal and vertical control for the project shall be verified by the Contractor prior to any construction activity.
- D. The Contractor shall verify, if applicable, existing field elevations where planned foundations, pilings, piers, and support structures are to be placed prior to any construction activity.

- E. The Contractor shall verify, if applicable, depth of water and existing ocean or lake bottom elevations for all dock and pier construction prior to commencing pile driving and excavation activity.
- F. If any discrepancies are found between the Contract Documents and existing conditions the Contractor shall inform the Construction Manager immediately.

3.04 MISCELLANEOUS CONSTRUCTION

- A. The Contractor shall provide sufficient stakes for adequate control of all structures and incidental construction not specifically covered above.
- B. A staking diagram with respect to centerline and measurements for pay quantities shall be maintained in the field notes.
- C. Other items such as horizontal and vertical control shall be shown in the field book and shall be governed by procedures established in previous articles of this Specification.

3.05 SUBMITTALS

- A. Submit in accordance with the General Conditions and Section 01 33 00:
 - 1. The name, address, and telephone number of the professional Surveyor performing the work.
 - 2. Record copies of surveys performed including but not limited to field notes, electronic records and information provided to the manufactures.
 - 3. Record copies of design drawings provided to the fabricators / manufactures

3.06 RECORD SURVEYS AND RECORD DRAWINGS

- A. Record survey measurements shall be required for all constructed facilities and improvements to confirm the dimensions, lines, grades, locations, or materials as shown on the Drawings.
- B. Survey measurements shall be taken, field notes shall be kept, and accuracy shall be attained in accordance with this Division.
- C. Record information shall be marked on a clean set of full-size paper copy.
- D. Drawings shall be submitted at the completion of construction activity in accordance with **Section 01 78 39**. The Drawings shall be clearly stamped "Record Drawings."
- E. No final project payment will be made to the Contractor until the record Drawings have been submitted to and approved by the Construction Manager.
- F. The following abbreviations shall be used on the Record Drawings to denote a deviation from the Drawings:
 - 1. REC "Record" - The actual horizontal, vertical, dimension, or quantity measured by survey after it has been constructed.
 - 2. F.C. "Field Change" - Revision or change of original design made in the field.

3. "DELETED" - Not constructed.
- G. Minimum requirements for construction of Record Drawings:
1. Record Work shall be marked in red ink or red pencil to clearly identify the changes to the original design.
 2. A straight line drawn through stationing, elevations, and notes shall show a change, deletion, or omission and shall be followed with the appropriate symbol.
 3. Storm sewer, water, sanitary sewer, gas lines, or any construction that has been deleted or relocated will be crosshatched.
 4. Crossed out information should still remain legible.
 5. The scale of new gas lines, water, sewer, or any new construction not shown should conform to the scale of the drawings.
 6. Reference information used to prepare Record Drawings, such as change orders, and field books, shall be noted on the drawings.
 7. Profile changes will be made with elevations or stationing only. The profile line need not be re-drawn unless the change is significant.
 8. Record drawings for water, sewer, gas lines, and storm drain systems shall be accurate within three-hundredths feet (0.03') vertically and one-half feet (0.5') horizontally. Record Information shall be referenced to existing subdivision survey control and/or monumented centerline of the right-of-way control.
 9. Record drawings for structures shall be accurate to within one-half inch (1/2") vertically and horizontally.
 10. The name of the Record Drawing preparer, the employer, and the date of the preparation shall appear in the appropriate title block on each Record Drawing sheet.
- H. The construction of Record Drawings is incidental to other Work and no measurement or payment shall be made.

END OF SECTION

SECTION 01 32 33
PHOTOGRAPHIC DOCUMENTATION

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies progress photographs to be provided for pre-construction, during construction, and post-construction.

1.02 SUBMITTALS

- A. Photographs shall be submitted in accordance with Section 01 33 00 - Submittal Procedures.

PART 2 PRODUCTS

2.01 PHOTOGRAPHS

- A. Photographs shall be taken using a digital camera. Photographs shall be in color and shall have a minimum image area of [1600 X 1200] pixels.
- B. Upload, maintain, and organize the photographs monthly using a commercially available photo management system. Organize files by area, year, and month. Assign file names that include location by area, direction, description and date taken.
- C. Submit photographs in digital format on a monthly basis.

PART 3 EXECUTION

3.01 GENERAL

- A. Photographs shall be taken at locations designated by the Owner and Construction Manager.
- B. The photographer shall be equipped to photograph interior and exterior exposures, with lenses ranging from wide-angle to telephoto and flash equipment as necessary for interior spaces.
- C. The photographer shall be experienced in construction photography.
- D. High-definition video ([1080p at 30 fps] or higher) images may be acceptable for certain operations. Confirm with Construction Manager.

3.02 PRE-CONSTRUCTION PHOTOGRAPHS

- A. The Contractor shall provide preconstruction photographs prior to commencement of work on the Site. The photos shall indicate the date, name of work, and the location where the photograph was taken. Before construction may start, the photographs shall be delivered to the Construction Manager in digital format. Preconstruction photographs shall be taken at locations to be designated by the Construction Manager. The

photographer shall be equipped to photograph either interior or exterior exposures, with lenses ranging from wide angle to 135 mm.

3.03 CONSTRUCTION PHOTOGRAPHS

- A. The Contractor shall provide construction photographs showing the progress of the Work. The photographs shall be taken of such subjects as may be directed by the Owner and Construction Manager. The photographs shall be taken of such subjects as may be directed, and shall indicate the date, job title and brief description of the photograph including the location where the photograph was taken. Starting one month after the date of the preconstruction photographs and continuing as long as the work is in progress, monthly photographs shall be taken and provided to the Construction Manager in digital format.
- B. Photographs of all underground piping and structures prior to backfilling. Include associated location information.

3.04 POST-CONSTRUCTION PHOTOGRAPHS

- A. Take the number of exposures specified until Final Acceptance of the Work. Locations shall be designated by the Owner and Construction Manager.

3.05 REQUIRED NUMBER OF PHOTOGRAPHS

- A. For the work of this Contract, photographs shall provide the minimum number of photographs as follows:

Category	Number of Photographs
Preconstruction	[50]
Construction	[25] weekly
	[100] monthly
Acceptance	[50]

END OF SECTION

SECTION 01 33 00
SUBMITTAL PROCEDURES

PART 1 GENERAL

1.01 SUMMARY

- A. This Section includes administrative and procedural requirements for submittals.

1.02 ADMINISTRATIVE REQUIREMENTS

A. General:

1. Furnish submittal items as specified in the Contract Documents.
2. Review submittal information to verify it is accurate and fulfills specified submittal requirements before submitting for review and comment.
3. Edit submittal content to clearly indicate only those items, models, or series of equipment, which are being submitted for review. Cross out or otherwise obliterate extraneous materials.
4. Ensure there is no conflict with other submittals and notify the Owner's Representative in each case where the submittal may affect the work of another contractor or the Owner.
5. Coordinate submittals among subcontractors and suppliers including those submittals complying with unit responsibility requirements specified in the Contract Documents.
6. For each submittal, certify field conditions, compliance with the Contract Documents, and review of the submittal prior to submitting for review.
7. Designate the installation location within the facility, application, or intended purpose for each submittal item. Review comments are solely applicable to the circumstances designated in the submittal.
8. Coordinate submittals with the work so that work will not be delayed. Coordinate and schedule different categories of submittals, so that one will not be delayed for lack of coordination with others.
9. No extension of time will be allowed because of failure to properly schedule, coordinate or compile submittals.
10. Submittals will be rejected for lack of legibility, lack of coordination, ambiguity, or are incomplete. Incomplete submittals will be returned without review.
11. Do not proceed with work related to a submittal until the submittal process is complete. This requires that submittals for review and comment be returned to the Contractor stamped "No Exceptions Taken" or "Make Corrections Noted."
12. If desired, authorize material or equipment suppliers to deal directly with the Owner's Representative regarding a submittal. Such dealings require written authorization from the Contractor and are limited to contract interpretations to clarify and expedite the work.

B. Request for Substitution Procedures:

1. Requests for substitution for equipment specified by manufacture or manufacture's model number and listed below shall be in writing and shall be accompanied with sufficient information to permit the Construction Manager to identify the nature and

scope of the request. Information to be provided along with the request for substitution shall include:

- a. All submittal information required for the specified equipment, including all deviations from the specified requirements necessitated by the proposed substitution.
 - b. Materials of construction, including material specifications and references.
 - c. Performance data, including performance curves and guaranteed power consumption, over the range of specified operating conditions.
 - d. Dimensional drawings, showing required access and clearances, including any changes to the work required to accommodate the proposed substitution.
 - e. Where controls are part of the proposed substitution, piping, process, and instrumentation drawings (P&IDs), produced in the project format and with project-specific symbols, along with control descriptions.
 - f. Where controls specified in the project manual require modification to accommodate the proposed substitution, piping, process and instrumentation drawings (P&IDs), produced in project format and with project-specific symbols, with all required modifications highlighted.
 - g. Information and performance characteristics for all system components and ancillary devices to be furnished as a part of the proposed substitution.
 - h. Reproducible contract drawings, marked up to illustrate the alterations to all structural, architectural, mechanical, electrical and HVAC systems required to accommodate the proposed substitution.
 - i. A list of installations of the proposed substitution indicating application, location, owner and date of first use.
2. Upon receipt of written application for substitution from the Contractor, including the information specified above, the Construction Manager will estimate the cost of evaluating the request and present the estimate to the Contractor. The Contractor is advised that the estimate is based upon time and expense, will be documented and applied in the final analysis of the substitution request. If the Contractor wishes to proceed with the request, he shall advise the Construction Manager in writing and submit sufficient additional information as may be requested by the Construction Manager. No evaluation will take place until such time as the Contractor has agreed to the estimate in writing and has authorized the Construction Manager to deduct the cost of the evaluation from monthly progress payments due the Contractor.
 3. Cost for evaluating a requested substitution for any equipment item named shall be borne by the Contractor.

1.03 DEFINITIONS

A. Action Submittals:

1. Action Submittals content require review and response by the Owner's Representative before proceeding with incorporating the subject equipment, materials, or procedure into the work.
2. Review comments on Action Submittals, and perform subsequent actions based on the REVIEW ACTION requirements specified below.

B. Informational Submittals:

1. Informational Submittals are examined to verify that the specified submittal contents have been furnished as specified.
 2. The Contractor's actions are not contingent on the disposition of review comments on Informational Submittals.
 3. Review comments on Informational Submittals, and perform subsequent actions based on the REVIEW ACTION requirements specified below.
- C. Closeout Submittals:
1. Closeout Submittals consist of documentation that is not available for review at the time Action Submittals are submitted for review or documentation that is typically generated or furnished following incorporation of the equipment, materials, or procedure into the work. Closeout submittals include spare parts inventory listing, spare parts, extra stock materials, special tools and other materials or components that are furnished separate from the installed and completed work.
 2. Review comments on Closeout Submittals, and perform the subsequent actions based on the REVIEW ACTION requirements specified below.
- D. Samples:
1. Samples include partial sections of components, cuts, or containers of materials, color range sets, and swatches showing color, texture and pattern.
 2. Samples may be Action or Informational submittals.
- E. Mock-Ups:
1. Mock-ups are scale representations of items to be constructed as part of the work as required in the Contract Documents.
 2. Mock-ups are Action Submittals.
- F. Review Actions:
1. The following definitions and actions are associated with the REVIEW ACTIONS DEFINED below:
 - a. NO EXCEPTIONS TAKEN: If the review indicates that the material, equipment or work method complies with the Contract Documents, submittal will be marked "NO EXCEPTIONS TAKEN." Implement the work method or incorporate the material or equipment covered by the submittal.
 - b. MAKE CORRECTIONS NOTED: If the review indicates limited corrections are required, submittals will be marked "MAKE CORRECTIONS NOTED." Implement the work method or incorporate the material and equipment covered by the submittal in accordance with the noted corrections. Where submittal information will be incorporated in O&M data, provide a corrected copy.
 - c. AMEND AND RESUBMIT: If the review reveals that the submittal is insufficient or contains incorrect data, submittals will be marked "AMEND AND RESUBMIT." Do not undertake work until the submittal has been revised, resubmitted and returned marked either "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED".
 - d. REJECTED - SEE REMARKS: If the review indicates that the material, equipment, or work method does not comply with Contract Documents, the submittal will be marked "REJECTED - SEE REMARKS." Do not undertake the work covered by such

submittals until a new submittal is made and returned marked either "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED" except at your own risk.

e. Submittals (product data) for information only:

- 1) Such information is not subject to submittal review procedures and shall be provided as part of the work under this contract and its acceptability determined under normal inspection procedures.

1.04 MASTER SUBMITTAL LIST

- A. A minimum of [five (5)] business days following the Notice to Proceed, the Contractor will provide the Owner's Representative a Master Submittal List listing anticipated submittal requirements for the contract.
- B. Contractor shall update the list as submittals are completed and transmit to the Owner's Representative. Provide updated list to Owner's Representative monthly.
- C. Include the following as a minimum in the updated list:
 1. Submittal number.
 2. Date submitted.
 3. Requested time for return of comments.
 4. Special requests, if any, for that particular submittal.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 SUBMITTAL PROCEDURES

- A. General:
 1. Owner's Representative will review submittal information and indicate a REVIEW ACTION. Review of submittals does not relieve the Contractor of responsibility for performance of the work according to the Contract Documents.
 2. Coordinate submittal transmittal for related elements of work to ensure the submittals are processed as needed to meet the intent of the work and that delays are minimized.
 3. See Section 1.02 B - Substitution Procedures For product substitutions.
 4. Submittal review activity will be prioritized based on the order received unless otherwise requested by the Contractor.
 5. Submittal sequencing should coincide with the Construction Schedule in Section 01 32 16 - Construction Progress Schedule.
 6. A review duration of 15 calendar days is allotted for each submittal, from the date of receipt by the Owner's Representative to the date of return to the Contractor.
- B. Submittal Preparation:
 1. Excepting, mock-ups, spare parts, physical samples, and other items that cannot be converted to electronic media, furnish submittal contents electronically in a searchable PDF format.

- a. Include a table of contents and labeled divider sheets that are coordinated with the table of contents.
 - b. Diagrams, drawings, pictures, and illustrations presented with a consistent orientation.
 - c. Action and Closeout Submittals: [three (3)] copies of submitted information plus one reproducible original.
 - d. Informational Submittals: [three (3)] copies of submitted information.
- 2. Shop Drawings, Samples and Mock-ups
 - a. Submit one electronic copy per the requirements described above and the following:
 - 1) Shop Drawings: [one (1)] reproducible and [three (3)] prints for job site reference. One marked up print will be returned to the Contractor when the review is complete.
 - 2) Samples: [three (3)] samples
 - 3) Mock-up: As required by individual specification
 - 4) Demonstrations: As required to facilitate installation and inspection
 - b. Reference applicable specifications for additional requirements
- C. Submittal Completeness:
 - 1. Submittals without all required information are not acceptable and may be marked "REJECTED" and returned without review.
 - 2. For a submittal to be deemed complete, provide the information required below and specified in specification sections, including those elements in the special transmittal procedures where required.
- D. In the event of the need to "revise and resubmit", provide a complete stand-alone submittal with corrections, revisions, and new information clearly identified.
- E. Resubmit changes to submittals that require a stamp and signature by a licensed engineer or other certification with the requisite stamp and signature or certifications.
- F. If the Engineer must review a submittal more than twice, the Contractor shall bear financial responsibility for each subsequent review.

3.02 TRANSMITTAL PROCEDURE

- A. General:
 - 1. Include the following information on the submittal transmittal form:
 - a. Project names and date, including Owner's Project Name as follows: [East Facility Utilities and Clarifiers Rehabilitation Project]
 - b. Name of Contractor and Subcontractor
 - c. Name of supplier and name of manufacturer
 - d. Number and title of appropriate specification section
 - e. Drawing number and detail references, as appropriate
 - 2. Equipment and Material Submittals: Unless otherwise specified, complete the Transmittal Form 01 33 00-A - Submittal Transmittal Form specified in Section 01 99 90 - Reference Forms.

3. Operation and maintenance manuals, information and data Submittals: Complete the Transmittal Form 01 78 23-A - Operation and Maintenance Transmittal Form specified in Section 01 99 90 - Reference Forms.
 4. Use a separate form for each specific item, class of material, equipment, and items specified in separate, discrete sections, for which a submittal is required. Identify the appropriate equipment numbers for submittal documents common to more than one piece of equipment. Submit a single form for multiple items, if the items taken together constitute a Supplier's package or are functionally related, to facilitate checking or reviewing the group or package as a whole.
 5. Assign a unique sequential number to each transmittal form accompanying each item submitted.
 - a. Format submittal numbers as follows: "SS SS SS-XXX"; where "SS SS SS" is the referenced 6-digit section number from the Specifications and "XXX" is the sequential number assigned by the Contractor.
 - b. Format resubmittals as follows: : "SS SS SS-XXX-YY"; where "XXX" is the originally assigned submittal number and "YY" is a sequential number assigned for resubmittals, i.e., 00, 01, or 02 being the original, 1st, and 2nd resubmittals, respectively. Submittal 43 23 50-001-02, for example, is the second resubmittal of submittal 001 pertaining to Section 43 23 50.
 6. Deviation from contract: If deviations from the material, equipment or method of work are proposed, describe the proposed deviation and explain the reason for proposing the deviation under "deviations" on the transmittal form accompanying the submittal copies.
- B. Document Management System Specific Procedures:
1. [Unless otherwise specified, submittals regarding material and equipment shall be submitted electronically using a document control program/website.
 2. Log in information and instructions will be provided to Contractor upon project award.]
- C. Check Marked Specification Transmittal Procedures:
1. When submittal requirements require a "marked" copy of the specification, provide a copy of the specification marked as indicated below. Provide the following when transmitting the submittal:
 - a. Provide a copy of the specification section(s) that specifies a marked copy of the specification. Include addendum updates and referenced specification sections, with addendum updates. Complete the following:
 - 1) Checkmark each paragraph to indicate submittal compliance with that specification requirement. Check marks (✓) shall denote full compliance with that paragraph as a whole.
 - 2) Mark paragraphs where deviations are proposed by underlining text that is the subject of the proposed deviation. Denoting each proposed deviation with a number in the margin to the right of the identified paragraph and provide a detailed written explanation for each numbered deviation. The remaining portions of the paragraph not underlined signify compliance with specified requirements.
 - 3) The Engineer is the final authority for determining acceptability of requested deviations.

- b. For equipment specifications, provide a copy of the control diagrams and process and instrumentation diagrams relating to the submitted equipment, with addendum updates that apply to the subject equipment. Complete the following:
 - 1) Mark drawings or diagrams to show specific changes necessary for the equipment proposed in the submittal.
 - 2) If no changes are required, mark the drawings or diagrams with "no changes required".
- D. Provide a Certificate of Unit Responsibility assigning unit responsibility in accordance with the requirements of the specification Section. No other submittal material will be reviewed until the certificate has been received and found to be in conformance with the Specifications.
- E. Samples and Mock-ups:
 - 1. Submit samples and mock-ups in accordance with the Contract Documents. Package samples to facilitate review. Include the following with the Submittal Transmittal Form:
 - a. Generic description of the sample
 - b. Sample source
 - c. Product name and name of manufacturer
 - d. Compliance with recognized standards
 - e. Submittal Number
 - f. Availability and delivery time
 - g. Specification Section
 - 2. Submit samples and mock-ups before installation. Where variation in color, pattern, texture or other characteristics are inherent in the material, submit four units to show variation range.
 - 3. Where samples are for selection of appearance characteristics from a range of standard choices, submit a full set of choices for the material or products.
 - 4. Maintain sets of approved samples and mock-ups at the Project Site, for quality comparisons throughout the course of construction.
 - 5. Demolish and remove all samples and mock-ups prior to substantial completion.

3.03 REVIEW PROCEDURE

- A. General:
 - 1. Owner's Representative will review each submittal, indicate a REVIEW ACTION, and return to the Contractor.
 - 2. Returned submittals indicate one of the following REVIEW ACTIONS: NO EXEMPTIONS TAKEN, MAKE CORRECTIONS NOTED, AMEND AND RESUBMIT, or REJECTED – SEE REMARKS.

3.04 EFFECT OF REVIEW OF CONTRACTOR'S SUBMITTALS

- A. General:
 - 1. Review of contract drawings, methods of work, or information regarding materials or equipment the Contractor proposes to provide, does not relieve the Contractor of responsibility for errors therein and is not regarded as an assumption of risks or

liability by the Owner's Representative or the Owner, or by any officer or employee thereof, and the Contractor has no claim under the contract on account of the failure, or partial failure, of the method of work, material, or equipment reviewed. A mark of "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED" means that the Owner has no objection to the Contractor, upon his own responsibility, using the plan or method of work proposed, or providing the materials or equipment proposed.

END OF SECTION

SECTION 01 35 29

HEALTH, SAFETY, AND EMERGENCY RESPONSE PROCEDURES

PART 1 GENERAL

1.01 REQUIREMENTS

- A. The Contractor shall conduct operations in a safe manner at all times. All OSHA regulations, and all other regulations pertaining to the safe operation of construction equipment, workers, methods and the job-site shall be strictly adhered to by the Contractor.
- B. In accordance with the requirements of Local, State and Federal Safety Regulations, the Contractor will be solely and completely responsible for conditions of the job-site, including safety of all persons and property during performance of work. This requirement will apply continuously and not be limited to working hours. The duty of the Owner to conduct construction observation of the Contractor 's performance is not intended to include review of the adequacy of the Contractor 's and Subcontractor's safety measure in, on, or near the construction site.
- C. The Contractor shall at all times, whether or not so specifically directed by the Owner or Engineer, take necessary precautions to insure the protection of the public. The Contractor shall furnish, erect, and maintain all necessary barricades, fences, suitable and sufficient construction signs, provide a sufficient number of watchmen and take all necessary precautions for the protection of the work and safety of the public through or around the construction operations. City crews and representatives will not enter a trench that appears unsafe. It is the Contractor 's responsibility to provide a safe trench.
- D. The Contractor shall maintain a safe and clean job-site at all times. Construction debris on traveled road surfaces, temporary detours, access driveways, etc., shall be cleaned away daily. Where applicable (in the opinion of the Owner or Engineer), pedestrians and bicyclists shall be furnished with a safe and unobstructed route through the job-site. If the Contractor 's operations cause there to be nuisance dust on the road surface, the Contractor must sweep away such dust when so ordered by the Owner. All costs for maintaining a clean and safe job-site will be considered incidental to the contract and will not be paid for separately. No open excavations will be allowed overnight.

1.02 POTENTIAL JOBSITE HAZARDS

- A. Potential job-site hazards include the following:
 - 1. Construction related occupational injury; including the use of tools and heavy equipment; slips, trips and falls; buried gas and power lines, weather; and traffic.
 - 2. Other potential job-site hazards include the following:
 - a. Wastewater
 - b. Organic chemicals
 - c. Inorganic chemicals
 - d. Biologic hazards
 - e. Plant operations
 - f. Toxic gases

- B. Portions of the existing plant are exposed to wastewaters of varying degrees of treatment. Workmen involved in the removal, renovation, or installation of equipment within the treatment plant may be exposed to disease-producing organisms in wastewater. The Contractor shall require his personnel to observe proper hygienic precautions.
- C. Solvents, gasoline, and other hazardous materials enter the plant with incoming sewage, and, therefore, certain areas are hazardous to open flame, sparks, or unventilated occupancy. The Contractor shall take measures to assure his personnel observe proper safety precautions when working in these areas.

1.03 SAFETY AND HEALTH REGULATIONS

- A. The Contractor shall comply with Safety and Health Regulations for Construction, promulgated by the Secretary of Labor under Section 107 of the Contract Work Hours and Safety Standards Act, as set forth in Title 29, C.F.R. Copies of these regulations may be obtained from Labor Building, 14th and Constitution Avenue N.W., Washington, DC 20013.
- B. The Contractor shall also comply with the provisions of the Federal Occupational Safety and Health Act, as amended.

1.04 SAFETY AND HEALTH SUBMITTAL

- A. Before commencing Work on-site, the CONTRACTOR shall submit, in accordance with Section 01300 - Submittal Procedure, a Health and Safety Plan outlining methods and procedures to be implemented to protect worker safety and contingency plans in the event of an accident. The Health and Safety Plan shall address all regulatory and site-specific health and safety requirements, including, but not limited to the following:
 - 1. Excavation safety
 - 2. Confined space safety
 - 3. Traffic safety
 - 4. Other safety issues pertaining to activities that are typical of work as described in the Contract Drawings and Specifications.
- B. Emergency Numbers:
 - 1. Fire and Police 911
 - 2. Dominion Energy 1-800-767-1689
 - 3. Rocky Mountain Power 1-877-508-5088, 1-800-715-9238

END OF SECTION

SECTION 01 35 43
ENVIRONMENTAL PROCEDURES

PART 1 GENERAL

1.01 DESCRIPTION

- A. This section covers general requirements for environmental controls related to construction and demolition operations under this contract except for those measures set forth in other sections. The control of environmental pollution requires consideration of the effects of the activities of the Contractor on air, water, and land resources.

1.02 PRODUCT DATA

- A. Contractor shall provide Product Data in accordance with Section 01 33 00 on all manner of federal, state, municipal, Utah County, or other relevant permits not less than two (2) weeks prior to operations on areas covered by the permit. Appropriate permits may include, but are not limited to those for:
 - 1. Construction
 - 2. Erosion sediment control
 - 3. Construction stormwater management
 - 4. Air emissions
 - 5. Disposal of hazardous wastes
 - 6. Demolition

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 SITE MAINTENANCE AND HOUSEKEEPING

- A. The CONTRACTOR shall keep the work site neat, orderly, clean, free from rubbish and in a safe condition at all times. All debris disposal areas shall prevent wind from spreading the debris. Materials and equipment shall be removed from the site when they are no longer necessary. Upon completion of the Work and before final acceptance, the work site shall be cleared of equipment, unused materials, and rubbish to present a clean and neat appearance.
- B. The CONTRACTOR shall store and use equipment, tools, and materials in a manner that does not present a hazard. Immediately remove all hazardous rubbish. Do not allow rubbish to accumulate. Provide on-site containers for collection of rubbish and dispose of it at frequent intervals during progress of work. When excavations are made and if suitable, immediately utilize resultant earth with filling and compacting in place, or dispose of unsuitable materials off-site.
- C. Wet down dry materials and rubbish to prevent blowing dust.
- D. Keep volatile wastes in covered containers.

- E. Upon completion of work, the Contractor shall thoroughly clean the floor and sump of the Secondary Clarifiers to remove all debris from construction. A clean floor and sump is critical to protect the Primary Clarifier Sludge Pumps and other downstream equipment and processes from potential damage due to conveyance of construction debris.

3.02 TEMPORARY DAMS / SPILL CONTAINMENT

- A. Except in time of emergency, earth dams are not acceptable at catch basin openings, local depressions, or elsewhere. Temporary dams of sand bags, asphaltic concrete, or other acceptable material will be permitted when necessary to protect the work, provided their use does not create a hazard or nuisance to the public. Such dams shall be removed from the site as soon as they are no longer necessary.
- B. Temporary watertight leak containment filters shall be provided by the contractor for chemical, fuel, material storage, etc. Temporary facilities shall be removed and properly disposed of after construction is completed.

3.03 AIR POLLUTION CONTROL

- A. The Contractor shall not discharge smoke, dust, and other contaminants into the atmosphere that violate the regulations of any legally constituted authority. They shall also abate dust nuisance by cleaning, sweeping, and sprinkling with water, or other means as necessary. The use of water, in amounts which result in mud on public streets, is not acceptable as a substitute for sweeping or other methods.

3.04 NOISE CONTROL

- A. Noise from Contractor's operations shall not exceed limits established by applicable federal, state or local laws or regulations. Contractor shall follow construction noise limits established by local Ordinances and permitting. In no event shall noise exceed 86 dBA at a distance of 50 feet from the noise source and 75 dBA at the plant property line. Noise level monitoring shall be performed by the Contractor as necessary to show that the permitted levels are not being exceeded.

3.05 WATER AND SOIL CONTAMINATION

- A. The Contractor shall comply with all federal, state and local laws and regulations which apply to water pollution and soil contamination.
- B. If contaminated soil or water is encountered or suspected, the Contractor shall immediately suspend construction operations and notify the Engineer.
- C. In order to minimize the possibility of water or soil contamination due to spills of crankcase oil, gasoline and other fuels, the Contractor shall designate an area for the storage and handling of lubricants, fuels and other supplies which is acceptable to the Engineer. The Contractor shall comply with all applicable federal, state and local rules and regulations related to the storage of fuels and chemicals and the reporting and cleanup of spills.

3.06 ILLEGAL DISCHARGE

- A. At no time shall the Contractor release or dump solvents, paints, gasoline or other fuels or oils into any portion of the plants sewers or process facilities.

3.07 HAZARDOUS WASTES

- A. The Contractor shall comply with all federal, state, and local laws and regulations which apply to the removal and disposal of any and all hazardous wastes encountered during demo of old structures, utilities, and materials required by this project.

3.08 PRESERVATION OF NATURAL FEATURES

- A. The Contractor shall confine operations as much as possible and exercise special care to maintain natural surroundings in an undamaged condition. Within the work limits, barricade trees, rock outcroppings, and natural features to be preserved. Do not remove, injure, or destroy trees or other plantings without prior approval. Do not fasten ropes, cables or guys to existing trees for anchorage. Restore or replace damaged trees and shrubs or natural features as nearly as possible to original condition at no additional expense to the Owner. The Engineer shall determine if restoration or replacement is required.

3.09 DISPOSAL OF WASTE (UNSUITABLE) MATERIALS

- A. All material determined by the Engineer to be waste will be disposed of in approved landfill in a manner meeting all regulations. Dispose of waste materials, legally, at public or private disposal areas. Do not bury wastes inside of the limits of construction.
- B. Disposal of Garbage and other Construction Materials: Provide sanitary containers/ dumpsters and haul away contents such that no overflow exists.
- C. Excess excavation shall become the property of the Contractor and shall be legally disposed of by him outside the limits of construction. Excess sand, and excess excavated material not used on-site shall be hauled from the site to an approved disposal site. Excess excavated material suitable for backfill shall not be disposed of until all backfill operations are complete.
- D. Immediately remove any hazardous materials.

3.10 FIRE PREVENTION AND PROTECTION

- A. Hazard Control: Take all necessary precautions to prevent fire during construction. Provide adequate ventilation during use of volatile or noxious substances.
- B. Spark Arresters: Equip all gasoline or diesel powered equipment used in potential grass fire locations with spark arresters approved by the U.S. Forest Service.
- C. Locate internal combustion equipment so that exhausts discharge well away from combustible materials.
- D. Locate service areas a minimum of 100 feet from buildings. Shut down equipment before refueling.

- E. Smoking: Smoking within buildings or temporary storage sheds is prohibited. Smoking in potential grass fire locations shall be prohibited.
- F. Welding: Cutting by torch or welding shall be performed only when adequate fire protection is provided and maintained for the duration of the work in the area of operations.
- G. Familiarize all work crews with grass fire potential and methods of reporting fires to the proper authorities. Take immediate action with sufficient personnel from the project crew or with tools and equipment to suppress fires.

END OF SECTION

SECTION 01 42 19
REFERENCE STANDARDS

PART 1 GENERAL

1.01 ABBREVIATIONS

- A. Wherever used in the project manual, the following abbreviations will have the meanings listed:

Abbreviation	Meaning
AA	Aluminum Association Incorporated P.O. Box 753 Waldorf, MD 20604
AABC	Associated Air Balance Council 1518 K Street N.W. Washington, DC 20005
AAMA	American Architectural Manufacturers Association 1540 East Dundee Road, Suite 310 Palatine, IL 60067
AASHTO	American Association of State Highway and Transportation Officials 444 North Capitol Street, N.W., Suite 249 Washington, DC 20001
ABMA	American Bearing Manufacturers Association 1200 19th Street N.W., Suite 300 Washington, DC 20036
ACI	American Concrete Institute 22400 West Seven Mile Road P.O. Box 19150, Redford Station Detroit, MI 48219
AEIC	Association of Edison Illuminating Companies 600 North 18th Street P.O. Box 2641 Birmingham, AL 35291
AGA	American Gas Association ATTN: Records 1515 Wilson Boulevard Arlington, VA 22209
AGMA	American Gear Manufacturer's Association, Inc. 1500 King Street, Suite 201 Alexandria, VA 22314
AHA	American Hardboard Association 1210 West Northwest Highway Palatine, IL 60067
AISC	American Institute of Steel Construction One East Wacker Drive, Suite 3100 Chicago, IL 60601

Abbreviation	Meaning
AISI	American Iron and Steel Institute 1101 Seventeenth Street, NW, Suite 1300 Washington, DC 20036
AITC	American Institute of Timber Construction 7012 South Revere Parkway, Suite 140 Englewood, CO 80112
ALSC	American Lumber Standard Committee P.O. Box 210 Germantown, MD 20875
AMCA	Air Movement and Control Association, Inc. 30 West University Drive Arlington Heights, IL 60004
ANSI	American National Standards Institute 11 West 42nd Street, 13th Floor New York, NY 10036
APA	American Plywood Association 7011 South 19th Street Tacoma, WA 98466
API	American Petroleum Institute 1220 "L" Street N.W. Washington, DC 20005
ARI	Air-Conditioning and Refrigeration Institute 4301 North Fairfax Drive, Suite 425 Arlington, VA 22203
ASCE	American Society of Civil Engineers United Engineering Center 345 East 47th Street New York, NY 10017
ASCII	American Standard Code for Information Interchange United States of America Standards Institute 10 East 40th Street New York, NY 10016
ASE Code	American Standard Safety Code for Elevators, Dumbwaiter and Escalators American National Standards Institute 1430 Broadway New York, NY 10018
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers, Inc. 1791 Tullie Circle, NE Atlanta, GA 30329
ASME	American Society of Mechanical Engineers 345 East 47th Street New York, NY 10017

Abbreviation	Meaning
ASTM	American Society for Testing and Materials 100 Barr Harbor Drive West Conshohocken, PA 19428
AWPA	American Wood-Preservers' Association 9549 Old Fredrick Road Ellicott City, MD 21042
	or P.O. Box 286 Woodstock, MD 21163-0286
AWS	American Welding Society 550 NW LeJeune Road P.O. Box 351040 Miami, FL 33135
AWWA	American Water Works Association 6666 West Quincy Avenue Denver, CO 80235
BOCA	Building Officials and Code Administrators, International, Inc. 4051 West Flossmoor Road Country Club Hills, IL 60478
CALTEST	Materials Manual, State of California, Business and Transportation Agency Department of Public Works State of California, Department of Transportation 6002 Folsom Boulevard Sacramento, CA 95819
CALTRANS	Standard Specifications, State of California, Department of Transportation State of California, Business and Transportation Agency P.O. Box 1499 Sacramento, CA 95807
CBM	Certified Ballast Manufacturers 2120 Keith Building Cleveland, OH 44115
CMAA	Crane Manufacturers Association of America, Inc. (Formerly called: Overhead Electrical Crane Institute) (OECI) 8720 Red Oak Boulevard, Suite 201 Charlotte, NC 28217
CRSI	Concrete Reinforcing Steel Institute 933 N Plum Grove Road Schaumburg, IL 60173
CSA	Canadian Standards Association 178 Rexdale Boulevard Rexdale, Ontario, M9W 1R3, Canada
DEMA	Diesel Engine Manufacturer's Association 30200 Detroit Road Cleveland, OH 44145

Abbreviation	Meaning
DHI	Door and Hardware Institute 14170 Newbrook Drive Chantilly, VA 22021
DIS	Division of Industrial Safety California Department of Industrial Relations 2422 Arden Way Sacramento, CA 95825
EI	Edison Electric Institute 90 Park Avenue New York, NY 10016
EIA	Electronic Industries Association Order from: Global Engineering Documents 18201 McDermott West Irvine, CA 92714
EJMA	Expansion Joint Manufacturers Association 25 North Broadway Tarrytown, NY 10591
ESO	Electrical Safety Orders California Administrative Code, Title 8, Chap. 4, Subarticle 5 Office of Procurement, Publications Section P.O. Box 20191 8141 Elder Creek Road Sacramento, CA 95820
FEDSPEC	Federal Specifications General Services Administration Specification and Consumer Information Distribution Branch Washington Navy Yard, Bldg. 197 Washington, DC 20407
FEDSTDs (see FEDSPECS)	Federal Standards
FM	Factory Mutual Engineering and Research Corporation 1151 Boston-Providence Turnpike P.O. Box 9102 Norwood, MA 02062
HEI	Heat Exchange Institute 1300 Sumner Avenue Cleveland, OH 44115
HI	Hydraulic Institute 9 Sylvan Way, Suite 180 Parsippany, NJ 07054

Abbreviation	Meaning
HPVA	Hardwood Plywood & Veneer Association 1825 Michael Faraday Drive P.O. Box 2789 Reston, VA 22090-2789
IAPMO	International Association of Plumbing and Mechanical Officials 20001 Walnut Drive S Walnut, CA 91789
ICBO	International Conference of Building Officials 5360 Workman Mill Road Whittier, CA 90601
ICEA	Insulated Cable Engineers Association P.O. Box 440 South Yarmouth, MA 02664
IEEE	Institute of Electrical and Electronics Engineers 445 Hoes Lane P.O. Box 1331 Piscataway, NJ 08855
IES	Illuminating Engineering Society of North America 120 Wall Street New York, NY 10017
ISA	Instrument Society of America 67 Alexander Drive P.O. Box 12277 Research Triangle Park, NC 27709
JIC	Joint Industrial Council 7901 West Park Drive McLean, VA 22101
MFMA	Metal Framing Manufacturers Association 401 N. Michigan Avenue Chicago, IL 60611
MILSPEC	Military Specifications Naval Publications and Forms Center 5801 Tabor Avenue Philadelphia, PA 19120
MSS	Manufacturers Standardization Society of the Valve & Fittings Industry, Inc. 127 Park Street, N.E. Vienna, VA 22180
NAAMM	National Association of Architectural Metal Manufacturers 11 South La Salle Street, Suite 1400 Chicago, IL 60603
NACE	National Association of Corrosion Engineers 1440 South Creek Drive Houston, TX 77084
NBC	National Building Code Published by BOCA

Abbreviation	Meaning
NEC	National Electric Code National Fire Protection Association One Batterymarch Park P.O. Box 9101 Quincy, MA 02269
NELMA	Northeastern Lumber Manufacturers Association, Inc. P.O. Box 87A Cumberland Center, ME 04021
NEMA	National Electrical Manufacturer's Association 2101 L Street, NW, Suite 300 Washington, DC 20037
NESC	National Electric Safety Code American National Standards Institute 1430 Broadway New York, NY 10018
NFOR	National Forest Products Association (Formerly National Lumber Manufacturer's Association) 1111 19 Street NW, Suite 700 Washington, DC 20036
NFPA	National Fire Protection Association One Batterymarch Park P.O. Box 9101 Quincy, MA 02269
NHLA	National Hardwood Lumber Association 6830 Raleigh LaGrange P.O. Box 34518 Memphis, TN 38184-0518
NSF	National Sanitation Foundation 3475 Plymouth Road P.O. Box 130140 Ann Arbor, MI 48113
OSHA	Occupational Safety and Health Act U.S. Department of Labor Occupational and Health Administration San Francisco Regional Office 450 Golden Gate Avenue, Box 36017 San Francisco, CA 94102
PCI	Precast/Prestressed Concrete Institute 175 West Jackson Blvd., Suite 1859 Chicago, IL 60604
PPIC	The Plumbing & Piping Industry Council, Inc. 510 Shatto Place, Suite 402 Los Angeles, CA 90020

Abbreviation	Meaning
RIS	Redwood Inspection Service California Redwood Association 405 Enfrente Dr., Suite 200 Novato, CA 94949
RMA	Rubber Manufacturers Association 1400 K Street NW, Suite 900 Washington, DC 20005
SAE	Society of Automotive Engineers, Inc. 400 Commonwealth Drive Warrendale, PA 15096
SAMA	Scientific Apparatus Makers Association One Thomas Circle Washington, DC 20005
SBC	Standard Building Code Published by SBCCI
SBCCI	Southern Building Code Congress International Inc. 900 Montclair Road Birmingham, AL 35213
SCMA	Southern Cypress Manufacturers Association 400 Penn Center Boulevard, Suite 530 Pittsburg, PA 15235
SDI	Steel Door Institute 30200 Detroit Road Cleveland, OH 44145
SMACNA	Sheet Metal and Air Conditioning Contractors National Association, Inc. P.O. Box 221230 Chantilly, VA 22021
SPI	Society of the Plastics Industry, Inc. 1275 K Street NW, Suite 400 Washington, DC 20005
SPIB	Southern Pine Inspection Bureau 4709 Scenic Highway Pensacola, FL 32504
SSPC	Society for Protective Coatings 40 24th Street, 6th Floor Pittsburgh, PA 15222
SSPWC	Standard Specifications for Public Works Construction Building News, Inc. 3055 Overland Avenue Los Angeles, CA 90034
TEMA	Tubular Exchanger Manufacturer's Association 25 North Broadway Tarrytown, NY 10591

Abbreviation	Meaning
TPI	Truss Plate Institute 583 D'Onofrio Drive, Suite 200 Madison, WI 53719
UBC	Uniform Building Code Published by ICBO
UL	Underwriters Laboratories Inc. 333 Pfingsten Road Northbrook, IL 60062
UMC	Uniform Mechanical Code Published by ICBO
UPC	Uniform Plumbing Code Published by IAPMO
USBR	Bureau of Reclamation U.S. Department of Interior Engineering and Research Center Denver Federal Center, Building 67 Denver, CO 80225
WCLIB	West Coast Lumber Inspection Bureau 6980 SW Varns St. P.O. Box 23145 Portland, OR 97223
WWPA	Western Wood Products Association (Formerly called: West Coast Lumbermen's Association (WCLA)) Yeon Building 522 SW 5th Avenue Portland, OR 97204

END OF SECTION

SECTION 01 45 00
CONTRACTOR QUALITY CONTROL

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies administrative and procedural requirements for quality control services, field inspections and field testing of civil and structural constructs required for this project.
- B. The Contractor is responsible for the quality assurance and quality control of their respective work for the construction of this project in accordance with the Contract Documents.

1.02 RELATED SECTIONS

- A. This section contains specific references to the following related section. Additional related sections may apply that are not specifically listed below.
 - 1. Section 01 45 23 Testing and Inspection Services

1.03 DEFINITIONS

- A. Quality Control System (QCS): The quality control, assurance, and inspection system established and carried out to ensure compliance with the Plans and specifications.
- B. QCS Supervisor: That person in responsible charge of the work occurring, as designated by the Contractor in the QCS Plan.
- C. QCS Inspector: Responsible, certified personnel inspecting the various constructs at specified milestones and during the project overall and designated by the Construction Manager.
- D. Factory Test: Tests made on various materials, products and component parts prior to shipment to the job site.
- E. Field Tests: Tests and analyses made at or in the vicinity of the job site in connection with the actual construction.
- F. Certified Inspection Report: Reports signed by approved inspectors attesting that the items inspected meet the specification requirements other than any exceptions included in the report.
- G. Certificate of Compliance: Certificate from the manufacturer of the material or equipment identifying said manufacturer, product and stating that the material or equipment meet specified standards, and shall be signed by a designated officer of the manufacturer.
- H. Standard Compliance: Condition whereby specified materials or equipment must conform to the standards of organizations such as the American National Standard Institute (ANSI), American Society for Testing and Materials (ASTM), Underwriters Laboratories (UL) or similar organization.

- I. Quality Assurance: The day-to-day, in-process supervisory observations of work and materials conducted by the Contractor to assure that the proper methods and materials are being used and installed by tradesmen.
- J. Source Quality Control: The in-process testing and inspections conducted by the QCS Inspector(s) to verify that the materials, equipment; workmanship and shop manufactured constructs are in compliance with the Contract Documents, applicable Codes and standards.
- K. Field Quality Control: The testing and inspections conducted by the QCS Inspector(s) in the field during and at the completion of each construct to verify that the in-process and completed construction is in compliance with the Contract Documents, applicable Codes and standards.
- L. Special Inspector – A qualified individual employed or retained by an approved agency and approved by the local governing authorities having jurisdiction (AHJ) as having the competency necessary to inspect a particular type of construction requiring special inspection.

1.04 SUBMITTALS

A. Action Submittals:

1. Procedures: Section 01 33 00.
2. A copy of this specification section with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.
3. Check-marks (✓) denote full compliance with a paragraph as a whole. Deviations shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined signify compliance with the specification. Include a detailed, written justification for each deviation. Failure to include a copy of this marked-up specification section, along with justification(s) for requested deviations, with the submittal, is cause for rejection of the entire submittal with no further consideration.
4. Written description of Contractor's proposed QCS plan in sufficient detail to illustrate adequate measures for verification and conformance to defined requirements. The QCS plan and submittal shall include a log showing anticipated inspections, QCS Inspectors, Special Inspections, and source and field Quality Assurance procedures. Submittal of the QCS plan shall be made prior to commencing field work.
5. Contractor's proposed QCS Supervisor and QCS Inspectors (other than the Special Inspectors provided by Owner), including qualifications, responsibilities, and if requested, references.
6. Complete structural system information describing Contractor designed structural systems, including sealed calculations, shop and erection drawings, product literature for the various components, International Code Council (ICC) Evaluation Reports for structural components, and a discussion of risk issues associated with the proposed system which could adversely impact overall project completion.
7. If requested by the Construction Manager during the work, manufacturer's field services and reports.

A. Informational Submittals:

1. Procedures: Section 01 33 00.
2. Manufacturers' field services and reports unless requested by Construction Manager to be submitted for review.
3. Special Inspection reports, unless otherwise directed in each technical specification Section.

1.05 REGULATORY REQUIREMENTS

- A. **GENERAL:** Comply with all Federal, State, and local Codes as referenced herein. Such regulations apply to activities including, but not limited to, site work and zoning, building practices and quality, on and offsite disposal, safety, sanitation, nuisance, and environmental quality.
- B. **SPECIAL INSPECTION:** Special Inspection shall be performed by the Special Inspector under contract with the Owner or registered design professional in responsible charge acting as the Owner's agent in conformance with the IBC. Special Inspection is in addition to, but not replacing, other inspections and quality control requirements herein. Where sampling and testing required herein conforms to Special Inspection standards, such sampling and testing need not be duplicated.
- C. **STRUCTURAL OBSERVATION:** Registered Design Professional shall make visual inspections of the work to assess general conformance with the Contract Documents at significant construction stages and at completion of the structural system in accordance with IBC 1704.6 Structural Observations requirements.

1.06 CONTRACTOR'S RESPONSIBILITIES

- A. Monitor quality assurance over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.
- B. Coordinate with, schedule specified inspections by, and provide normal and customary assistance to the QCS Inspectors and Owner provided Special Inspectors.
- C. Coordinate with, schedule specified structural observations by Engineer, and provide normal and customary assistance to Engineer performing structural observations.
- D. Comply fully with manufacturers' instructions, including each step in sequence.
- E. Should manufacturers' instructions conflict with Contract Documents, request clarification before proceeding from Construction Manager.
- F. Comply with specified standards as a minimum quality for the work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- G. The Contractor shall retain the services of a licensed land surveyor, registered in the State of Utah, to perform survey work including but not limited to establishing line and grade, in advance of the construction; and to perform other surveying services for the work included under the Contract. The surveyor to be retained by the Contractor shall not be the same surveyor engaged for the Engineer's use. The surveyor shall be subject to

the approval of the Engineer. Survey drawings shall be submitted to the Engineer for approval.

- H. The Contractor shall take all necessary measurements in the field to verify pertinent data and dimensions shown on the Drawings or to determine the exact dimensions of the Work.

1.07 FIELD SAMPLE PROCEDURES

- A. When field samples are specified in a unit of work, construct each field sample to include work of all trades required to complete the field sample prior to starting related field work. Field samples may be incorporated into the project after acceptance by Construction Manager. Remove unacceptable field samples when directed by Construction Manager. Acceptable samples represent a quality level for the work.

1.08 CONTRACTOR DESIGNED STRUCTURAL SYSTEMS

- A. DESIGN ENGINEERING: Contractor shall employ and pay for engineering services from a Professional Engineer registered in the State of Utah for structural design of Contractor designed structural systems including but not limited to temporary shoring and bracing, formwork support, interior wall and ceiling systems, and support systems for fire sprinkler, plumbing, mechanical, and electrical systems and equipment.
- B. TESTS AND INSPECTIONS OF CONTRACTOR DESIGNED STRUCTURAL SYSTEMS: Contractor shall pay for preliminary testing of concrete, grout, and mortar mix designs where required by Code or these specifications prior to start of work. Contractor shall pay for required shop and site inspection of Contractor designed structural systems where required by Code or these specifications.

1.09 JOB SITE CONDITIONS

- A. Schedule to ensure all preparatory work has been accomplished prior to proceeding with current work. Proceeding with the work constitutes acceptance of conditions. Allow adequate time for materials susceptible to temperature and humidity to “stabilize” prior to installation. Establish and maintain environmental conditions (i.e., temperature, humidity, lighting) as recommended by the various material manufacturers for the duration of the work.

PART 2 PRODUCTS

2.01 SOURCE QUALITY CONTROL

- A. CONTRACTOR RESPONSIBILITIES: Provide source quality control according to the reviewed and accepted QCS plan and paragraph 1.06 herein. Coordinate with Construction Manager to facilitate the work of the Testing Laboratory specified in Section 01 45 23 and Special Inspector. Provide ready access to sampling and inspection locations and incidental labor customary in such sampling and inspections. Timely prepare and submit submittals, and revise as indicated by review comments. Comply with technical requirements in each specification Section that applies to the work.
- B. CONSTRUCTION MANAGER RESPONSIBILITIES: Review Contractor’s tracking of QCS activities at monthly meetings. Facilitate completion of submittal review per Section 01

33 00. Assist Contractor to ensure that Special Inspection occurs where and when specified.

- C. ACCEPTANCE CRITERIA: Acceptable characteristics and quality of a particular item or construct is defined in that item's or construct's specification Section.

PART 3 EXECUTION

3.01 FIELD QUALITY CONTROL

- A. Field quality control responsibilities of the Contractor and Construction Manager are substantially the same as described in paragraph 2.01, with the exception that this work occurs primarily on the jobsite as the work progresses, and Special Inspection will occur more often than at the source.
- B. Acceptable characteristics and quality of a particular item or construct is defined in that item's or construct's specification Section.

3.02 REGULATORY COMPLIANCE – SPECIAL INSPECTIONS

- A. The types of work requiring Special Inspection are specified in the Construction Documents and required to obtain regulatory approval by State or required by local governing authorities having jurisdiction over the building permit of the project.
- B. Section 01 45 23 describes Testing Laboratory sampling, testing and reporting.
- C. Contractor designed structural systems are subject to the same Special Inspection requirements as all other work.

3.03 CORRECTION OF DEFECTIVE WORK

- A. Any defective or imperfect Work, equipment, or materials furnished by the Contractor which is discovered before the Final Acceptance of the Work, or during a warranty period, shall be removed immediately even though it may have been overlooked by the Engineer and approved for payment. The Contractor shall repair such defect, without compensation, in a manner satisfactory to the Engineer.
- B. Unsuitable materials and equipment may be rejected, notwithstanding that such defective Work, materials and equipment may have been previously overlooked by the Engineer and accepted or approved for payment.
- C. If any workmanship, materials or equipment shall be rejected by the Engineer as unsuitable or not in conformity with the Specifications or Drawings, the Contractor shall promptly replace such materials and equipment with acceptable materials and equipment at no additional cost to Owner. Equipment or materials rejected by the Engineer shall be tagged as such and shall be immediately removed from the site.
- D. The Engineer may order tests of imperfect or damaged Work equipment, or materials to determine the required functional capability for possible acceptance, if there is no other reason for rejection. The cost of such tests shall be borne by the Contractor, and the nature, tester, extent and supervision of the tests will be as determined by the Engineer. If the results of the tests indicate that the required functional capability of the Work,

equipment, or material was not impaired, the Work, equipment or materials may be deemed acceptable, in the discretion of the Engineer. If the results of such tests reveal that the required functional capability of the questionable Work, equipment or materials has been impaired, then such Work, equipment or materials shall be deemed imperfect and shall be replaced. The Contractor may elect to replace the imperfect Work, equipment or material in lieu of performing the tests.

END OF SECTION

SECTION 01 45 20

EQUIPMENT AND SYSTEM PERFORMANCE AND OPERATIONAL TESTING

PART 1 GENERAL

1.01 DESCRIPTION

- A. This section contains requirements for the Contractor's performance in documenting testing work required under this contract. In addition, this section contains requirements for the Contractor's performance during installed performance testing of all mechanical, electrical, instrumentation and systems, including structures for watertight construction, provided under this contract. This section supplements but does not supersede specific testing requirements found elsewhere in this project manual.

1.02 QUALITY ASSURANCE

- A. Contractor's Quality Assurance Manager:
1. The Contractor shall appoint an operations engineer or equally qualified operations specialist as Quality Assurance Manager to manage, coordinate, and supervise the Contractor's quality assurance program. The Quality Assurance Manager shall have at least 5 years of total experience, or experience on at least five separate projects, in managing the startup commissioning of mechanical, electrical, instrumentation, and piping systems. Operations engineers shall be graduates from a minimum 4-year course in mechanical or civil engineering. Operations specialists shall have equivalent experience in plant operation and maintenance. The quality assurance program shall include:
 - a. A testing plan setting forth the sequence in which all testing work required under this project manual will be implemented.
 - b. A documentation program to record the results of all equipment and system tests.
 - c. An installed performance testing program for all mechanical, electrical, instrumentation equipment and systems installed under this contract.
 - d. A calibration program for all instruments, meters, monitors, gages, and thermometers installed under this contract.
 - e. A calibration program for all instruments, gages, meters, and thermometers used for determining the performance of equipment and systems installed under this contract.
 - f. A testing schedule conforming to the requirements specified in paragraph 2.02 Testing Schedule.
 2. For the purposes of this section, a system shall include all items of equipment, devices and appurtenances connected in such a fashion as their operation or function complements, protects or controls the operation or function of the others. The Quality Assurance Manager shall coordinate the activities of all subcontractors and suppliers to implement the requirements of this section.
 3. The Contractor shall contract with [] for assistance in the installation, adjustment, start-up, and testing of the secondary clarifier equipment.

B. Calibration:

1. All test equipment (gages, meters, thermometers, analysis instruments, and other equipment) used for calibrating or verifying the performance of equipment installed under this contract shall be calibrated to within plus or minus 2 percent of actual value at full scale. Test equipment employed for individual test runs shall be selected so that expected values as indicated by the detailed performance specifications will fall between 60 and 85 percent of full scale. Pressure gages shall be calibrated in accordance with ANSI/ASME B40.1. Thermometers shall be calibrated in accordance with ASTM E77 and shall be furnished with a certified calibration curve.
2. Liquid flow meters, including all open channel flow meters and all meters installed in pipelines with diameters greater than 2 inches shall be calibrated in situ using either the total count or dye dilution methods. Gas flow meters installed in piping systems with diameters greater than 6 inches shall be calibrated in situ using the pitot tube velocity averaging method. Flow meter calibration work shall be performed by individuals skilled in the techniques to be employed. Calibration tests for flow metering systems shall be performed over a range of not less than 10 percent to at least 75 percent of system full scale. At least five confirmed valid data points shall be obtained within this range. Confirmed data points shall be validated by not less than three test runs with results which agree within plus or minus 2 percent.

C. References:

1. This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.
2. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ANSI/ASME B40.1	Gauges Pressure Indicating Dial Type—Elastic Element
ASTM E77	Method for Verification and Calibration of Liquid-in-Glass Thermometers
ASHRAE 41.8	Standard Methods of Measurement of Flow of Gas
Dye Dilution Calibration Method	Flow Measurements in Sanitary Sewers By Dye Dilution, Turner Designs Mountain View, California,
	Flow Measurement in Sewer Lines by the Dye Dilution Method, <u>Journal of the Water Pollution Control Federation</u> , Vol. 55, Number 5, May, 1983, pg. 531
	<u>Flow Measurement in Open Channels and Closed Conduits</u> , Vol 1, U.S. Department of Commerce, National Bureau of Standards, pg. 361

Reference	Title
	<u>Techniques of Water-Resources Investigations of the United States Geological Survey, Chapter 16, Measurement of Discharge Using Tracers</u>

1.03 SUBMITTALS

- A. Submittal material, to be submitted in accordance with Section 01 33 00, shall consist of the following:
 - 1. A complete description of the Contractor's plan for documenting the results from the test program in conformance with the requirements of paragraph 2.02 Documentation Plans, including:
 - a. Proposed plan for documenting the calibration of all test instruments.
 - b. Proposed plan for calibration of all instrument systems, including flow meters and all temperature, pressure, weight, and analysis systems.
 - c. Sample forms for documenting the results of field pressure and performance tests.
 - 2. The credentials and certification of the testing laboratory proposed by the Contractor for calibration of all test equipment.
 - 3. Preoperational check-out procedures, reviewed and approved by the respective equipment manufacturers.
 - 4. Detailed testing plans, setting forth step-by-step descriptions of the procedures proposed by the Contractor for the systematic testing of all equipment and systems installed under this contract.
 - 5. A schedule and subsequent updates, presenting the Contractor's plan for testing the equipment and systems installed under this contract.
 - 6. A schedule establishing the expected time period (calendar dates) when the Contractor plans to commence operational testing of the completed systems, along with a description of the temporary systems and installations planned to allow operational testing to take place.
 - 7. A summary of the Quality Assurance Manager's qualifications, showing conformance to paragraph 1.02 Contractor's Quality Assurance Manager requirements.

PART 2 PRODUCTS

2.01 GENERAL

- A. The Contractor shall prepare test plans and documentation plans as specified in the following paragraphs. The Construction Manager will not witness any test work for the purpose of acceptance until all test documentation and calibration plans and the specified system or equipment test plans have been submitted and accepted.

2.02 DOCUMENTATION

- A. Documentation Plans:
 - 1. The Contractor shall develop a record keeping system to document compliance with the requirements of this Section. Calibration documentation shall include identification (by make, manufacturer, model, and serial number) of all test

equipment, date of original calibration, subsequent calibrations, calibration method, and test laboratory.

2. Equipment and system documentation shall include date of test, equipment number or system name, nature of test, test objectives, test results, test instruments employed for the test and signature spaces for the Construction manager's witness and the Contractor's quality assurance manager. A separate file shall be established for each system and item of equipment. These files shall include the following information as a minimum:
 - a. Metallurgical tests
 - b. Factory performance tests
 - c. Accelerometer recordings made during shipment
 - d. Field calibration tests¹
 - e. Field pressure tests¹
 - f. Field performance tests¹
 - g. Field operational tests¹
3. Section 01 99 90 contains samples showing the format and level of detail required for the documentation forms. The Contractor is advised that these are samples only and are not specific to this project nor to any item of equipment or system to be installed under this contract. The Contractor shall develop test documentation forms specific to each item of equipment and system installed under this contract. Acceptable documentation forms for all systems and items of equipment shall be produced for review by the Construction Manager as a condition precedent to the Contractor's receipt of progress payments in excess of 50 percent of the contract amount. Once the Construction Manager has reviewed and taken no exception to the forms proposed by the Contractor, the Contractor shall produce sufficient forms, at his expense, to provide documentation of all testing work to be conducted as a part of this contract.

B. Test Plans:

1. The Contractor shall develop test plans detailing the coordinated, sequential testing of each item of equipment and system installed under this contract. Each test plan shall be specific to the item of equipment or system to be tested. Test plans shall identify by specific equipment or tag number each device or control station to be manipulated or observed during the test procedure and the specific results to be observed or obtained. Test plans shall also be specific as to support systems required to complete the test work, temporary systems required during the test work, subcontractors' and manufacturers' representatives to be present and expected test duration. As a minimum, the test plans shall include the following features:
 - a. Step-by-step proving procedure for all control and electrical circuits by imposing low voltage currents and using appropriate indicators to affirm that the circuit is properly identified and connected to the proper device.
 - b. Calibration of all analysis instruments and control sensors.
 - c. Performance testing of each individual item of mechanical, electrical, and instrumentation equipment. Performance tests shall be selected to duplicate the operating conditions described in the project manual.

¹Each of these tests is required even though not specifically noted in detailed specification section.

- d. System tests designed to duplicate, as closely as possible, operating conditions described in the project manual.
 2. Test plans shall contain a complete description of the procedures to be employed to achieve the desired test environment.
 3. As a condition precedent to receiving progress payments in excess of 75 percent of the contract amount, or in any event, progress payments due to the Contractor eight weeks in advance of the date the Contractor wishes to begin any testing work (whichever occurs earliest in the project schedule), the Contractor shall have submitted all test plans required for the systematic field performance and operational tests for all equipment and systems installed under this contract. Once the Construction Manager has reviewed and taken no exception to the Contractor's test plans, the Contractor shall reproduce the plans in sufficient number for the Contractor's purposes and an additional ten copies for delivery to the Construction Manager. No test work shall begin until the Contractor has delivered the specified number of final test plans to the Construction Manager.
- C. Testing Schedule:
1. The Contractor shall produce a testing schedule setting forth the sequence contemplated for performing the test work. The schedule shall be in bar chart form, plotted against calendar time, shall detail the equipment and systems to be tested, and shall be coordinated with the Contractor's construction schedule specified in Section 01 32 16. The schedule shall show the contemplated start date, duration of the test and completion of each test. The test schedule shall be submitted no later than 4 weeks in advance of the date testing is to begin. The Construction Manager will not witness any testing work for the purpose of acceptance until the Contractor has submitted a schedule to which the Construction Manager takes no exception. The test schedule shall be updated weekly, showing actual dates of test work, indicating systems and equipment testing completed satisfactorily and meeting the requirements of this project manual.

2.03 SYSTEM AND EQUIPMENT PERFORMANCE TESTS

- A. Each item of mechanical, electrical, instrumentation, and HVAC equipment installed under this contract shall be tested to demonstrate compliance with the performance requirements of this project manual. Each electrical, instrumentation, mechanical, piping, and HVAC system installed or modified under this contract shall be tested in accordance with the requirements of this project manual.

2.04 OPERATIONAL TESTS

- A. Once all equipment and systems have been tested individually, the Contractor shall fill all systems except wastewater, scum sludge and other wastewater derived systems with the intended process fluids. Wastewater-derived process systems shall be filled with water. After filling operations have been completed, the Contractor shall operate all systems for a continuous period of not less than 5 days, simulating actual operating conditions to the greatest extent possible. The Contractor shall install temporary connections, bulkheads and make other provisions to recirculate process fluids or otherwise simulate anticipated operating conditions. During the operational testing period, the Contractor's Quality Assurance Manager and testing team shall monitor the characteristics of each machine and system and report any unusual conditions to the Construction Manager.

2.05 PRODUCT DATA

- A. Product data, to be provided in accordance with Section 01 33 00, shall be the original and three copies of all records produced during the testing program.

PART 3 EXECUTION

3.01 GENERAL

- A. The Contractor's quality control manager shall organize teams made up of qualified representatives of equipment suppliers, subcontractors, the Contractor's independent testing laboratory, and others, as appropriate, to efficiently and expeditiously calibrate and test the equipment and systems installed and constructed under this contract. The objective of the testing program shall be to demonstrate, to the Construction Manager's complete satisfaction, that the structures, systems, and equipment constructed and installed under this contract meet all performance requirements and the facility is ready for the commissioning process to commence. In addition, the testing program shall produce baseline operating conditions for the Owner to use in a preventive maintenance program.

3.02 CALIBRATION OF FIXED INSTRUMENTS

- A. Calibration of analysis instruments, sensors, gages, and meters installed under this contract shall proceed on a system-by-system basis. No equipment or system performance acceptance tests shall be performed until instruments, gages, and meters to be installed in that particular system have been calibrated and the calibration work has been witnessed by the Construction Manager.
- B. All analysis instruments, sensors, gages, and meters used for performance testing shall be subject to recalibration to confirm accuracy after completion, but prior to acceptance of each performance test. All analysis instruments, sensors, gages, and meters installed under this contract shall be subject to recalibration as a condition precedent to commissioning under the provisions of Section 01 91 00.

3.03 PERFORMANCE TESTS

- A. General:
 - 1. Performance tests shall consist of the following:
 - a. Pressure and/or leakage tests.
 - b. Electrical testing as specified in Division 26.
 - c. Wiring and piping, individual component, loop, loop commissioning and tuning testing as described in Division 40.
 - d. Preoperational checkout for all mechanical and HVAC equipment. Preoperational check-out procedures shall be reviewed and approved by the respective equipment manufacturers.
 - e. Initial operation tests of all mechanical, electrical, and instrumentation equipment and systems to demonstrate compliance with the performance requirements of this project manual.
 - f. Secondary Clarifier Equipment as Specified in:
 - 1) Division 46 43 21.11

2) Division 46 43 21.13

2. In general, performance tests for any individual system shall be performed in the order listed above. The order may be altered only on the specific written authorization of the Construction Manager after receipt of a written request, complete with justification of the need for the change in sequence.

B. Pressure And Leakage Tests:

1. Pressure and leakage tests shall be conducted in accordance with applicable portions of Divisions 3 and 40. All acceptance tests shall be witnessed by the Construction Manager. Evidence of successful completion of the pressure and leakage tests shall be the Construction Manager's signature on the test forms prepared by the Contractor.

C. Functional Checkout:

1. Prior to energization (in the case of electrical systems and equipment), all circuits shall be rung out and tested for continuity and shielding in accordance with the procedures required in Division 26.

D. Component Calibration And Loop Testing:

1. Prior to energization (in the case of instrumentation system and equipment), all loops and associated instruments shall be calibrated and tested in accordance with the procedures required in Division 40.

E. Electrical Resistance:

1. Electrical resistance testing shall be in accordance with Division 26.

F. Preoperational Tests:

1. Preoperational tests shall include the following:
 - a. Alignment of equipment using reverse dial indicator method.
 - b. Pre-operation lubrication.
 - c. Tests per the manufacturers' recommendations for prestart preparation and preoperational check-out procedures.

G. Functional Tests:

1. General: Once all affected equipment has been subjected to the required preoperational check-out procedures and the Construction Manager has witnessed and has not found deficiencies in that portion of the work, individual items of equipment and systems may be started and operated under simulated operating conditions to determine as nearly as possible whether the equipment and systems meet the requirements of these specifications. If available, plant effluent may be employed for the testing of all liquid systems except gaseous, oil, or chemical systems. If not available, potable water shall be employed as the test medium. Test media for these systems shall either be the intended fluid or a compatible substitute. The equipment shall be operated a sufficient period of time to determine machine operating characteristics, including noise, temperatures and vibration; to observe performance characteristics; and to permit initial adjustment of operating controls. When testing requires the availability of auxiliary systems such as looped piping, electrical power, compressed air, control air, or instrumentation which have not yet been placed in service, the Contractor shall provide acceptable substitute sources,

capable of meeting the requirements of the machine, device, or system at no additional cost to the Owner. Disposal methods for test media shall be subject to review by the Construction Manager. During the functional test period, the Contractor shall obtain baseline operating data on all equipment with motors greater than 1 horsepower to include amperage, bearing temperatures, and vibration. The baseline data shall be collected for the Owner to enter in a preventive maintenance system.

- a. Test results shall be within the tolerances set forth in the detailed specification sections of this project manual. If no tolerances have been specified, test results shall conform to tolerances established by recognized industry practice. Where, in the case of an otherwise satisfactory functional test, any doubt, dispute, or difference should arise between the Construction Manager and the Contractor regarding the test results or the methods or equipment used in the performance of such test, then the Construction Manager may order the test to be repeated. If the repeat test, using such modified methods or equipment as the Construction Manager may require, confirms the previous test, then all costs in connection with the repeat test will be paid by the Owner. Otherwise, the costs shall be borne by the Contractor. Where the results of any functional test fail to comply with the contract requirements for such test, then such repeat tests as may be necessary to achieve the contract requirements shall be made by the Contractor at his expense.
 - b. The Contractor shall provide, at no expense to the Owner, all power, fuel, compressed air supplies, water, and chemicals, all labor, temporary piping, heating, ventilating, and air conditioning for any areas where permanent facilities are not complete and operable at the time of functional tests, and all other items and work required to complete the functional tests. Temporary facilities shall be maintained until permanent systems are in service.
2. Retesting: If under test, any portion of the work should fail to fulfill the contract requirements and is adjusted, altered, renewed, or replaced, tests on that portion when so adjusted, altered, removed, or replaced, together with all other portions of the work as are affected thereby, shall, unless otherwise directed by the Construction Manager, be repeated within reasonable time and in accordance with the specified conditions. The Contractor shall pay to the Owner all reasonable expenses incurred by the Owner, including the costs of the Construction Manager, as a result of repeating such tests.
 3. Post-test Inspection: Once functional testing has been completed, all machines shall be rechecked for proper alignment and realigned, as required. All equipment shall be checked for loose connections, unusual movement, or other indications of improper operating characteristics. Any deficiencies shall be corrected to the satisfaction of the Construction Manager. All machines or devices which exhibit unusual or unacceptable operating characteristics shall be disassembled and inspected. Any defects found during the course of the inspection shall be repaired or the specific part or entire equipment item shall be replaced to the complete satisfaction of the Construction Manager at no cost to the Owner.

3.04 OPERATIONAL TESTS

- A. The Contractor shall provide system operation testing. After completion of all performance testing and certification by the Construction Manager that all equipment complies with the requirements of the specifications, the Contractor shall fill all process units and process systems, except those employing domestic water, oil, air, or chemicals,

with plant effluent water. All domestic water, oil, air, and chemical systems shall be filled with the specified fluid.

- B. Upon completion of the filling operations, the Contractor shall circulate water through the completed facility for a period of not less than 48 hours, during which all parts of the system shall be operated as a complete facility at various loading conditions, as directed by the Construction Manager. The operational testing period shall commence after this initial period of variable operation. The operational testing period shall have duration of 7 days. Should the operational testing period be halted for any reason related to the facilities constructed or the equipment furnished under this contract, or the Contractor's temporary testing systems, the operational testing program shall be repeated until the specified continuous period has been accomplished without interruption. All process units shall be brought to full operating conditions, including temperature, pressure, and flow.
- C. As-built documents specified in Section 01 78 39 of facilities involved shall be accepted and ready for turnover to the Owner at the time of operational testing.

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SECTION 01 45 23
TESTING AND INSPECTION SERVICES

PART 1 GENERAL

1.01 SUMMARY

- A. **GENERAL REQUIREMENTS:** Comply with the testing and inspection specified in this Section and elsewhere in the Construction Documents. For the purpose of this Section, all references made herein to Testing Agency or Special Inspector or Geotechnical Consulting Firm shall be referred to as those tests or inspections which will be conducted by an inspector provided by the Owner.
 - 1. The Owner or registered design professional in responsible charge acting as the Owner's agent will select and employ an independent Testing Agency to conduct the tests and inspections in accordance with applicable standard methods of American Society for Testing and Materials (ASTM) or other standards specified by the local governing authorities having jurisdiction (AHJ) as a requirement of the building permit. The Owner may require other special inspection services to inspect and verify the Work installed is in accordance with the Construction Documents and construction industry standards.
 - 2. The Contractor shall provide and pay for other inspection and testing services where specified in the Construction Documents or required to obtain regulatory approval by State or AHJ.

1.02 DEFINITIONS

- A. **Special Inspector** – A qualified individual employed or retained by an approved agency and approved by the AHJ as having the competency necessary to inspect a particular type of construction requiring special inspection.
- B. **Testing Agency** - firm responsible for performing specific inspections and/or tests as part of the Special Inspection program.

1.03 QUALITY ASSURANCE

- A. **QUALIFICATIONS:** The inspector for all Work as hereinafter specified, except for geotechnical inspections, waterproofing and roofing, shall be a registered Special Inspector employed by an approved inspection and/or Testing Agency. All inspection personnel used on this Project are subject to being disapproved from the Project at the discretion of the Owner.
 - 1. The Special Inspector shall have the required technical knowledge and experience for the product or construction element being installed.
 - 2. Geotechnical Inspection will be performed by a licensed Geotechnical Consulting Firm.

1.04 DUTIES OF OWNER'S TESTING AGENCY

- A. **GENERAL:** The Owner's Testing Agency will conduct testing and inspection services, interpret them, and evaluate the results for compliance with the building permit, the site development permit, and the Construction Documents; agency will report findings to the

Owner, Contractor, and AHJ. Testing and inspection services shall be in accordance with applicable standard methods of ASTM or other standards specified by AHJ, the Construction Documents, and construction industry standards. The Testing Agency will reasonably support overtime, second shift, and out-of-area activity if requested by the Contractor and approved at the Owner's sole discretion.

- B. TESTING AND INSPECTION: Materials to be tested are specified by the building permit and as required by the Construction Documents, as directed by Owner, or required by AHJ. Quantities and extent of tests and inspections shall be as specified and/or required by the Owner's Inspector or AHJ.
- C. NON-CONFORMING WORK: The Owner's Inspector shall document and immediately notify the Contractor and Owner of any Work found defective or not in accordance with the requirements of the Construction Documents. Non-conforming Work shall be corrected.
- D. The Owner's inspectors are not authorized to do the following:
 - 1. Release, revoke, alter or enlarge on requirements of Construction Documents.
 - 2. Approve or accept any portion of the Work, except as allowed by the special inspection duties delegated by governing AHJ for building permit inspections and testing.
 - 3. Perform any duties of the Contractor.
 - 4. Stop Work.

1.05 COSTS

- A. The Owner's Testing Agency and Special Inspector costs for initial testing and inspection as specified in the Construction Documents will be paid for by the Owner or registered design professional in responsible charge acting as the Owner's agent. Initial tests and inspections are defined as those required to complete the first tests and inspections specified. Costs for subsequent re-testing and re-inspection of items found not to be in compliance with Construction Documents shall be borne by the Contractor.
- B. Additional tests and inspections not herein specified, but requested by the Owner, shall be paid for by the Owner. However, if the results of such tests or inspections are found to be not in compliance with Construction Documents, the Contractor will be back charged for all costs for initial testing as well as re-testing, re-inspection and Owner's Consultants services.
- C. Costs for additional tests or inspections required because of Contractor changes to reviewed and accepted products or materials provided, or source, or supply shall be borne by the Contractor.
- D. Costs for any Work which is required to correct any deficiencies shall be borne by the Contractor.
- E. Costs of any testing which is required solely for the convenience of Contractor in its scheduling and performance of the Work shall be borne by the Contractor.
- F. Costs for verification testing of Work done without prior notice, with improper supervision, or contrary to construction practice shall be borne by the Contractor.

- G. Costs for testing of materials for which fabrication and mill reports are required but not furnished shall be borne by the Contractor.
- H. The cost, if any, of providing access for inspections and tests shall be considered part of the normal expense of conducting business and therefore non-reimbursable.
- I. In those instances where inspector(s) arrive at the agreed-upon location, at the agreed upon date and time, and find articles to be inspected are not ready for inspection, the inspector(s) shall return to their home office and all expenses incurred shall be borne by the Contractor.

1.06 TESTS AND INSPECTION REPORTS

- A. Copies of Owner and Contractor test and inspection reports shall be distributed at weekly intervals. All reports will be signed by a certified Special Inspector or Professional Engineer registered in the State of Utah, as appropriate. Such reports shall include all tests made, regardless of whether such tests indicate that the material is satisfactory or unsatisfactory; a final report should be submitted documenting corrective work done on of any unsatisfactory material and or work identified in the testing or inspection reports. Samples taken, but not tested, shall also be reported. Records of special sampling operations that are required shall also be reported. Test and inspection reports shall be distributed as follows:
 - 1. Owner
 - 2. Owner's Testing Agency
 - 3. Contractor
 - 4. Authority Having Jurisdiction
- B. A report shall be prepared for each inspection and test and shall include:
 - 1. Date issued.
 - 2. Project title and number.
 - 3. Name and signature of inspector.
 - 4. Date of inspection or sampling and test.
 - 5. Record of temperature and weather.
 - 6. Identification of product and Specification Section.
 - 7. Location in Project.
 - 8. Type of inspection or test.
 - 9. Results of inspections and tests, and observations regarding compliance with Laws and Regulations, and standards.

1.07 CONTRACTOR'S RESPONSIBILITIES

- A. **COORDINATION:** It is the Contractor's responsibility to initiate, coordinate, and conform to the required tests and inspections of governing State and AHJ. Inspection of the Work by the Owner's Special Inspectors and/or Testing Agency shall not relieve the Contractor from responsibility for compliance with the Construction Documents requirements. Owner's Special Inspectors and/or Testing Agency and Owner shall have authority to reject Work whenever the provisions of the Construction Documents are not being complied with, and the Contractor shall instruct his employees accordingly.

- B. ACCESS FOR THE PURPOSE OF INSPECTION: Ensure the Owner's Special Inspectors and/or Testing Agency have free access to all parts of the Work and to the shops where the Work is in preparation; are provided proper facilities and safe access for such inspection; and are reasonably furnished access, equipment, tools, samples, certifications, test reports, design mixes, storage, and assistance as requested by the Owner's Inspector.
- C. STORAGE FACILITIES: Furnish adequate storage facilities as approved by the Owner for the sole use of the Owner's Testing Agency for safe storage and curing of such specimens which must remain on the site prior to transport to the laboratory.
- D. DATA: Furnish records, Contract Drawings and shop drawings, certificates, approved Change Orders, and similar data as required by Owner's Inspectors to perform their work to assure compliance with the Construction Documents.
- E. NOTICE: Furnish notice to Owner and coordinate with Owner's Inspectors a minimum of five (5) working days in advance of all required tests and a minimum of forty-eight (48) hours in advance of all required inspections, unless otherwise specified.
- F. NON-CONFORMING WORK: Remove and replace Non-conforming Work at no additional cost to the Owner prior to Final Completion. Where Non-conforming Work requires design modifications, such re-design shall be performed by the Engineer of Record and costs shall be borne by the Contractor.
- G. CANCELLATIONS: Contractor shall give sufficient advance notice to Owner and Inspectors to allow rescheduling of their work load in the event of cancellation or time extension of any scheduled test or inspection

1.08 TEST FAILURES

- A. GENERAL: The Owner may require re-test of a sampled material when a sample or procedure has failed to pass the required tests. In the event any test or inspection indicates failure of a material or procedure to meet requirements of Construction Documents, all costs for re-testing or re-inspection shall be borne by the Contractor. The Contractor may opt to replace the imperfect Work, equipment or material in lieu of performing the tests.

1.09 REPORT TEST FAILURES

- A. GENERAL: Immediately upon determination of a test failure, the Owner's Inspector shall notify the Owner and Contractor. By the end of the following day the Owner's Inspector shall send written test results to those named on the distribution list.
- B. Contractor shall similarly report test failures to Owner resulting from work of testing agencies provided by the Contractor.

PART 2 - NOT USED

PART 3 - NOT USED

END OF SECTION

SECTION 01 51 00
TEMPORARY UTILITIES

PART 1 GENERAL

1.01 OFFICE

- A. The Contractor may locate an office trailer on site. No office space will be provided by the Owner.

1.02 POWER

- A. The Owner shall provide power for construction at the plant site if necessary for the Contractor to perform the Work. The Contractor is to provide a temporary power pedestal to be set up near the east secondary clarifier splitter box. He shall make arrangements with the Owner for power takeoff points, voltage and phasing requirements, transformers and metering.. The Contractor shall provide the special connections required for his work. The Contractor is allowed to supply His own power for the site work in lieu of Owner supplied power. Contractor is responsible to monitor all power critical systems and those systems critical to the work that required electrical power to perform the Work.

1.03 SANITARY FACILITIES

- A. Existing plant sanitary facilities are not available for the Contractor's use. The Contractor shall provide toilet and washup facilities at the site of the Work for all construction workers and others performing work or furnishing services on the Project, as provided herein. Facilities shall comply with applicable laws, ordinances, and regulations pertaining to the public health and sanitation of dwellings and camps.
- B. Sanitary facilities shall be of reasonable capacity, properly maintained throughout the construction period, and obscured from public view to the greatest practical extent. If toilets of the chemically treated type are used, at least one toilet will be furnished for each 20 project related people at the site. Contractor shall enforce the use of such sanitary facilities by all personnel at the site.

1.04 TELEPHONE

- A. The Contractor shall provide a 24-hour telephone contact so that the Owner may contact the Contractor in an emergency condition.

1.05 WATER

- A. NON-POTABLE (3W) WATER:
 - 1. Non-potable water (3W), will be available at no cost to the Contractor as long as its use does not hamper plant operation as determined by the Owner. Subject to Owner approval, the Contractor shall coordinate with Owner for use and provide the necessary connections to the plant water supply and the conveyance facilities required for his work. Subject to owner approval, non-potable water may be available at higher flow rates depending on location and season.
 - 2. The source of the 3W water is at the yard hydrants adjacent to each of the east facility secondary clarifiers. The 3W is not to be used for drinking or body contact

purposes. The 3W may contain fecal coliform from plant processes as permitted by the discharge permit. The 3W shall not be used for mixing concrete or grout or in other admixtures to be incorporated in the Work. It may be used for washing tools or equipment and in soil moisture control, non-potable pipe testing, and tank leakage testing.

3. The Contractor shall maintain the integrity of the existing water systems and shall provide and maintain easily visible warning signs at all 3W water yard hydrants stating: "WARNING - DO NOT DRINK, RECYCLED WASTEWATER!"

1.06 ACCESS ROADS AND PARKING

- A. Areas for Contractor parking use, as shown on the Drawings, are in paved areas. The Contractor shall provide and maintain paved surfaces to permit easy access by the Contractor's employees, the Owner and Engineer.

1.07 STORAGE BUILDINGS

- A. The Contractor may use West Storage Building, labeled as item 21 on the Overall Site Plan for temporary equipment and material storage. The Contractor shall provide and maintain weatherproof temporary storage structures for the protection of equipment and materials delivered to and stored on-site. Facilities shall be lockable.
- B. Combustible materials (paints, solvents, fuels, etc.) shall be stored in a well-ventilated storage facility removed and separate from other storage facilities and other buildings.

1.08 STORAGE YARDS

- A. The Contractor may use the laydown areas shown on the Drawings. Materials such as sunlight resistant pipe, reinforcing and structural steel shall be stored on pallets or racks, off the ground and in a manner that allows ready access for inspection and inventory.

1.09 RUBBISH DISPOSAL

- A. During the course of the Contract, the Contractor shall provide, maintain, and pay for all costs associated with a rubbish collection subcontractor. Rubbish shall be collected in containers of suitable size or number to prevent piling of rubbish outside of the containers. Collection and disposal shall be performed at regular intervals or as needed to keep rubbish build-up under control. Containers shall not permit rubbish to be wind blown out of the container.
- B. Solvents, greases, oils, and other such wastes shall be packaged and disposed of by other qualified carriers in a manner required by the laws governing the handling of such materials.

1.10 SECURITY

- A. The treatment plant maintains a day staff and uses a skeleton crew on Fridays, at night and on the weekends. However, the Contractor shall be responsible for protection of the site, and all work, materials, equipment, and existing facilities thereon, against vandals and other unauthorized persons.

- B. No claim shall be made against the District by reason of any act of an employee or trespasser, and Contractor shall make good all damage to the District's property resulting from his failure to provide security measures as specified.
- C. Security measures shall be at least equal to those usually provided by the District to protect its existing facilities during normal operation, but shall also include such additional security fencing, barricades, lighting, and other measures as required to protect the site.

1.11 REMOVAL OF TEMPORARY FACILITIES AND UTILITIES

- A. At such time any temporary construction facility and utility are no longer needed for the Work, the Contractor shall notify the Engineer of his intent and schedule for removal. The Contractor shall disconnect and/or dismantle or remove such items of this section from the site, including access roads and parking areas. The Contractor shall leave the site in equivalent or better condition to the pre-construction conditions and as shown on the Drawings.
- B. In unfinished areas, the condition of the site shall be left in a way that will restore original drainage, be evenly graded, incorporate erosion control and left with an appearance equal to or better than the original condition. Pre-construction photographs may be used to assist in determining that these requirements have been satisfied.

1.12 DAMAGE TO EXISTING PROPERTY

- A. Contractor will be held responsible for any damage to existing structures, work, materials, or equipment because of his operations and shall repair or replace any damaged structures, work, materials, or equipment to the satisfaction of, and at no additional cost to the Owner.
- B. Contractor shall protect all existing structures and property from damage and shall provide bracing, shoring, or other work necessary for such protection.
- C. Contractor shall be responsible for all damage to streets, roads, curbs, sidewalks, highways, shoulders, ditches, embankments, culverts, bridges, or other public or private property, which may be caused by transporting equipment, materials, or employees to or from the work. Contractor shall make satisfactory and acceptable arrangements with the District regarding the damaged property concerning its repair or replacement.

1.13 POLLUTION CONTROL

- A. Contractor shall prevent the pollution of drains and watercourses by sanitary wastes, sediment, debris, and other substances resulting from construction activities. No sanitary wastes will be permitted to enter any drain or watercourse, sanitary sewers, or plant drain systems. No sediment, debris, or other substance will be permitted to enter storm water, sanitary sewers, and plant drain system and reasonable measures will be taken to prevent such materials from entering any drain or watercourse.

END OF SECTION

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SECTION 01 57 28

DEWATERING

PART 1 GENERAL

1.01 REQUIREMENTS

- A. CONTRACTOR shall provide all labor, equipment, materials and services necessary to dewater trench, pits and structure excavations as necessary to complete the Work.
- B. CONTRACTOR may be able to discharge to the OWNER's facility at location within the plant's storm drain system not connected to the process piping or plant drain system at a location approved by the Owner. The Contractor is not allowed to discharge to the plant drain system.
- C. The CONTRACTOR shall be responsible to identify how to dewater to the defined locations.
- D. Sand and grit may not be discharged to the OWNER's storm water facilities. Sand and grit are to be collected in a frac tank type system and disposed of properly.
- E. The CONTRACTOR shall satisfy himself as to the level of effort necessary to dewater where required. Analysis of groundwater levels, quality sampling nor pump tests have not been performed for this project. CONTRACTOR shall utilize the services of a geotechnical engineer to develop a dewatering plan. Groundwater data is available in the geotechnical report in the Technical Data included with the bid package.
 - 1. Preliminary Geotechnical Engineering Report – TO 2022-01 MP Ph 1-Program Management, TSSD Capital Improvements (Shannon & Wilson)
- F. All dewatering is incidental to the Work and shall be included in the lump sum pricing for the Work.

1.02 DEFINITIONS

- A. Aquifer – rock or sediment in a formation, group of formations, or part of a formation that is saturated and sufficiently permeable to transmit water to pumped wells, wellpoints, eductors and sumps.
- B. Confining layer – a body of material of low hydraulic conductivity/permeability that is stratigraphically adjacent to one or more aquifer. It may lie above or below the aquifer and has a permeability lower than the adjacent aquifer.
- C. Dewatering System – a system that will lower the water table, piezometric or potentiometric surface adequately to permit safe and dry construction.
- D. Ground water – water that is found in fully saturated soils, sediments and rocks below the surface of the ground and which flows primarily in response to gravitational forces.
- E. Confined Ground Water – ground water under pressure that is greater than atmospheric pressure. Confined ground water is separated from direct contact with atmospheric

pressure because of overlying impermeable or relatively low permeability layers (confining layers) of sediments or rock.

- F. Ground Water Table – is a particular potentiometric surface for an unconfined aquifer.
- G. Incidental Sump Pumping – Sump pumping of perched or pocketed ground water in an excavation where the static ground water table has already been lowered below subgrade using wells or vacuum wellpoints.
- H. Hydrostatic head – the difference in elevation between the surface of the static head of groundwater in a confined or unconfined confined aquifer and the elevation of target drawdown.
- I. Perched groundwater – Groundwater separated from an underlying body of groundwater by unsaturated or relatively low permeability soil.
- J. Potentiometric surface/Piezometric level – theoretical (imaginary) surface of the static head of ground water in an aquifer. The water table is a particular potentiometric surface for an unconfined aquifer.
- K. Sand/Gravel pack – a sand or gravel material which is placed in the annular space between a drilled hole and the well casing and/or well screen.
- L. Screen (well screen) – a cylinder of steel or plastic material with slots or perforations used to allow water to enter a well while preventing sediment or rock particles from entering the well.
- M. Specific Capacity – The volume in gallons per minute of a pumped well's discharge divided by the concurrent drawdown of the pumped well's water level in feet during pumping.
- N. Piezometric level/head – the level representing the total hydraulic head of groundwater in a confined aquifer.
- O. Piezometric pressure – pore water pressure at a specific point.
- P. Pumped well – A hole in the ground with a casing and screen that includes its own motorized pump in the casing or screen to lift water to the surface.
- Q. Pumping Level – the level of water in a well casing or screen when pumping is in progress.
- R. Observation Well – a non-pumping well used to observe changes in the elevation of the water table or the potentiometric surface/piezometric head.
- S. Subgrade – the finished grade level of an excavation as shown on the drawings, below any slab including excavation for foundation materials.
- T. Sump – Shallow hole in the ground adjacent to or in excavation trench with a slotted or perforated casing containing a pump and surrounded by filter sand or gravel to prevent the pumping of formation material.

- U. Unconfined Ground Water – water in an aquifer that has a water table that is at atmospheric pressure.
- V. Vacuum Wellpoints – small diameter wells installed in 6- to 8-inch diameter holes typically less than 25 feet (constrained by the limits of the vacuum to suck water out of the ground). Well points typically have a 3 foot length of slotted well screen at the bottom and are spaced 2 to 10 feet apart with the closer spacing for finer grained soils (i.e. silt and clay). Wellpoints are connected to a common vacuum header and typically operate using a single pump for the whole system.
- W. Well Development – The method of using swabbing, surging, jetting, resonance and / or pumping techniques to:
 1. Clean drilling debris from the well and the surrounding formation.
 2. Repair damage done by drilling to the formation.
 3. Remove biological or chemical encrustation from the well screen.
 4. Improve the efficiency.
 5. Enhance the hydraulic connection between the well screen and the formation by bringing a percentage of the fines in the aquifer formation into the properly sized well screen so that a more open filter pack is obtained around the well screen.
 6. A technique to move water or air out through the screen and then back into the well quickly is common. Also, a means to remove or control the fines is required.

1.03 SUBMITTALS

- A. Submittals in accordance with the General Conditions and Section 01 33 00.
- B. The CONTRACTOR shall submit a dewatering plan containing drawings and complete design data showing methods and equipment the CONTRACTOR proposes for dewatering, including relief of hydrostatic head, groundwater monitoring, management of other water, and in maintaining the east facility clarifier site in a dewatered, hydrostatically controlled condition. CONTRACTOR shall provide a Ground Water Control Plan (GWCP). The CONTRACTOR shall submit information sufficient for the Engineer to understand the dewatering system including, but not limited to, the following:
 1. Specifications and manufacturer's literature of the materials and a description of the methods proposed for use in the construction of dewatering system.
 2. Drawings indicating the location and size of berms, dikes, ditches, wells, vacuum wellpoints, sumps, monitoring wells, gravel drains, treatment facilities, frac tank(s), discharge lines, flow meters and outfall design. The drawings shall include, at a minimum, all dewatering system elements.
 3. Capacities of pumps, prime movers, and standby equipment.
 4. Information supporting the location, size, adequacy and number of any wells, vacuum wellpoints, gravel drains, sumps and discharge lines, and the adequacy and suitability of discharge pipe sizes, pumps, frac tank(s), filters/gravel packs, screens and treatment facilities.
 5. Information supporting the design of the dewatering wells, vacuum wellpoints, gravel packs, water treatment and disposal, frac tank(s), systems.
 6. Groundwater monitoring plan and monitoring well logs.
 7. Dewatering schedule, operation, maintenance, and abandonment procedures.

8. Dewatering well logs.

1.04 CONTROLS

- 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. Critical structures and facilities exist immediately adjacent to areas of proposed dewatering, Reference points shall be established and observed at daily intervals by a Professional Land Surveyor of the State of Utah to detect settlement that may develop.
 - 1. Conduct dewatering operation in a manner that will protect adjacent structures and facilities.
 - 2. Repair damage to adjacent structures and restore facilities at no expense to OWNER.
 - 3. Comply with Section 31 09 00 Geotechnical Instrumentation and Monitoring.

PART 2 PRODUCTS

2.01 REQUIREMENTS

- A. The dewatering system shall be designed using accepted and professional methods of design and engineering consistent with the best modern practice. The dewatering system shall include any trench dikes, deep wells, well points, sumps, frac tank(s) and other equipment, appurtenances, and related earthwork or soil modification necessary to complete the Work. The CONTRACTOR shall be or employ the services of a subcontractor who is generally acknowledged as experienced in dewatering design, installation, operation and maintenance.
- B. Provide and maintain equipment necessary for dewatering. Standby equipment shall be kept available at all times to insure efficient dewatering and maintenance of dewatering operation during power failure.

2.02 DISCHARGE SITES

- A. Discharge sites shall be coordinated with the OWNER.

PART 3 EXECUTION

3.01 GENERAL

- A. Dewatering operations shall continue throughout construction to maintain the groundwater level a minimum of 2 feet below bottom of the floor of the clarifier. A lower groundwater elevation might be required to facilitate clarifier pipe repairs.
- B. Site grading shall promote drainage. Surface runoff shall be diverted from excavations. Maintain a trench bottom free from standing water.

- C. Owner will provide 3 phase 460 V temporary power for construction at the plant site. The Contractor shall make arrangements with the Owner for power takeoff points, voltage and phasing requirements, and transformers. The Contractor shall provide the special connections required for this work. The Contractor is not required to use on site Owner provided electrical power. Contractor shall provide continuous power for dewatering operations. Repairs to Owners facilities including the clarifiers due to damage caused as a result of a loss of dewatering shall be paid for by the Contractor.
- D. Dewatering, if determined to be necessary by the CONTRACTOR, shall be conducted in such a manner as to preserve the undisturbed bearing capacity of the sub-grade soils at the bottom of excavation.
- E. Flotation of clarifiers and surrounding structures is not permitted and shall be prevented by maintaining a positive and continuous removal of ground water. CONTRACTOR shall be fully responsible and liable for all damages to the clarifiers and surrounding structures that may result from failure to adequately keep the clarifier site dewatered. Flotation mitigation strategies are to be included in the dewatering plan. Strategies are to include groundwater level and clarifier structure monitoring, monitoring locations on the structures, frequency of monitoring, triggers for immediate remedial action, items to prevent and stop flotation, mitigation of damage to surrounding structures, and repair plans if clarifiers or surrounding structures are damaged.
- F. The CONTRACTOR shall design, construct, operate, and maintain the dewatering system such that the fine fraction of the clarifier foundation soils will not be removed upon pumping.

3.02 WATER DISPOSAL

- A. Dispose of water in suitable manner without damage to adjacent property.
- B. No water shall be drained into work built or under construction.
- C. Under no conditions shall debris be allowed to enter into any facilities of the OWNER.
- D. All debris accumulated in pipeline or manhole shall be removed and the structure thoroughly cleaned prior to testing and acceptance.
- E. Water shall be filtered using an approved method, frac tank(s), to remove sand and fine sized soil particles before disposal.
- F. The return of groundwater to its static level shall be performed in such a manner as to maintain the undisturbed state of the natural foundation soils, prevent disturbance of compacted backfill and prevent flotation or movement of clarifiers, structures, pipelines, and sewers.

END OF SECTION

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SECTION 01 66 00
PRODUCT STORAGE AND HANDLING REQUIREMENTS

PART 1 GENERAL

1.01 DAMAGE

- A. Equipment, products and materials shall be shipped, handled, stored, and installed in ways which will prevent damage to the items. Damaged items will not be permitted as part of the work except in cases of minor damage that have been satisfactorily repaired and are acceptable to the Construction Manager.

1.02 PIPE

- A. Pipe and appurtenances shall be handled, stored, and installed as recommended by the manufacturer. Pipes with paint, tape coatings, linings or the like shall be stored to protect the coating or lining from physical damage or other deterioration. Pipes shipped with interior bracing shall have the bracing removed only when recommended by the pipe manufacturer.

1.03 CLARIFIER COMPONENTS

- A. Clarifier components and appurtenances shall be shipped, handled, stored, and installed as recommended by the manufacturer. Components with paint, tape coatings, linings or the like shall be stored to protect the coating or lining from physical damage or other deterioration. Components shipped with bracing shall have the bracing removed only when recommended by the component manufacturer.

1.04 ELECTRICAL COMPONENTS

- A. Electrical components and appurtenances shall be shipped, handled, stored, and installed as recommended by the manufacturer. Components with sensitive components, paint, tape coatings, linings or the like shall be stored to protect these items from physical damage or other deterioration. Components shipped with bracing shall have the bracing removed only when recommended by the component manufacturer.

PART 2 EQUIPMENT

2.01 PACKAGE AND MARKING:

- A. All equipment shall be protected against damage from moisture, dust, handling, or other cause during transport from manufacturer's premises to site. Each item or package shall be marked with the number unique to the specification reference covering the item.
- B. Stiffeners shall be used where necessary to maintain shapes and to give rigidity. Parts of equipment shall be delivered in assembled or subassembled units where possible.

2.02 IDENTIFICATION:

- A. Each item of equipment and valve shall have permanently affixed to it a label or tag with its equipment or valve number designated in this contract. Marker shall be of stainless steel. Location of label will be easily visible.

2.03 SHIPPING:

- A. Bearing housings, vents and other types of openings shall be wrapped or otherwise sealed to prevent contamination by grit and dirt.
- B. Damage shall be corrected to conform to the requirements of the contract before the assembly is incorporated into the work. The Contractor shall bear the costs arising out of dismantling, inspection, repair and reassembly.

2.04 FACTORY APPLIED COATINGS:

- A. Unless otherwise specified, each item of equipment shall be shipped to the site of the work with the manufacturer's shop applied epoxy prime coating as specified in **Section 09 90 00**. The prime coating shall be applied over clean dry surfaces in accordance with the coating manufacturer's recommendations. The prime coating will serve as a base for field-applied finish coats. Electrical equipment and materials shall be painted by manufacturer as specified in **Section 09 90 00-3.03 Electrical and Instrumentation Equipment and Materials**.

2.05 STORAGE:

- A. During the interval between the delivery of equipment to the site and installation, all equipment, unless otherwise specified, shall be stored in an enclosed space affording protection from weather, dust and mechanical damage and providing favorable temperature, humidity and ventilation conditions to ensure against equipment deterioration. Manufacturer's recommendations shall be adhered to in addition to these requirements.
- B. Equipment and materials to be located outdoors may be stored outdoors if protected against moisture condensation. Equipment shall be stored at least 6 inches above ground. Temporary power shall be provided to energize space heaters or other heat sources for control of moisture condensation. Space heaters or other heat sources shall be energized without disturbing the sealed enclosure.

2.06 PROTECTION OF EQUIPMENT AFTER INSTALLATION:

- A. After installation, all equipment shall be protected from damage from, including but not limited to, dust, abrasive particles, debris and dirt generated by the placement, chipping, sandblasting, cutting, finishing and grinding of new or existing concrete, terrazzo and metal; and from the fumes, particulate matter, and splatter from welding, brazing and painting of new or existing piping and equipment. As a minimum, vacuum cleaning, blowers with filters, protective shieldings, and other dust suppression methods will be required at all times to adequately protect all equipment. During concreting, including finishing, all equipment that may be affected by cement dust must be completely covered. During painting operations, all grease fittings and similar openings shall be covered to prevent the entry of paint. Electrical switchgear, unit substation, and motor load centers shall not be installed until after all concrete work and sandblasting in those areas have been completed and accepted and the ventilation systems installed.

END OF SECTION

SECTION 01 73 24
DESIGN REQUIREMENTS FOR
NON-STRUCTURAL COMPONENTS AND NON-BUILDING STRUCTURES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Minimum structural requirements for the design, anchorage, and bracing of non-structural components such as architectural/mechanical/HVAC/electrical components, equipment, or systems, and non-building structures such as tanks.
- B. The requirements of this section apply to design of the structural elements and features of equipment and to platforms/walkways that are provided with equipment or non-building structures.
- C. This section applies to non-building structures and non-structural components that are permanently attached to structures as defined below and in ASCE 7.
- D. Design and conform to criteria and design codes listed within this section. Engineering design is not required for attachments, anchorage, or bracing detailed on the Drawings or where the size of attachments, anchorage, or bracing is defined in specific technical specification sections.
- E. The following non-structural components are exempt from seismic design loading requirements of this section.
 - 1. Components in Seismic Design Category A.
 - 2. Furniture (except permanent floor supported storage cabinets over 6 ft tall).
 - 3. Temporary or movable equipment.
 - 4. Architectural components in Seismic Design Category B other than parapets supported by bearing walls or shear walls provided that the component importance factor, I_p , is equal to 1.0.
 - 5. Mechanical and electrical components in Seismic Design Category B.
 - 6. Mechanical and electrical components in Seismic Design Category C provided that the component importance factor, I_p , is equal to 1.0.
 - 7. Mechanical and electrical components in Seismic Design Categories D, E, or F where all of the following apply:
 - a. The component importance factor, I_p , is equal to 1.0;
 - b. The component is positively attached to the structure;
 - c. Flexible connections are provided between the component and associated ductwork, piping, and conduit;
 - d. And either:
 - 1) the component weighs 400 lb or less and has a center of mass located 4 ft or less above the adjacent floor level; or
 - 2) the component weighs 20 lb or less, or in the case of a distributed systems, 5 lb/ft or less.

1.02 RELATED SECTIONS

- A. This section contains specific references to the following related section. Additional related sections may apply that are not specifically listed below.
1. Section 05 05 20 Anchor Bolts
 2. Section 05 50 00 Metal Fabrications

1.03 REFERENCES

- A. The references listed below are a part of this section. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
Aluminum Design Manual	Aluminum Association, Aluminum Design Manual with Specifications and Guidelines for Aluminum Structures
AAMA	American Architectural Manufacturer's Association
ACI 318	Building Code Requirements for Structural Concrete
ACI 350	Code Requirements for Environmental Engineering Concrete Structures
ACI 350.3	Seismic Design of Liquid-Containing Concrete Structures
AISC 341	Seismic Provisions for Structural Steel Buildings
ACI 360	Specification for Structural Steel Buildings
ASCE 7	Minimum Design Loads for Buildings and Other Structures
ASTM C635	Manufacture, Performance and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings
ASTM C636	Installation for Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings
AWS D1.1	Structural Welding Code – Steel
AWS D1.2	Structural Welding Code – Aluminum
AWS D1.6	Structural Welding Code – Stainless Steel
AWS D1.8	Structural Welding Code – Seismic Supplement
UOSH	Utah Occupational Safety and Health Act
IBC	International Building Code with local amendments
NFPA-13	Installation of Sprinkler Systems
OSHA	U.S. Dept. of Labor, Occupational Safety and Health Administration
SMACNA	Seismic Restraint Manual Guidelines for Mechanical Systems

1.04 DEFINITIONS

- A. Structure: The structural elements of a building that resist gravity, seismic, wind, and other types of loads. Structural components include columns, posts, beams, girders, joists, bracing, floor or roof sheathing, slabs or decking, load-bearing walls, and foundations.
- B. Non-structural Components: Non-structural portions of a building include every part of the building and all its contents, except the structural portions, that carry gravity loads and that may also be required to resist effects of wind, snow, impact, temperature and

seismic loads. Non-structural components include, but are not limited to, ceilings, partitions, windows, equipment, piping, ductwork, furnishings, lights, etc.

- C. Non-building Structures: Self-supporting structures that carry gravity loads and that may also be required to resist the effects of wind, snow, impact, temperature and seismic loads. Non-building structures include, but are not limited to, pipe racks, storage racks, stacks, tanks, vessels and structural towers that support tanks and vessels.

1.05 SUBMITTALS

A. Action Submittals:

1. Procedures: Section 01 33 00.
2. A copy of this specification section with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.
3. Check-marks (✓) shall denote full compliance with a paragraph as a whole. Deviations shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Include a detailed, written justification for each deviation. Failure to include a copy of the marked-up specification sections, along with justification(s) for requested deviations to specification requirements, with the submittal is sufficient cause for rejection of the entire submittal with no further consideration.
4. For structural elements of non-structural components and non-building structures required to be designed per this section, provide Drawings and design calculations stamped by a Utah licensed professional engineer qualified to perform structural engineering.
5. List of non-structural components and non-building structures requiring wind and seismic design and anchorage.
6. Shop drawings showing details of complete wind and seismic bracing and anchorage attachment assemblies including connection hardware, and embedment into concrete.
7. Shop drawings showing plans, elevations, sections and details of equipment support structures and non-building structures, including anchor bolts, structural members, platforms, stairs, ladders, and related attachments.
8. Identify interface points with supporting structures or foundations, as well as size, location, and grip of required attachments and anchor bolts. Clearly indicate who will be providing each type of attachment/anchor bolt. Equipment vendor shall design anchor bolts, including embedment into concrete, and submit stamped calculations.
9. Calculations for supports, bracing, and attachments shall clearly indicate design criteria applied. Coordinate concrete embedment calculations with thickness and strength of concrete members. Submit a tabulation of the magnitude of unfactored (service level) equipment loads at each support point, broken down by type of loading (dead, live, wind, seismic, etc.). Indicate impact factors applied to these loads in design calculations.

1.06 QUALITY ASSURANCE

A. Quality Control By Owner:

1. Special Inspection of non-structural components and non-building structures, and their anchorages shall be performed by the Special Inspector under contract with the Owner and in conformance with IBC Chapter 17. Special Inspector(s) and laboratory shall be acceptable to the Owner in their sole discretion. Special Inspection is in addition to, but not replacing, other inspections and quality control requirements. Where sampling and testing required conforms to Special Inspection standards, such sampling and testing need not be duplicated.

PART 2 PRODUCTS

2.01 GENERAL

- A. Provide materials in conformance with information shown on the Drawings and in other technical specification sections. See individual component and equipment specifications for additional requirements.

2.02 DESIGN CRITERIA

- A. Design Codes

Design	Code
Buildings/Structures:	International Building Code 2021 and ASCE 7-16
Reinforced concrete:	ACI 350-20 and ACI 350.3-20 for Concrete Liquid Containing Structures, ACI 318-19 for all other reinforced concrete
Structural steel:	AISC 360-16 and AISC 341-16
Aluminum:	Aluminum Design Manual, Latest Edition
Welding:	AWS Welding Codes, Latest Edition
Occupational health and safety requirements:	OSHA and DOSH

Note: When conflicting requirements occur, the most stringent requirements will govern the design.

- B. Design Loads

1. Design non-structural components and non-building structures for the following minimum loads: (Do not apply wind and snow loads to non-structural components and non-building structures that are located inside buildings.)
2. Dead Loads:
 - a. Add an additional allowance for piping and conduit when supported and hung from the underside of equipment and platforms.
 - b. Typical allowance for piping and conduit: 20 psf
3. Uniform Live Loads:

Elevated grating floors:	100 psf
Columns:	No column live load reduction allowed
Exitways, stairs and landings:	100 psf
Equipment platforms, walkways/catwalks (other than exitways):	100 psf
Utility bridges:	100 psf per level

4. Snow Loads:

Code:	IBC 2021 & ASCE 7-16
Risk Category:	III (Wastewater Treatment facilities are Risk Category III)
Ground Snow Load (p_g):	30 psf
Exposure Factor (C_e):	C
Thermal Factor (C_t):	1.0
Importance Factor (I_s):	1.1
Flat Roof Snow Load (p_f):	25 psf
Drifting:	Per ASCE 7

5. Wind Loads:

Code:	IBC 2021 & ASCE 7-16
Risk Category:	III (Wastewater Treatment Facilities are Risk Category III)
Basic Wind Speed (Ultimate, 3-second gust) for Risk Category Shown Above:	109 mph
Exposure:	C
Topographic Factor (K_{zt})	1.0

Note:

1. Design exterior non-structural components and non-building structures, unless located in a pit or basin, to withstand design wind loads without consideration of shielding effects by other structures.

6. Seismic Loads:

Code:	IBC 2021 & ASCE 7-16
Risk Category:	III (Wastewater Treatment Facilities are Risk Category III)
0.2 Sec. Mapped Spectral Response, S_s :	1.29 g
1.0 Sec. Mapped Spectral Response, S_1 :	0.53 g
Site Class:	D
0.2 Sec. Design Spectral Response, S_{DS} :	1.03 g
1.0 Sec. Design Spectral Response, S_{D1} :	0.76 g
Importance Factor (I_e):	1.50 (Intentionally higher than code minimum)
Component Importance Factor (I_p):	1.0, except $I_p=1.5$ for components identified in Section 13.1.3 of ASCE 7
Seismic Design Category	D

Notes:

1. Calculate seismic loads on the basis of governing building code. Include equipment operating loads in structure dead load.
2. Check individual members for seismic and full member live load acting simultaneously, except that flooded equipment loads (infrequent occurrence) need not be combined with seismic loads. Combine equipment operating loads with seismic loads.

7. Impact Loads:

- a. Consider impact loads in design of support systems.
- b. Use the following impact load factors unless recommendations of the equipment manufacturer will cause a more severe load case:

Rotating machinery:	20% of moving load
Reciprocating machinery:	50% of moving load

8. Temperature:

- a. Include effects of temperature in design where non-structural components and non-building structures are exposed to differential climatic conditions. See climatic conditions below for temperature extremes.

C. Load Combinations

1. Design non-structural components and non-building structures to withstand load combinations as specified in the governing building code. Where the exclusion of live load or impact load would cause a more severe load condition for the member under investigation, ignore the load when evaluating that member.

D. Design Considerations

1. Design non-structural components and non-building structures for the following conditions:
2. Climatic Conditions:

Maximum design temperature:	90	degrees Fahrenheit
Minimum design temperature:	15	degrees Fahrenheit

3. Foundations:

- a. Extend foundations supporting non-structural components and non-building structures below the frost line, or support on non-frost susceptible structural fill down to the frost line.

Frost line for foundations:	30 inches
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Note: Consult project geotechnical report for allowable soil bearing recommendations at location of structure.

E. Column Base Fixity

1. Design column bases as pinned connections. No moments shall be assumed to be transferred to foundations.
2. Where significant shear loads (greater than 5,000 lb. per anchor bolt) are transferred at column base plates, provide a shear key designed to transfer shear load.

F. Deflection

1. Maximum beam deflection as a fraction of span for walkways and platforms: $L/240$ for total load and $L/360$ for live load.
2. Maximum total load deflection for equipment support: $L/450$.

PART 3 EXECUTION

3.01 GENERAL

- A. Make attachments and braces in such a manner that component force is transferred to the lateral force-resisting system of the structure. Base attachment requirements and size and number of braces per calculations submitted by Contractor.
- B. Anchorage of equipment is specified to be made by cast-in anchor bolts in concrete elements unless specifically noted otherwise on the Drawings or other specification sections. Contractor is responsible for remedial work or strengthening (of concrete

elements because of superimposed seismic loading) if anchor bolts are improperly installed or omitted due to lack of submittal review or improper placement for any reason, at no additional cost to Owner.

- C. Provide anchor bolts in accordance with Section 05 05 20. Base size of anchor bolts and embedment on submitted calculations.
- D. Submit details of and calculations for anchorages prior to placement of concrete or erection of other structural supporting members. Submittals received after structural supports are in place will be rejected if proposed anchorage method would create an overstressed condition of the supporting member. Contractor is responsible for revisions to anchorages and/or strengthening of structural support so that there is no overstress condition, at no additional cost to Owner.

END OF SECTION

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SECTION 01 74 23
RESTORATION OF IMPROVEMENTS AND CLOSEOUT

PART 1 GENERAL

1.01 STRUCTURES

- A. The Contractor shall take all precautions necessary to protect the integrity and usefulness of all existing facilities. If necessary, the Contractor may, with the approval of the Owner, remove such existing improvements, structures, including curbs, gutters, sidewalks, pipelines and utility poles as may be necessary for the performance of the work, and shall rebuild the structures thus removed in as good a condition as found with the requirements specified. He shall also repair existing structures which may be damaged as a result of the work under this contract.

1.02 ROADS AND STREETS

- A. Unless otherwise specified, roads and streets in which the surface is removed, broken, or damaged, or in which the ground has caved or settled during the work under this contract, shall be resurfaced and brought to the original grade and section. Roadways used by the Contractor shall be cleaned and repaired. Before resurfacing material is placed, edges of pavements shall be trimmed back far enough to provide clean, solid, vertical faces, and shall be free of loose material. All paved surfaces shall be cut with a pavement saw. Rough cuts are not allowed. Repair work shall conform to all local jurisdiction requirements and the paving specifications.

1.03 CULTIVATED AREAS AND OTHER SURFACE IMPROVEMENTS

- A. Cultivated or planted areas and other surface improvements which are damaged by actions of the Contractor shall be restored as nearly as possible to their original condition. Restoration shall take place within 1 week or sooner as directed by the Construction Manager.
- B. Existing guard posts, barricades, signs, and fences shall be protected and replaced if damaged.

1.04 PROTECTION OF EXISTING INSTALLATIONS

- A. The Contractor shall protect all existing operating facilities and structures from damages. However, if damage occurs, the Contractor shall immediately correct or replace existing equipment, controls, systems, structures, or facilities which are damaged in any way as a result of his operations.

1.05 FINAL CLEANUP

- A. The Contractor shall promptly remove from the vicinity of the completed Work, all rubbish, unused materials, concrete forms, construction equipment, and temporary structures and facilities used during construction. Final acceptance of the Work by the Owner will be withheld until the Contractor has satisfactorily performed the final cleanup of the Site.

1.06 CLOSEOUT TIMETABLE

- A. The Contractor shall establish dates for equipment testing, acceptance periods, and on-site instructional periods (as required under the Contract). Such dates shall be established not less than one week prior to beginning any of the foregoing items, to allow the Owner, the Construction Manager, and their authorized representatives sufficient time to schedule attendance at such activities.

1.07 FINAL SUBMITTALS

- A. The Contractor, prior to requesting final payment, shall obtain and submit the following items to the Construction Manager for transmittal to the Owner:
 - 1. Written guarantees, where required.
 - 2. Completed record drawings.
 - 3. New permanent cylinders and key blanks for all locks.
 - 4. Completed pre and post construction photos and videos.
 - 5. Certificates of inspection and acceptance by local governing agencies having jurisdiction.
 - 6. Releases from all parties who are entitled to claims against the subject project, property, or improvement pursuant to the provisions of law.

PART 2 NOT USED

PART 3 NOT USED

END OF SECTION

SECTION 01 78 23
OPERATION AND MAINTENANCE DATA

PART 1 GENERAL

1.01 SCOPE

- A. Operation and maintenance (O&M) instructions shall be provided in accordance with this section and as required in the technical sections of this project manual. O&M information shall be provided for each maintainable piece of equipment, equipment assembly or subassembly, and material provided or modified under this contract.
- B. O&M instructions must be submitted and accepted before on-site training may start.

1.02 TYPES OF INFORMATION REQUIRED

- A. General:
 - 1. O&M information shall contain the names, addresses, and telephone numbers of the manufacturer, the nearest representative of the manufacturer, and the nearest supplier of the manufacturer's equipment and parts. In addition, one or more of the following items of information shall be provided as applicable.
- B. Operating Instructions:
 - 1. Specific instructions, procedures, and illustrations shall be provided for the following phases of operations:
 - a. Safety Precautions: List personnel hazards for equipment and list safety precautions for all operating conditions.
 - b. Operator Prestart: Provide requirements to set up and prepare each system for use.
 - c. Start-Up, Shutdown, And Postshutdown Procedures: Provide a control sequence for each of these operations.
 - d. Normal Operations: Provide control diagrams with data to explain operation and control of systems and specific equipment.
 - e. Emergency Operations: Provide emergency procedures for equipment malfunctions to permit a short period of continued operation or to shut down the equipment to prevent further damage to systems and equipment. Include emergency shutdown instructions for fire, explosion, spills, or other foreseeable contingencies. Provide guidance on emergency operations of all utility systems including valve locations and portions of systems controlled.
 - f. Operator Service Requirements: Provide instructions for services to be performed by the operator such as lubrication, adjustments, and inspection.
 - g. Environmental Conditions: Provide a list of environmental conditions (temperature, humidity, and other relevant data) which are best suited for each product or piece of equipment and describe conditions under which equipment should not be allowed to run.
- C. Preventive Maintenance:
 - 1. The following information shall be provided for preventive and scheduled maintenance to minimize corrective maintenance and repair:

- a. Lubrication Data: Provide lubrication data, other than instructions for lubrication in accordance with **paragraph 1.02 Operator Service Requirements**.
 - 1) A table showing recommended lubricants for specific temperature ranges and applications;
 - 2) Charts with a schematic diagram of the equipment showing lubrication points, recommended types and grades of lubricants, and capacities; and
 - 3) A lubrication schedule showing service interval frequency.
- b. Preventive Maintenance Plan And Schedule: Provide manufacturer's schedule for routine preventive maintenance, inspections, tests, and adjustments required to ensure proper and economical operation and to minimize corrective maintenance and repair. Provide manufacturer's projection of preventive maintenance man-hours on a daily, weekly, monthly, and annual basis including craft requirements by type of craft.

D. Corrective Maintenance:

1. Manufacturer's recommendations shall be provided on procedures and instructions for correcting problems and making repairs.
 - a. Troubleshooting Guides And Diagnostic Techniques: Provide step-by-step procedures to promptly isolate the cause of typical malfunctions. Describe clearly why the checkout is performed and what conditions are to be sought. Identify tests or inspections and test equipment required to determine whether parts and equipment may be reused or require replacement.
 - b. Wiring Diagrams And Control Diagrams: Wiring diagrams and control diagrams shall be point-to-point drawings of wiring and control circuits including factory-field interfaces. Provide a complete and accurate depiction of the actual job-specific wiring and control work. On diagrams, number electrical and electronic wiring and pneumatic control tubing and the terminals for each type identically to actual installation numbering.
 - c. Maintenance And Repair Procedures: Provide instructions and list tools required to restore product or equipment to proper condition or operating standards.
 - d. Removal And Replacement Instructions: Provide step-by-step procedures and list required tools and supplies for removal, replacement, disassembly, and assembly of components, assemblies, subassemblies, accessories, and attachments. Provide tolerances, dimensions, settings, and adjustments required. Instructions shall include a combination of test and illustrations.
 - e. Spare Parts And Supply Lists: Provide lists of spare parts and supplies required for maintenance and repair to ensure continued service or operation without unreasonably delays. Special consideration is required for facilities at remote locations. List spare parts and supplies that have a long lead time to obtain.
 - f. Corrective Maintenance Manhours: Provide manufacturer's projection of corrective maintenance man-hours including craft requirements by type of craft. Corrective maintenance that requires participation of the equipment manufacturer shall be identified and tabulated separately.

E. Appendices:

1. The following information shall be provided; include information not specified in the preceding paragraphs but pertinent to the maintenance or operation of the product or equipment.

- a. **Parts Identification:** Provide identification and coverage for all parts of each component, assembly, subassembly, and accessory of the end items subject to replacement. Include special hardware requirements, such as requirement to use high-strength bolts and nuts. Identify parts by make, model, serial number, and source of supply to allow reordering without further identification. Provide clear and legible illustrations, drawings, and exploded views to enable easy identification of the items. When illustrations omit the part numbers and description, both the illustrations and separate listing shall show the index, reference, or key number which will cross-reference the illustrated part to the listed part. Parts shown in the listings shall be grouped by components, assemblies, and subassemblies.
- b. **Warranty Information:** List and explain the various warranties and include the servicing and technical precautions prescribed by the manufacturers or contract documents to keep warranties in force.
- c. **Personnel Training Requirements:** Provide information available from the manufacturers to use in training designated personnel to operate and maintain the equipment and systems properly.
- d. **Testing Equipment And Special Tool Information:** Provide information on test equipment required to perform specified tests and on special tools needed for the operation, maintenance, and repair of components.

1.03 TRANSMITTAL PROCEDURE

- A. Unless otherwise specified, O&M manuals, information, and data shall be transmitted in accordance with Section 01 33 00 accompanied by Transmittal Form 01 78 23-A and Equipment Record Forms 01 78 23-B and/or 01 78 23-C, as appropriate, all as specified in Section 01 99 90. The transmittal form shall be used as a checklist to ensure the manual is complete. Only complete sets of O&M instructions will be reviewed for acceptance.
- B. Three copies of the specified O&M information shall be provided. For ease of identification, each manufacturer's brochure and manual shall be appropriately labeled with the equipment name and equipment number as it appears in the project manual. The information shall be organized in the binders in numerical order by the equipment numbers assigned in the project manual. The binders shall be provided with a table of contents and tab sheets to permit easy location of desired information. Binders shall be provided with a table of contents and tab sheets to permit easy location of desired information.
- C. If manufacturers' standard brochures and manuals are used to describe O&M procedures, such brochures and manuals shall be modified to reflect only the model or series of equipment used on this project. Extraneous material shall be crossed out neatly or otherwise annotated or eliminated.

1.04 PAYMENT

- A. Acceptable O&M information for the project must be delivered to the Construction Manager prior to the project being 65 percent complete. Progress payments for work in excess of 65 percent completion will not be made until the specified acceptable O&M information has been delivered to the Construction Manager.

1.05 FIELD CHANGES

- A. Following the acceptable installation and operation of an equipment item, the item's instructions and procedures shall be modified and supplemented by the Contractor to reflect any field changes or information requiring field data.

END OF SECTION

SECTION 01 78 39
PROJECT RECORD DOCUMENTS

PART 1 GENERAL

1.01 DRAWINGS

- A. Record Documents refer to those documents maintained and annotated by the Contractor during construction and are defined as:
 - 1. A neatly and legibly marked set of Contract Drawings showing the final location of piping, appurtenances, equipment, electrical conduits, outlet boxes and cables;
 - 2. Additional documents such as schedules, lists, drawings, electrical and instrumentation diagrams included in the specifications;
 - 3. Contractor layout and installation drawings such as loop drawings, single line diagrams, control schematics/elementary diagrams, control panel drawings, and wiring drawings; and
 - 4. Three-dimensional database-driven models used in the development of drawings or schedules, if applicable.
- B. Unless otherwise specified, record drawings shall be full size.

1.02 MODELS

- A. The Contractor has the option of utilizing three-dimensional database driven models in the development of Project Record Documents.
- B. The use of modeling software does not absolve the Contractor from meeting the other requirements of this Section.
- C. If the Contractor uses modeling software in the development of record drawings and schedules, the following requirements apply:
 - 1. The modelling software used by the Contractor shall be the same as that used by the Engineer during design development.
 - 2. The model Level of Development (LOD) shall be the same as that employed by Engineer during design development, but no less than **[LOD 300]**.
 - 3. Contractor shall coordinate with Engineer and Construction Manager in the development of a BIM execution plan to provide continuity to the model structure.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Procedures: Section 01 33 00.
 - 2. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph checkmarked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated and, therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified

paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

3. BIM execution plan outlining continuity with the model structure developed during the design phase.]

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.01 USE DURING CONSTRUCTION

- A. Record Documents shall be maintained in a clean, dry, and legible condition.
- B. Record Documents shall not be used for construction purposes and shall be available for review by the Construction Manager during normal working hours at the Contractor's field office.

3.02 UPDATES

- A. Marking of the Record Documents shall be kept current and shall be done at the time the material and equipment are installed.
- B. Annotations to the Record Documents shall be made with an erasable colored pencil conforming to the following color code:
 1. Additions – Red
 2. Deletions – Green
 3. Comments – Blue
 4. Dimensions – Graphite*

**Legibly mark to record actual depths, horizontal and vertical location of underground raceways, cables, and appurtenances referenced to permanent surface improvements.*

- C. Monthly Review Meetings:
 1. During the monthly project meetings, the Contractor and Construction Manager shall review the record documents.
 2. At that time the Contractor and Construction Manager shall review the working set of record drawings and initial the accepted areas where everyone has agreed that the location, elevation and/or other construction modification is at the indicated final location.
 3. At the conclusion of each meeting, the Contractor shall submit the up-to-date Record Drawings to the Construction Manager.

- D. Underground Utilities:

1. Contractor shall provide digital photographs of underground piping and conduits, a fixed measurement on the record drawings, and/or GPS coordinates showing locations from buildings or structures prior to burying piping or electrical conduit.
2. Contractor shall note the depth of buried piping and electrical conduit.

3.03 SUBMISSION

- A. At the completion of the work, prior to final payment, all record drawings shall be submitted to the Construction Manager.
- B. The electrical and instrumentation record drawings are typically the last mark ups to be completed. Final payment shall be withheld until the Contractor, Construction Manager, and Engineer have reviewed, verified and agreed on the final electrical and instrumentation record drawings.
- C. At the completion of the work, all models (if applicable) shall be submitted to the Construction Manager in NWD format or other format approved by the Construction Manager and Owner.

END OF SECTION

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SECTION 01 79 00
DEMONSTRATION AND TRAINING

PART 1 GENERAL

1.01 DESCRIPTION

- A. This section contains requirements for training the Owner's personnel, by persons retained by the Contractor specifically for the purpose, in the proper operation and maintenance of the equipment and systems installed under this contract.

1.02 QUALITY ASSURANCE

- A. Where required by the detailed specifications, the Contractor shall provide on-the-job training of the Owner's personnel. The training sessions shall be conducted by qualified, experienced, factory-trained representatives of the various equipment manufacturers. Training shall include instruction in both operation and maintenance of the subject equipment.

1.03 SUBMITTALS

- A. The following information shall be submitted to the Construction Manager in accordance with the provisions of **Section 01 33 00**. The material shall be reviewed and accepted by the Construction Manager as a condition precedent to receiving progress payments in excess of 50 percent of the contract amount and not less than 3 weeks prior to the provision of training.
 - 1. Lessons plans for each training session to be conducted by the manufacturer's representatives. In addition, training manuals, handouts, visual aids, and other reference materials shall be included.
 - 2. Subject of each training session, identity and qualifications of individuals to be conducting the training, and tentative date and time of each training session.

PART 2 PRODUCTS

2.01 GENERAL

- A. Where specified, the Contractor shall conduct training sessions for the Owner's personnel to instruct the staff on the proper operation, care, and maintenance of the equipment and systems installed under this contract. Training shall take place at the site of the work and under the conditions specified in the following paragraphs. Approved operation and maintenance manuals shall be available at least 30 days prior to the date scheduled for the individual training session.

2.02 LOCATION

- A. Training sessions shall take place at the site of the work in the Administration Building Board Room. Training sessions shall be scheduled around regularly scheduled meetings.

2.03 LESSON PLANS

- A. Formal written lesson plans shall be prepared for each training session. Lesson plans shall contain an outline of the material to be presented along with a description of visual aids to be utilized during the session. Each plan shall contain a time allocation for each subject.
- B. One complete set of originals of the lesson plans, training manuals, handouts, visual aids, and reference material shall be the property of the Owner and shall be suitably bound for proper organization and easy reproduction. The Contractor shall furnish ten copies of necessary training manuals, handouts, visual aids and reference materials at least 1 week prior to each training session.

2.04 FORMAT AND CONTENT

- A. Each training session shall be comprised of time spent both in the classroom and at the specific location of the subject equipment or system. As a minimum, training session shall cover the following subjects for each item of equipment or system:
 - 1. Familiarization
 - a. Review catalog, parts lists, drawings, etc., which have been previously provided for the plant files and operation and maintenance manuals.
 - b. Check out the installation of the specific equipment items.
 - c. Demonstrate the unit and indicate how all parts of the specifications are met.
 - d. Answer questions.
 - 2. Safety
 - a. Using material previously provided, review safety references.
 - b. Discuss proper precautions around equipment.
 - 3. Operation
 - a. Using material previously provided, review reference literature.
 - b. Explain all modes of operation (including emergency).
 - c. Check out Owner's personnel on proper use of the equipment.
 - 4. Preventive Maintenance
 - a. Using material previously provided, review preventive maintenance (PM) lists including:
 - 1) Reference material.
 - 2) Daily, weekly, monthly, quarterly, semiannual, and annual jobs.
 - b. Show how to perform PM jobs.
 - c. Show Owner's personnel what to look for as indicators of equipment problems.
 - 5. Corrective Maintenance
 - a. List possible problems.
 - b. Discuss repairs--point out special problems.
 - c. Open up equipment and demonstrate procedures, where practical.
 - 6. Parts
 - a. Show how to use previously provided parts list and order parts.
 - b. Check over spare parts on hand. Make recommendations regarding additional parts that should be available.

7. Local Representatives
 - a. Where to order parts: name, address, telephone.
 - b. Service problems:
 - 1) Who to call.
 - 2) How to get emergency help.
8. Operation and Maintenance Manuals
 - a. Review any other material submitted.
 - b. Update material, as required.

2.05 VIDEO RECORDING:

- A. The Owner will retain the services of a commercial video taping service to record each training session. After taping, the material will be edited and supplemented with professionally produced graphics to provide a permanent record. The Contractor shall advise all manufacturers providing training sessions that the material will be video taped and shall make available to the Owner's video taping contractor such utility services and accommodation as may be required to facilitate the production of the video tape record.

PART 3 EXECUTION

3.01 SUMMARY

- A. Training shall be conducted in conjunction with the operational testing and commissioning periods. Classes shall be scheduled such that classroom sessions are interspersed with field instruction in logical sequence. The Contractor shall arrange to have the training conducted on consecutive days, with no more than 6 hours of classes scheduled for any one day. Concurrent classes shall not be allowed. Training shall be certified on **Form 43 05 11-B** specified in **Section 01 99 90**.
- B. Acceptable operation and maintenance manuals for the specific equipment shall be provided to the Owner prior to the start of any training. Video taping shall take place concurrently with all training sessions.
- C. The following services shall be provided for each item of equipment or system as required in individual specification sections. Additional services shall be provided, where specifically required in individual specification sections.
 1. As a minimum classroom equipment training for operations personnel will include:
 - a. Using slides and drawings, discuss the equipment's specific location in the plant and an operational overview.
 - b. Purpose and plant function of the equipment.
 - c. A working knowledge of the operating theory of the equipment.
 - d. Start-up, shutdown, normal operation, and emergency operating procedures, including a discussion on system integration and electrical interlocks, if any.
 - e. Identify and discuss safety items and procedures.
 - f. Routine preventative maintenance, including specific details on lubrication and maintenance of corrosion protection of the equipment and ancillary components.
 - g. Operator detection, without test instruments, of specific equipment trouble symptoms.

- h. Required equipment exercise procedures and intervals.
 - i. Routine disassembly and assembly of equipment if applicable (as judged by the Owner on a case-by-case basis) for purposes such as operator inspection of equipment.
2. As a minimum, hands-on equipment training for operations personnel will include:
 - a. Identify location of equipment and review the purpose.
 - b. Identifying piping and flow options.
 - c. Identifying valves and their purpose.
 - d. Identifying instrumentation:
 - 1) Location of primary element.
 - 2) Location of instrument readout.
 - 3) Discuss purpose, basic operation, and information interpretation.
 - e. Discuss, demonstrate, and perform standard operating procedures and round checks.
 - f. Discuss and perform the preventative maintenance activities.
 - g. Discuss and perform start-up and shutdown procedures.
 - h. Perform the required equipment exercise procedures.
 - i. Perform routine disassembly and assembly of equipment if applicable.
 - j. Identify and review safety items and perform safety procedures, if feasible.
 3. Classroom equipment training for the maintenance and repair personnel will include:
 - a. Theory of operation.
 - b. Description and function of equipment.
 - c. Start-up and shutdown procedures.
 - d. Normal and major repair procedures.
 - e. Equipment inspection and troubleshooting procedures including the use of applicable test instruments and the "pass" and "no pass" test instrument readings.
 - f. Routine and long-term calibration procedures.
 - g. Safety procedures.
 - h. Preventative maintenance such as lubrication; normal maintenance such as belt, seal, and bearing replacement; and up to major repairs such as replacement of major equipment part(s) with the use of special tools, bridge cranes, welding jigs, etc.
 4. Hands-on equipment training for maintenance and repair personnel shall include:
 - a. Locate and identify equipment components.
 - b. Review the equipment function and theory of operation.
 - c. Review normal repair procedures.
 - d. Perform start-up and shutdown procedures.
 - e. Review and perform the safety procedures.
 - f. Perform Owner approved practice maintenance and repair job(s), including mechanical and electrical adjustments and calibration and troubleshooting equipment problems.

END OF SECTION

SECTION 01 91 00
COMMISSIONING

PART 1 GENERAL

1.01 DESCRIPTION:

- A. This section contains requirements for the Contractor's performance during the commissioning of the structures, equipment and systems constructed and installed during the course of this contract. All commissioning work, as described in this section, shall be performed by the Contractor.

1.02 QUALITY ASSURANCE

- A. Cleanup:
 - 1. Following completion of the operational testing period, the Contractor shall remove, clean, and replace all permanent and temporary filters and strainers in all pipeline systems; dewater and clean all sumps; and dewater all process units for final inspection as a condition precedent to commissioning.
- B. Commissioning Team:
 - 1. The Contractor shall assemble a commissioning team under the direction of an individual duly authorized to commit the Contractor's personnel and resources to respond to requests for assistance from the Construction Manager or the Owner.
 - 2. The commissioning team shall consist of representatives of the Contractor's mechanical, electrical, and instrumentation subcontractors, and others as appropriate. [] **shall also be included in the commissioning process for the secondary clarifiers.**
 - 3. The commissioning team shall be available at the site of the work during normal working hours (8 hours a day, 5 days a week, Saturdays, Sundays, and legal holidays excepted) and shall be available within 2 hours' notice at all other times upon notice by telephone. The commissioning team shall at all times be equipped and ready to provide for emergency repairs, adjustments, and corrections to the equipment and systems installed and modified as a part of this contract.

1.03 SUBMITTALS

- A. The following information shall be submitted to the Construction Manager in accordance with the provisions of Section 01 33 00:
 - 1. Detailed plans for commissioning each process unit and each system constructed or modified as a part of the work performed under this contract.
 - 2. The Contractor's plan for providing a commissioning team conforming to the requirements of paragraph 1.02 Commissioning Team during the commissioning period. The plan shall be complete with a daytime staffing plan and names, qualifications, and telephone numbers of those assigned to off-hour standby duty.

PART 2 PRODUCTS

2.01 SUMMARY

- A. Working with representatives of the Owner and the Construction Manager, the Contractor shall develop and produce a detailed, written plan for the startup and initial operation, under actual operating conditions, of the equipment and systems installed and constructed under this contract. The document, after acceptance by the Construction Manager, shall serve as the guidance manual for the commissioning process.

PART 3 EXECUTION

3.01 SUMMARY

- A. After completion of the equipment and system performance and operational testing, where required, and agreement on the part of the Construction Manager that the systems did meet all test requirements, commissioning will begin. The commissioning period for each modified or new unit process system shall be 3 weeks. The Contractor shall remove all temporary piping, bulkheads, controls and other alterations to the permanent systems that may have been needed during the performance and operational testing and shall perform the tasks necessary to make the improvements constructed under this contract fully operational. The Construction Manager shall confirm in writing the date(s) that the system is ready for commissioning and on which actual commissioning activities commence. Activities conducted prior to such written confirmation shall not constitute commissioning. The following specific tasks are to be performed as a part of the commissioning process:
 - 1. Coordinate the startup and commissioning of each system and component with the Owner and Construction Manager.
 - 2. Document the performance of all systems during the commissioning period.
 - 3. Document all malfunctions of equipment repairs and maintenance performed, and all equipment taken out of service and period of time.
 - 4. Coordinate manufacturer's service representatives for on-site troubleshooting and repair.
 - 5. Confirm and document proper clarifier rotation direction, electrical bump testing may be required to verify. Coordinate clarifier rotation direction commissioning tests with the Owner.
 - 6. Document completion of the commissioning period.
- B. The Owner's operation and maintenance personnel will be responsible for operation of the systems to be commissioned. The portion of the work to be commissioned shall be fully operational, performing all functions for which it was designed.
- C. The Contractor shall be available at all times during commissioning periods to provide immediate assistance in case of failure of any portion of the system being constructed. At the end of the commissioning period and when all corrections required by the Construction Manager to assure a reliable and completely operational facility are complete, the Construction Manager shall issue a completion certificate. Each system shall have been issued a completion certificate as a condition precedent to the final acceptance of the work of this contract.
- D. During the commissioning period, the Owner shall be responsible for all normal operational costs and the Contractor shall bear the costs of all necessary repairs or

replacements, including labor and materials, required to keep the portion of the plant being commissioned, operational.

END OF SECTION

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SECTION 01 99 90
REFERENCE FORMS

PART 1 FORMS

1.01 DESCRIPTION

- A. The forms listed below and included in this section are referenced from other sections of the project manual:

Form No.	Title
01 33 00-A	Submittal Transmittal Form
01 45 20-A	Equipment Test Report Form
01 78 23-A	Operation and Maintenance Transmittal Form
01 78 23-B	Equipment Record Form
01 78 23-C	Equipment Record Form
09 90 00-A	Coating System Inspection Checklist
26 05 00-A	Wire and Cable Resistance Test Data Form
26 05 00-B	Installed Motor Test Data Form
26 05 00-C	Dry Transformer Test Data Form
26 05 00-D	Motor Control Center Test Form
26 05 00-E	Medium Voltage Motor Starter Test Form
26 05 00-F	Medium Voltage Switchgear Test Form
26 05 00-G	Protective Relay Test Form
26 05 00-H	Low Voltage Switchgear Test Form
26 05 00-I	Medium Voltage Load Interrupter Switch Test Form
26 05 00-J	Liquid-Filled Transformer Test Form
26 05 00-K	Automatic Transfer Switch Test Form
26 05 00-L	Neutral Grounding Resistor Test
40 61 13-A	Loop Wiring and Insulation Resistance Test Data Form
40 61 13-B	Control Circuit Piping Leak Test Form
40 61 13-C	Controller Calibration Test Data Form
40 61 13-D	Panel Indicator Calibration Test Data Form
40 61 13-E	Recorder Calibration Test Data Form
40 61 13-F	Signal Trip Calibration Test Data Form
40 61 13-G	Field Switch Calibration Test Data Form
40 61 13-H	Transmitter Calibration Test Data Form
40 61 13-I	Miscellaneous Instrument Calibration Test Data Form
40 61 13-J	Individual Loop Test Data Form
40 61 13-K	Loop Commissioning Test Data Form
43 05 11-A	Manufacturer's Installation Certification Form
43 05 11-B	Manufacturer's Instruction Certification Form
43 05 11-C	Unit Responsibility Certification Form
43 05 13-A	Rigid Equipment Mount Installation Inspection Checklist
43 05 21-A	Motor Data Form

01 33 00-A. SUBMITTAL TRANSMITTAL FORM**Submittal Transmittal**

Submittal Description:	Submittal No: ¹	Spec Section:
------------------------	----------------------------	---------------

	Routing	Sent	Received
Owner:	Contractor/CM		
Project:	CM/Engineer		
	Engineer/CM		
Contractor:	CM/Contractor		

We are sending you:

- ☐ Attached
☐ Under separate cover via _____
☐ Submittals for review and comment
☐ Product data for information only

Remarks: _____

Item	Copies	Date	Section No.	Description	Review action ^a	Reviewer initials	Review comments attached

^aNote: NET = No exceptions taken; MCN = Make corrections noted; A&R = Amend and resubmit; R = Rejected
 Attach additional sheets if necessary.

Contractor

Certify either a or b:

- a. ☐ We have verified that the material or equipment contained in this submittal meets all the requirements, including coordination with all related work, specified (no exceptions).
 b. ☐ We have verified that the material or equipment contained in this submittal meets all the requirements specified except for the attached deviations.

No.	Deviation

Certified by: _____

Contractor's Signature: _____

¹See **Section 01 33 00-1.04. A, Transmittal Procedure.**

01 45 20-A. EQUIPMENT TEST REPORT FORM

NOTE: This example equipment test report is provided for the benefit of the Contractor and is not specific to any piece of equipment to be installed as a part of this project. The example is furnished as a means of illustrating the level of detail required for the preparation of equipment test report forms for this project.

City Of Sample

Example Water Treatment Plant

Stage IV Expansion Project

ABC Construction Company, Inc., General Contractor

XYZ Engineering, Inc., Construction Manager

Equipment Test Report

- Equipment Name: Sludge Pump 2
- Equipment Number: P25202
- Specification Ref: 11390
- Location: East Sedimentation Basin Gallery

	Contractor		Construction Manager	
	Verified	Date	Verified	Date
A. Preoperational Checklist				
1. Mechanical				
a. Lubrication				
b. Alignment				
c. Anchor bolts				
d. Seal water system operational				
e. Equipment rotates freely				
f. Safety guards				
g. Valves operational				
h. Hopper purge systems operational				
i. Sedimentation tank/hopper clean				
j. O&M manual information complete				
k. Manufacturer's installation certificate complete				
2. Electrical (circuit ring-out and high-pot tests)				
a. Circuits:				
1) Power to MCC 5				
2) Control to HOA				
3) Indicators at MCC:				
a) Red (running)				
b) Green (power)				
c) Amber (auto)				
4) Indicators at local control panel				
b. Wiring labels complete				
c. Nameplates:				
1) MCC				
2) Control station				
3) Control panel				

	Contractor		Construction Manager	
	Verified	Date	Verified	Date
d. Equipment bumped for rotation				
3. Piping Systems				
a. Cleaned and flushed:				
1) Suction				
2) Discharge				
b. Pressure tests				
c. Temporary piping screens in place				
4. Instrumentation and Controls				
a. Flowmeter FE2502F calibration				
1) Calibration Report No.				
b. Flow recorder FR2502G calibrated against transmitter				
c. VFD speed indicator calibrated against independent reference				
d. Discharge overpressure shutdown switch calibration				
e. Simulate discharge overpressure Shutdown				
B. Functional Tests				
1. Mechanical				
a. Motor operation temperature satisfactory				
b. Pump operating temperature satisfactory				
c. Unusual noise, etc?				
d. Pump operation: 75 gpm/50 psig				
(1) Measurement:				
(a) Flow:				
(b) Pressure:				
(c) Test gage number:				
e. Alignment hot				
f. Dowelled in				
g. Remarks:				
2. Electrical				
a. Local switch function:				
1) Runs in HAND				
2) No control power in OFF				
3) Timer control in AUTO				
b. Overpressure protection switch PS2502C functional in both HAND and AUTO				
c. Overpressure protection switch PS2502C set at 75 psig				
d. PLC 2500 set at 24-hour cycle, 25 min ON				
C. Operational Test				
1. 48-hour continuous test. Pump cycles as specified, indicators functional, controls functional, pump maintains capacity, overpressure protection remains functional, hour meter functional				

RECOMMENDED FOR BENEFICIAL OCCUPANCY:

Construction Manager	Date
----------------------	------

ACCEPTED FOR BENEFICIAL OCCUPANCY

Owner's Representative	Date
------------------------	------

01 78 23-A. OPERATION AND MAINTENANCE TRANSMITTAL FORM

Date:	Submittal No: ²
To:	Contract No:
	Spec. Section:
	Submittal Description:
Attention:	From:

Checklist	Contractor		Construction Manager	
	Satisfactory	N/A	Accept	Deficient
1. Table of contents				
2. Equipment record forms				
3. Manufacturer information				
4. Vendor information				
5. Safety precautions				
6. Operator prestart				
7. Start-up, shutdown, and postshutdown procedures				
8. Normal operations				
9. Emergency operations				
10. Operator service requirements				
11. Environmental conditions				
12. Lubrication data				
13. Preventive maintenance plan and schedule				
14. Troubleshooting guides and diagnostic techniques				
15. Wiring diagrams and control diagrams				
16. Maintenance and repair procedures				
17. Removal and replacement instructions				
18. Spare parts and supply list				
19. Corrective maintenance man-hours				
20. Parts identification				
21. Warranty information				
22. Personnel training requirements				
23. Testing equipment and special tool information				

Remarks:

Contractor's Signature :

--

² See Section 01 33 00-1.04.A, Transmittal Procedure.

01 78 23-B. EQUIPMENT RECORD FORM

Equip Descrip		Equip Loc	
Equip No.	Shop Dwg No.	Date Inst	Cost
Mfgr		Mfgr Contact	
Mfgr Address		Phone	
Vendor		Vendor Contact	
Vendor Address		Phone	

Maintenance Requirements	D	W	M	Q	S	A	Hours

Lubricants:	Recommended:
	Alternative:

Misc. Notes:

Recommended Spare Parts				Electrical Nameplate Data			
Part No	Quan	Part Name	Cost	Equip			
				Make			
				Serial No.		Id No.	
				Model No.		Frame No.	
				Hp	V	Amp	Hz
				Ph	Rpm	Sf	Duty
				Code	Insl. Cl	Des	Type
				Nema Des	C Amb	Temp Rise	Rating
				Misc.			
				Mechanical Nameplate Data			
				Equip			
				Make			
				Serial No.		Id No.	
				Model No.		Frame No.	
				Hp	Rpm	Cap	Size
				Tdh	Imp Sz	Belt No.	Cfm
				Psi	Assy No.	Case No.	
				Misc			

01 78 23-C. EQUIPMENT RECORD FORM

Equip Descrip		Equip Loc	
Equip No.	Shop Dwg No.	Date Inst	Cost
Mfgr		Mfgr Contact	
Mfgr Address			Phone
Vendor		Vendor Contact	
Vendor Address			Phone

[illegible]

09 90 00-A COATING SYSTEM INSPECTION CHECKLIST

Project Name			
Owner		Coating System Manufacturer (CSM)	
General Contractor (GC)		Coating System Applicator (CSA)	
Area or Structure		Location within Structure	
Coating System (eg E-1)		Coating Type (eg Epoxy, etc.)	

Coating System Inspection Checklist

Step	Description		Name	Signature	Date
1	Completion of cleaning and substrate decontamination prior to abrasive blast cleaning.	GC QC			
		CSM QC			
		CSA QC			
2	Installation of protective enclosure of structure or area and protection of adjacent surfaces or structures that are not to be coated.	GC QC			
		CSM QC			
		CSA QC			
3	Completion of ambient condition control in structure or building area and acceptance of ventilation methods in structure or Area.	GC QC			
		CSM QC			
		CSA QC			
4	Completion of Surface Preparation for Substrates to Be Coated.	GC QC			
		CSM QC			
		CSA QC			
5	Completion of Primer Application.	GC QC			
		CSM QC			
		CSA QC			
6	Completion of Concrete Repairs If Required and Related Surface Preparation Rework Prior to Coating System Application.	GC QC			
		CSM QC			
		CSA QC			
7	Completion of Concrete Filler/ Surface Application to Concrete.	GC QC			
		CSM QC			
		CSA QC			
8	Completion of First Finish Coat Application and of Detail Treatment at Transitions or Terminations.	GC QC			
		CSM QC			
		CSA QC			

Coating System Inspection Checklist

Step	Description		Name	Signature	Date
9	Completion of Second Finish Coat Application and of Detail Treatment at Transitions and Terminations.	GC QC			
		CSM QC			
		CSA QC			
10	Completion of Full and Proper Cure of Coating System.	GC QC			
		CSM QC			
		CSA QC			
11	Completion of Testing of Cured Coating System including Adhesion, Holiday (Continuity) Testing and Dry Film Thickness.	GC QC			
		CSM QC			
		CSA QC			
12	Completion of Localized Repairs to Coating System Following Testing.	GC QC			
		CSM QC			
		CSA QC			
13	Final Acceptance of Coating System Installation Including Final Clean-Up Complying with Specification Requirements and the CSM's Quality Requirements.	GC QC			
		CSM QC			
		CSA QC			

26 05 00-A. WIRE AND CABLE RESISTANCE TEST DATA FORM

Wire or Cable No.: _____ Temperature, °F: _____

Location of Test	Insulation resistance, megohms
1.	
2.	
3.	
4.	
5.	
6.	
7.	

CERTIFIED _____ Date _____

Contractor's Representative

WITNESSED _____ Date _____

Owner's Representative

26 05 00-B. INSTALLED MOTOR TEST DATA FORM

Motor Equipment Number: _____ Date of test: _____

Equipment Driven: _____

MCC Location: _____

				Ambient temp	°F
Resistance:					
Insulation resistance phase-to-ground megohms:					
Phase A		Phase B		Phase C	
Current at Full Load:					
Phase		Current, amps			
Phase		Current, amps			
Phase		Current, amps			
Thermal Overload Device:	Manufacturer/catalog #			Amperes	
Circuit breaker (MCP) setting:					

Motor Nameplate Markings:

Mfr		Mfr Model		Frame		HP	
Volts		Phase		RPM		Service factor**	
Amps		Freq		Ambient temp rating			°C
Time rating				Design letter**			
	(NEMA 1-10.35)				(NEMA MG-1.16)		
Code letter				Insulation class			

**Required for 3-phase squirrel cage induction motors only.

CERTIFIED _____ Date _____

Contractor's Representative

WITNESSED _____ Date _____

Owner's Representative

26 05 00-C. DRY TRANSFORMER TEST DATA FORM

(Note: Use Data Form for dry type transformers with voltage rating of 600 Vac or less and sizes to 167 kVA single phase and 500 kVA three phase. Use NETA Test Forms and Test Procedures for higher voltages and larger transformers.)

Equipment Tag No.: _____ Temperature Rating: _____

Description/Location: _____ Feeder size/Source: _____

Primary Voltage: _____ Secondary Voltage: _____ Winding Connection: _____

A. VISUAL INSPECTION

Transformer Inspection	Pass	Fail	Note
1. Nameplate data as specified			
2. Mechanical condition			
a. Free of dents and scratches			
b. Anchored properly			
c. Shipping brackets removed			
d. Spacing from wall per nameplate			
3. Grounding *			
a. Equipment grounding			
b. System grounding			

B. INSULATION-RESISTANCE TESTS:

Perform tests with calibrated megohmmeter. Apply 1000 Vdc test voltage for 60 seconds and record readings in megohms at 30-seconds and 60-seconds intervals.

Test Group	Resistance between		30-second reading	60-second reading	Absorption Ratio Index 60-sec. / 30-sec.
Primary Winding to ground	A	GRD			
	B	GRD			
	C	GRD			
Secondary Winding to ground with * N-G Bond removed	a	GRD			
	b	GRD			
	c	GRD			
Primary Winding to Secondary Winding	A	a			
	B	b			
	C	c			

Submit resistance readings to the Construction Manager immediately after the tests that are less than the manufacturer's recommended value or less than 10-megohms. Record the Absorption Ratio Index values for future reference. Ratio must be 1.0 or greater, with infinity (∞) equal to 1.0.

Contractor Representative Certified: _____ Date _____

Owner Representative Witnessed: _____ Date _____

26 05 00-D. MOTOR CONTROL CENTER TEST FORM

Equipment No.: _____ Ambient room temperature: _____

Location: _____

A. MECHANICAL CHECK:

All bolted connections either bus to bus or cable to bus shall be torqued to the manufacturer's recommendations.

B. ELECTRICAL TESTS:

1. Measure insulation resistance of each bus section phase to phase and phase to ground for 1 minute using a megohmmeter at 1000 volts.

Test results (megohms)			
Phase		Phase	
A-GRD		A-B	
B-GRD		B-C	
C-GRD		C-A	

2. Set the circuit breaker in the starter unit to comply with the requirements of NEC, Article 430-52 and Table 430-152.
3. Motor overload heater elements shall be sized and installed based on the actual nameplate full load amperes of the motor connected to the starter.

CERTIFIED _____ Date _____

Contractor's Representative

WITNESSED _____ Date _____

Owner's Representative

26 05 00-E. MEDIUM VOLTAGE MOTOR STARTER TEST FORM

Equipment No.: _____

Location: _____

Room Temperature: _____

The protective devices shall be set in accordance with the specification before the tests are performed.

1. Measure contact resistance (micro-ohms)

Phase:	A		B		C	
--------	---	--	---	--	---	--

Contacts shall be replaced if resistance exceeds 50 micro-ohms.

2. Perform an insulation resistance test (1000 volts DC for 1 minute).

Phase	A		B		C		
Pole to ground							megohms
Across open pole							megohms
Pole to pole	AB		BC		CA		megohms

3. Perform minimum pickup voltage tests on trip and close coils.
4. Motor RTDs shall be tested by using a hot oil bath. The temperature at which the sensor trips shall be recorded for each RTD.
5. The Contactor shall be tripped by operation of each protective device.

26 05 00-F. MEDIUM VOLTAGE SWITCHGEAR TEST FORM

Equipment No.: _____

Location: _____

Room Temperature: _____

The protective devices shall be set in accordance with the specification before the tests are performed.

1. Measure contact resistance (micro-ohms).

Phase:	A		B		C	
--------	---	--	---	--	---	--

Contacts shall be replaced if resistance exceeds 50 micro-ohms.

2. Perform an insulation resistance test (1000 volts DC for 1 minute).

Phase	A		B		C		
Pole to ground							megohms
Across open pole							megohms
Pole to pole	AB		BC		CA		megohms

3. Perform minimum pickup voltage tests on trip and close coils.
4. Verify the instrument transformer ratios. Check the transformer's polarity electrically.
5. The Contactor shall be tripped by operation of each protective device.

26 05 00-G. PROTECTIVE RELAY TEST FORM

Location: _____

Switchgear Breaker No.: _____

Protective Relay Description: _____

The protective relays shall be tested in the following manner:

1. Each protective relay circuit shall have its insulation resistance tested to ground.
2. Perform the following tests on the specified relay setting:
 - a. Pickup parameters on each operating element.
 - b. Timing test shall be performed at three points on the time dial curve.
 - c. Pickup target and seal-in units.

The results shall be recorded and signed. A copy shall be given to the Construction Manager in accordance with **paragraph 26 05 00-1.05 Corrosive Areas.**

26 05 00-H. LOW VOLTAGE SWITCHGEAR TEST FORM

Equipment No.: _____

Location: _____

Room Temperature: _____

The protective devices shall be set in accordance with the specification before the tests are performed.

1. Measure contact resistance (micro-ohms).

Phase:	A		B		C	
--------	---	--	---	--	---	--

Contacts shall be replaced if resistance exceeds 50 micro-ohms.

2. Perform an insulation resistance test (1000 volts DC for 1 minute).

Phase	A		B		C		
Pole to ground							megohms
Across open pole							megohms
Pole to pole	AB		BC		CA		megohms

3. Minimum pickup current shall be determined by primary current injection.
4. Long time delay shall be determined by primary injection at three hundred percent (300%) pickup current.
5. Short time pickup and time delay shall be determined by primary injection of current.
6. Instantaneous pickup current shall be determined by primary injection.
7. Trip unit reset characteristics shall be verified.
8. Auxiliary protective devices, such as ground fault or under voltage relays, shall be activated to ensure operation of shunt trip devices.

26 05 00-I. MEDIUM VOLTAGE LOAD INTERRUPTER SWITCH TEST FORM

Equipment Number: _____

Location: _____

Date: _____

1. Measure switch blade resistance (micro-ohms).

Phase:	A		B		C	
--------	---	--	---	--	---	--

Contacts shall be replaced if resistance exceeds 50 micro-ohms.

2. Perform an insulation resistance test (1000 volts DC for 1 minute).

Phase	A		B		C		
Pole to ground							megohms
Across open pole							megohms
Pole to pole	AB		BC		CA		megohms

The results shall be recorded and signed. A copy shall be given to the Construction Manager in accordance with paragraph 26 05 00-2.06 Product Data.

CERTIFIED _____ Date _____
Contractor's Representative

WITNESSED _____ Date _____
Owner's Representative

26 05 00-J. LIQUID-FILLED TRANSFORMER TEST FORM

Equipment Number: _____

Location: _____

Date/Weather Conditions: _____

- A. Perform the "Insulation-Resistance Test" and "Dielectric Absorption Test" using Form 26 05 00-C, Dry Transformer Test Data Form.
- B. Perform an applied voltage (low frequency dielectric) test in accordance with ANSI C57.12.90, paragraph 10.5, Applied Voltage Test. Applied voltage levels shall be 75 percent of recommended factory test levels or recommended test levels of ANSI C57.12.00, Table 5.
- C. Insulating oil shall be sampled and shall be laboratory tested for the following:
 - 1. Dielectric strength.
 - 2. Acid neutralization.
 - 3. Interfacial tension.
 - 4. Color.
 - 5. Power factor.
- D. Perform a turns ratio test between the windings for all tap positions.
- E. The temperature and pressure switches shall be tested using a hot oil bath and air pump.
- F. The results shall be recorded and signed by the Contractor and Construction Manager. A copy shall be given to the Construction Manager in accordance with paragraph 26 05 00-2.06 Product Data. Any readings which are abnormal to ANSI industry standards shall be reported to the Construction Manager.

26 05 00-K. AUTOMATIC TRANSFER SWITCH TEST FORM

Equipment Number: _____

Location: _____

Date: _____

1. Perform an insulation resistance test (1000 volts DC for 1 minute):

Phase	A		B		C		
Pole to ground							megohms
Pole to pole	AB		BC		CA		megohms

2. Perform the following operations and initial:

- a. Manual transfer _____
- b. Loss of normal power; __sec delay
- c. Return to normal power; _____sec delay

The results shall be recorded and signed. A copy shall be given to the Construction Manager in accordance with **paragraph 26 05 00-2.06 Product Data.**

CERTIFIED _____ Date _____

Contractor's Representative

WITNESSED _____ Date _____

Owner's Representative

26 05 00-L. NEUTRAL GROUNDING RESISTOR TEST

Equipment No.: _____

Location: _____

The pickup and time delay setting on the ground fault relay shall be set in accordance with Section 26 05 74.

1. The transformer neutral insulation resistance shall be measured with and without the grounding resistor connected to insure no parallel ground paths exist.
2. The protective relay pickup current shall be determined by injecting test current into the current sensor. The pickup current should be within 10 percent of the dial setting. Record the dial setting and actual pickup tie.
3. The relay timing shall be tested by injecting 150 and 300 percent of pickup current into the current sensor. The relay timing shall be in accordance with the manufacturer's published time-current characteristic curves. Record the relay timing at 150 and 300 percent of pickup current.
4. The circuit interrupting device shall be operated by operating the relay.

The results shall be recorded and signed by the Contractor and Construction Manager. A copy shall be given to the Construction Manager in accordance with paragraph 26 05 00-2.06 Product Data.

40 61 13-A. LOOP WIRING AND INSULATION RESISTANCE TEST DATA FORM

Loop No.: _____

List all wiring associated with a loop in table below. Make applicable measurements as indicated after disconnecting wiring.

Wire No.	Panel Tie	Field TB	Continuity Resistance ^a		Insulation Resistance ^b			
			Cond./ Cond.	Cond./ Shield	Shield/ Gnd.	Shield/ Cond.	Cond./ Gnd.	Shield/ Shield
A			--	(A/SH)				
B			(A/B)	--				
C			(A/C)	--				
D			(A/D)	--				
etc.								

NOTES:

- a. Continuity Test. Connect ohmmeter leads between wires A and B and jumper opposite ends together. Record resistance in table. Repeat procedure between A and C, A and D, etc. Any deviation of ± 2 ohms between any reading and the average of a particular run indicates a poor conductor, and corrective action shall be taken before continuing with the loop test.
- b. Insulation Test. Connect one end of a 500 volt megger to the panel ground bus and the other sequentially to each completely disconnected wire and shield. Test the insulation resistance and record each reading.

CERTIFIED _____ Date _____

Contractor's Representative

WITNESSED _____ Date _____

Owner's Representative

40 61 13-B. CONTROL CIRCUIT PIPING LEAK TEST FORM

Loop No.: _____

List tubing associated with loop in table below. Make applicable measurements after isolating any air consuming pilots from circuit.

Tube No.	Tubing Equivalent Length of 1/4-Inch Copper ^a	Test Period (seconds)	Permitted Pressure Drop (psi) ^b	Measured Pressure Drop (psi)
A				
B				
C				
D				
etc.				

NOTES:

- a. Convert actual tubing and air motor volume to equivalent 1/4-inch copper tubing.
- b. Pressure drop shall not exceed 1 psi per hundred feet 1/4-inch tubing per 5 seconds.

CERTIFIED _____ Date _____

Contractor's Representative

WITNESSED _____ Date _____

Owner's Representative

40 61 13-C. CONTROLLER CALIBRATION TEST DATA FORM

Tag No. and Description: _____

Make & Model No.: _____ Serial No.: _____

Input: _____ Process Variable (PV) Scale: _____

Output: _____ Output Scale: _____

PV Scale Calibration

% of Range	Input	Expected Reading	Actual Reading	% Deviation
0				
50				
100				
% Deviation Allowed:				

Connect output to PV for following tests:

Set Point (SP) Indicator Accuracy			Output Meter Accuracy			Controller Accuracy		
SP	PV Reading	Expected % Dev.	Actual Reading	Expected Reading	Actual % Dev.	OUTPUT	OUTPUT	% Dev.
(0%)								
(50%)								
(100%)								
% Deviation Allowed:			% Deviation Allowed:			% Deviation Allowed:		

CERTIFIED _____ Date _____

Contractor's Representative

WITNESSED _____ Date _____

Owner's Representative

40 61 13-D. PANEL INDICATOR CALIBRATION TEST DATA FORM

Tag No. and Description: _____

Make & Model No.: _____ Serial No.: _____

Input: _____

Scale: _____ Range: _____

PV Scale Calibration

% of Range	Input	Expected Reading	Actual Reading	% Deviation
0				
50				
100				
% Deviation Allowed:				

CERTIFIED _____ Date _____

Contractor's Representative

WITNESSED _____ Date _____

Owner's Representative

40 61 13-E. RECORDER CALIBRATION TEST DATA FORM

Tag No. and Description: _____

Make & Model No.: _____ Serial No.: _____

Input: _____ Chart: _____

Scale: _____ Range: _____

% of Range	Input	Expected Reading	Actual Reading	% Deviation
0				
50				
100				
% Deviation Allowed:				

CERTIFIED _____ Date _____

Contractor's Representative

WITNESSED _____ Date _____

Owner's Representative

40 61 13-F. SIGNAL TRIP CALIBRATION TEST DATA FORM

Tag No. and Description: _____

Make & Model No.: _____ Serial No.: _____

Input: _____

Scale: _____ Range: _____

Set Point(s): _____

After setting set point(s), run signal input through entire range and calculate deadband.

Set Point	Incr. Input Trip Point	Decr. Input Trip Point	Calc. Deadband	Required Deadband

CERTIFIED _____ Date _____

Contractor's Representative

WITNESSED _____ Date _____

Owner's Representative

40 61 13-G. FIELD SWITCH CALIBRATION TEST DATA FORM

Tag No. and Description: _____

Make & Model No.: _____ Serial No: _____

Input: _____

Range: _____

Set Point(s): _____

Simulate process variable (flow, pressure, temperature, etc.) and set desired set point(s). Run through entire range of switch and calculate deadband.

Set Point	Incr. Input Trip Point	Decr. Input Trip Point	Calc. Deadband	Required Deadband

CERTIFIED _____ Date _____

Contractor's Representative

WITNESSED _____ Date _____

Owner's Representative

40 61 13-H. TRANSMITTER CALIBRATION TEST DATA FORM

Tag No. and Description: _____

Make & Model No.: _____ Serial No.: _____

Input: _____

Output: _____

Range: _____ Scale: _____

Simulate process variable (flow, pressure, temperature, etc.) and measure output with appropriate meter.

% of Range	Input	Expected Reading	Actual Reading	% Deviation
0				
50				
100				
% Deviation Allowed:				

CERTIFIED _____ Date _____

Contractor's Representative

WITNESSED _____ Date _____

Owner's Representative

40 61 13-I. MISCELLANEOUS INSTRUMENT CALIBRATION TEST DATA FORM

(For instruments not covered by any of the preceding test forms, the Contractor shall create a form containing all necessary information and calibration procedures.)

CERTIFIED _____ Date _____
Contractor's Representative

WITNESSED _____ Date _____
Owner's Representative

40 61 13-J. INDIVIDUAL LOOP TEST DATA FORM

Loop No.: _____

Description: (Give complete description of loop's function using tag numbers where appropriate.)

P&ID No.: (Attach copy of P&ID.)

- a. Wiring tested:
(Attach test form 40 61 13-A)
- b. Instrumentation tubing/piping tested:
(Attach test form 40 61 13-B)
- c. Instruments calibrated:
(Attach test forms 40 61 13-C through I)
- d. List step-by-step procedures for testing loop parameters. Test loop with instruments, including transmitters and control valves, connected and functioning. If it is not possible to produce a real process variable, then a simulated signal may be used with the Construction Manager's approval.

CERTIFIED _____ Date _____
Contractor's Representative

WITNESSED _____ Date _____
Owner's Representative

40 61 13-K. LOOP COMMISSIONING TEST DATA FORM

Loop No.: _____

- a. Loop tested:
(Attach test form 40 61 13-J)
- b. Controlled or connected equipment tests confirmed:
- c. Give complete description of loop's interface with process.
- d. With associated equipment and process in operation, provide annotated chart trace of loop response to changes in set points for verification of performance. This chart should demonstrate 1/4-amplitude damping as output adjusts to set point change. Show set points, starting and finishing times on chart, as well as any other pertinent data.

Connect 2-pen recorder to process variable (PV) and to controller output. Use 1 inch/second chart speed.

Pen 1 - PV - Connections:

Pen 2 - Output - Connections:

CERTIFIED _____ Date _____

Contractor's Representative

WITNESSED _____ Date _____

Owner's Representative

[illegible]

Date _____

43 05 11-B. MANUFACTURER'S INSTRUCTION CERTIFICATION FORM

Contract No:	Specification Section:
Equipment name:	
Contractor:	
Manufacturer of equipment item:	
The undersigned manufacturer certifies that a service engineer has instructed the wastewater treatment plant operating personnel in the proper maintenance and operation of the equipment designated herein.	

Operations Check List (check appropriate spaces)

Start-up procedure reviewed	
Shutdown procedure reviewed	
Normal operation procedure reviewed	
Others:	

Maintenance Check List (check appropriate spaces)

Described normal oil changes (frequency)	
Described special tools required	
Described normal items to be reviewed for wear	
Described preventive maintenance instructions	
Described greasing frequency	
Others:	

Manufacturer

Signature of Contractor Representative Date

Signature of Authorized Representative

Date

Signature of Authorized Representative Date

43 05 11-C. UNIT RESPONSIBILITY CERTIFICATION FORM

[PROJECT TITLE]

CERTIFICATE OF UNIT RESPONSIBILITY
FOR SPECIFICATION SECTION _____

[SECTION TITLE]

In accordance with **Section 43 05 11-1.02 Unit Responsibility** of the contract documents, the undersigned manufacturer of driven equipment ("manufacturer") accepts unit responsibility for all components of equipment furnished to the Project under specification Section _____, and for related equipment manufactured under sections _____, _____, and _____.

We have reviewed the requirements for sections **43 05 11** and **43 23 03** (where applicable) and all sections referencing this (these) section(s), including but not limited to drivers, supports for driving and driven equipment and all other specified appurtenances to be furnished to the Project by manufacturer. And, we have further reviewed, and modified as necessary, the requirements for associated variable speed drives and motor control centers. We hereby certify that all specified components are compatible and comprise a functional unit suitable for the specified performance and design requirements whether or not the equipment was furnished by us. We will make no claim nor establish any condition that problems in operation for the product provided under this specification Section _____ are due to incompatibility of any components covered by this Certificate of Unit Responsibility. Nor will we condition or void any warranty for the performance of the product of this specification Section _____ due to incompatibility of any components covered under this Certificate of Unit Responsibility.

Our signature on this Certificate of Unit Responsibility does not obligate us to take responsibility for, nor to warrant the workmanship, quality, or performance of related equipment provided by others under specification sections _____, _____, and _____. Our obligation to warranty all equipment provided by us shall remain unaffected.

Notary Public

Name of Corporation

Commission expiration date

Address

Seal:

By:

Duly Authorized Official

Legal Title of Official

Date

43 05 13-A. RIGID EQUIPMENT MOUNT INSTALLATION CHECKLIST

[CLIENT, PROJECT NAME]

Equipment Tag No.: _____ Date: _____

Grout Product Name and Type: _____

Grouting System Manufacturer: _____

Grouting Application Contractor: _____

General Contractor: _____

Step 1: Verify Equipment Anchor Installation Conformance to Equipment Pad Details

Name: Contractor Rep.		Date
Name: Construction Manager		Date
Name: Millwright		Date

Step 2: Completion of Cleaning and Concrete Substrate Preparation Prior to Grouting

Name: Contractor Rep.		Date
Name: Construction Manager		Date
Name: Grouting Contractor Rep.		Date
Name: Grout Manufacturer's Technical Rep.		Date

Step 3: Equipment Leveling

Name: Contractor Rep.		Date
Name: Construction Manager		Date
Name: Millwright		Date

Step 4: Installation of Protection of Adjacent Surfaces or Structures NOT TO BE GROUTED

Name: Contractor Rep.		Date
Name: Construction Manager		Date
Name: Grouting Contractor Rep.		Date
Name: Grout Manufacturer's Technical Rep.		Date

Step 5: Preparation and Construction of Forms and Epoxy Grout Filling Standpipes

Name: Contractor Rep.		Date
Name: Construction Manager		Date
Name: Grouting Contractor Rep.		Date
Name: Grout Manufacturer's Technical Rep.		Date

Step 6: Completion of Ambient Condition Control in Structure or Building Area and Acceptance of Ambient Conditions as They Apply to Application and Curing Requirements for the Grouting System

Name: Contractor Rep.		Date
Name: Construction Manager		Date
Name: Grouting Contractor Rep.		Date
Name: Grout Manufacturer's Technical Rep.		Date

Step 7: Epoxy Grout Installation

Name: Contractor Rep.		Date
Name: Construction Manager		Date
Name: Grouting Contractor Rep.		Date
Name: Grout Manufacturer's Technical Rep.		Date

Step 8: Completion of Full and Proper Cure of Epoxy Grout

Name: Contractor Rep.		Date
Name: Construction Manager		Date
Name: Grouting Contractor Rep.		Date

Name: Grout Manufacturer's Technical Rep.		Date
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Step 9: Completion of Localized Repair of Grout Voids

Name: Contractor Rep.		Date
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Name: Construction Manager		Date
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Name: Grouting Contractor Rep.		Date
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Name: Grout Manufacturer's Technical Rep.		Date
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Step 10: Final Acceptance of Grouting System Installation Including Final Clean-Up of the Work Site Complying with All Specification Requirements and the GSM's Quality Requirements

Name: Contractor Rep.		Date
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Name: Construction Manager		Date
----------------------------	--	------

Name: Grouting Contractor Rep.		Date
--------------------------------	--	------

Name: Grout Manufacturer's Technical Rep.		Date
---	--	------

43 05 21-A. MOTOR DATA FORM

Equipment Name: _____ Equipment No(s): _____

Project Site Location: _____

Nameplate Markings

Mfr:		Mfr Model:		Frame:		Horsepower:	
Volts:		Phase:		RPM:		Service Factor:	
FLA:		LRA:		Frequency:		Amb Temp Rating:	°C
Time rating:				Design Letter:			
	(NEMA MG1-10.35)				(NEMA MG-1.16)		
KVA Code Letter:				Insulation Class:			

The following information is required for explosion-proof motors only:

- A. Approved by UL for installation in Class _____, Div _____, Group _____
B. UL frame temperature code _____ (NEC Tables 500-8B)

The following information is required for all motors 1/2 horsepower and larger:

- A. Guaranteed minimum efficiency _____
(Section 43 05 21-2.04 Motor Efficiency)
- B. Nameplate or nominal efficiency _____

Data Not Necessarily Marked on Nameplate

Type of Enclosure:				Enclosure Material:			
Temp Rise:		°C (NEMA MG1-12.41,42)					
Space Heater included?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	If Yes:	Watts	Volts		
Type of motor winding over-temperature protection, if specified:							

Provide information on other motor features specified:

END OF SECTION

SECTION 02 41 00
DEMOLITION AND SALVAGE

PART 1 GENERAL

1.01 DESCRIPTION

A. Scope of Work:

1. This section includes materials and equipment to be salvaged and returned to the Owner; or demolished and removed from the site as trash by the Contractor. Equipment to be salvaged and reused as part of this project is specified in specification Section 01 64 00. The sequence in which systems can be worked on shall be as specified in specification Section 01 12 16, Work Sequence.
2. Furnish all labor, material, equipment, and incidentals required to demolish, modify, or alter, existing facilities as shown or specified and as required for the installation of new mechanical equipment, piping, architectural features and appurtenances. Existing piping and equipment shall be removed and dismantled as necessary for the performance of structural, architectural, and piping alterations in accordance with the requirements herein specified.
3. Removal and disposal of electrical Work is included in Division 26. Coordinate with the subcontractor and Owner for all materials required to be turned over to Owner. Dewatering requirements are defined in specification Section 01 51 00. Concrete surface preparation and coating is specified in specification Sections 03 30 00 and 09 90 00.

B. Performance Requirements:

1. Existing Conditions: Contractor shall visit the site and inspect the nature and condition of all facilities to be demolished, partially demolished, modified, or altered in any way prior to submittal of his Bid. No increase in cost or extension of Contract time will be considered for failure to know the conditions of the site and structures.
2. Salvage: Any items specifically indicated to be re-used or designated to be salvaged for Owner's own purposes shall be carefully removed, and be relocated to designated storage areas on the project site. Contractor shall protect salvaged equipment and materials from weather, staining, construction damage, theft, and vandalism. Arrange storage to facilitate inspection by Construction Manager.
 - a. The Contractor shall notify the Construction Manager fifteen (15) days prior to commencement of demolition work in an area. The Owner shall then tag equipment, piping, valves, control devices, electrical, etc. with a color code system to designate the location for salvaged items to be stored.
 - b. The Contractor shall provide four (4) colors of wire tags similar to EMED Co., Inc., LMT70 with a quantity of 2,000 for each color.
3. Demolition and Disposal: All other materials removed under the demolition Work, including dismantled equipment and materials, piping, pumps, fittings, valves, machinery, gates, concrete equipment pads, miscellaneous and structural metals, masonry, and other construction debris shall become the property of the Contractor and be removed from the site as trash. Trash and debris shall be disposed of legally, off the site, by Contractor. Upon removal from site, Contractor shall have the rights of salvage of materials.

1.02 QUALITY ASSURANCE

A. Protection of Existing Facilities:

1. The Contractor shall diligently protect existing structures and property of the Owner while proceeding with Work of this section and the entire Contract. All damage shall be repaired at once to the satisfaction of the Owner. All such repairs shall be at the expense of the Contractor and no claims for additional payment will be accepted.
2. When removing materials or portions of existing structures and when making openings in walls and partitions, the Contractor shall provide barriers, dust screens, and other protective devices so as not to damage the structures beyond the limits necessary for the new Work, nor to damage the structures or contents by falling or flying debris nor to transfer any heavy shocks and vibrations to structures to remain. Swinging weights shall not be used to demolish structures.

PART 2 MATERIALS AND METHODS

2.01 REPAIR AND RESTORATION

A. General:

1. The Contractor shall alter or rework existing structures as shown and specified. Generally, when items of equipment and piping are removed, the areas and surfaces from which items were removed shall be left with a neat appearance and finish compatible with surrounding areas, colors, and surfaces. The Contractor shall do all painting, sanding, grouting, sacking, resurfacing, and other Work as necessary to comply with the above requirements. Prior to structural modifications, all surfaces shall be subject to inspection by the Construction Manager. Colors shall match existing colors as closely as possible. For replacement, repair or restoration of Work removed, comply with the specifications for the type of Work to be done.

B. Penetrations:

1. Where holes in existing masonry or concrete are required to be sealed, unless otherwise specified, they shall be sealed with cement mortar or concrete. The sides of the openings shall be provided with keyed joints and shall be suitably roughened to furnish a good bond and make a watertight joint. All loose or unsound material adjacent to the opening shall be removed and, if necessary, replaced with new material. The method of placing the mortar seal shall provide a suitable means of releasing entrapped air.

C. Modifications of Existing Structures:

1. Where only a portion of the existing structure is to be removed, the existing concrete shall be sawed to neat lines as shown on the plans or as established by the Construction Manager. Reinforcing steel shall be removed to a depth of two inches from the finished surface. Anchor bolts for equipment and structural steel removed shall be cut off 1-inch below the concrete surface. Surface shall be finished as specified in Division 3.
2. When connections are to be made to existing concrete structures, the existing reinforcing steel shall be exposed to a depth of 12 inches and all bars spliced to the new reinforcing steel.

D. Piping Modifications:

1. Where necessary or required for the purpose of making piping connections, cut existing pipelines and provide suitable plugs, bulkheads, or other means to hold back the flow of water or other liquids, all as required in the performance of the Work under this Contract. The remaining open ends of all piping, valves, fittings, and appurtenances that are removed shall be plugged with standard pipe plugs or closed with flanges so that there will be no leakage through the closure.

PART 3 EXECUTION

3.01 GENERAL

A. Control of Hazard and Nuisance Conditions:

1. All demolition, salvage, and renovation Work shall be conducted in a manner which will protect the environment, promote public health and safety, and preclude nuisance conditions, in strict conformance with the requirements of CVWRF Health and Safety Plan, and 01 11 80 Environmental Conditions. In addition, Contractor shall enforce the following safety requirements:
 - a. No fires will be permitted on-site.
 - b. Post "No Smoking" signs in all interior spaces and in hazardous or confined spaces where dismantling operations are to be carried on. Strictly enforce "No Smoking" restrictions among all personnel employed on the Work.

B. Demolition of Existing Structures:

1. Structures that are in the way of new construction shall be removed completely, regardless if they are above or below existing or proposed ground or grade. This Work may be done in any manner selected by the Contractor, and reviewed by the Construction Manager, that does not endanger adjacent structures and property. The use of explosives will not be permitted for any purposes.
2. Structures not in the way of proposed construction, but designated to be demolished or removed shall be removed, to a point three feet below existing or proposed grade, whichever is lower. That portion that will remain below grade shall be cleaned of rubble and debris including exposed reinforcing steel, backfilled with Type A material in accordance with specification Section 31 23 00 Excavation and Fill and graded in accordance with the site grading plan.
3. Structural steel members shall be cut into sections of such weight and size as will permit convenient handling, hauling, and storage. Concrete to be demolished and removed shall be broken into pieces not greater than 24-inches in any dimension by methods reviewed by the Construction Manager.

C. Grading and Backfill:

1. All excavation made in connection with this item and all openings below permanent ground caused by the removal of a structure shall be backfilled with suitable material and graded to match the proposed grading plan. That portion of the backfill which will support any portion of a roadbed, driveway, or structure shall be backfilled and compacted in accordance with specification Sections 31 23 00 Excavation and Fill and 32 12 16 Asphalt Paving.

D. Weather Protection:

1. Removal of windows in exterior walls, or other elements providing weather protection, shall not be started until temporary weatherproof enclosures are in place or can be put in place immediately after such removal.

E. Existing Trees:

1. Extreme care should be taken when working around existing trees. No excavation or compaction shall take place within the tree drip line except with prior permission of the Owner or where the tree is shown for removal on the drawings.

3.02 ITEMS TO BE SALVAGED AND RETURNED TO OWNER

- A. Contractor shall request the Owner or Owner's Construction Manager to identify all items to be salvaged prior to the start of the Work. Salvaged items shall be properly disconnected to retain their full salvage value and cleaned before turning over to the Owner. See drawings for items to be demolished. Salvage items shall include:
1. Clarifier drives and corresponding controls
 2. Plug in YSI instrumentation on clarifier walkways
 3. Clarifier emergency worker floatation equipment
 4. Clarifier sludge judge (core taking) equipment

END OF SECTION

SECTION 03 01 00
CONCRETE REPAIR

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes concrete rehabilitation if needed for existing Secondary Clarifiers 1, 2, 3 and east clarifier splitter box. Concrete repairs are not anticipated for any of these structures and are not listed in the Summary or Work. Concrete sidewalks will require repair or replacement if removed or damaged during work.
 - 1. Inspection by Engineer and Contractor to identify areas in need of repair and extent of repair expected.
 - 2. Repair by Contractor, as coordinated with product manufacturers for final product selections, in accordance with this specification and drawings, including preparation, repair, and protective coating.
 - 3. Materials for reinforcement steel modifications below and for cast-in-place concrete construction for new walls shall comply with specification section 03 20 00 Concrete Reinforcing.

1.02 UNIT PRICE

- A. Work includes cost of preparing existing construction to receive Work indicated, installation of repair products, curing, and costs of field quality control.

1.03 RELATED SECTIONS

- A. Section 01 11 00 - Summary of Work
- B. Section 01 12 16 - Work Sequence
- C. Section 01 14 19 - Use of Site
- D. Section 03 20 00 - Concrete Reinforcing
- E. Section 03 30 00 - Cast-In-Place Concrete
- F. Section 09 90 00 - Painting and Coating

1.04 REFERENCE

- A. The references listed below are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between requirements of this section and those of listed documents, requirements of this section prevail.
- B. References listed below indicate those documents in effect at the time of Advertisement for Bids, Invitation to Bid, or on the effective date of the Agreement if there were no Bids. Where documents are referenced in applicable local, state, or federal codes, use the version referenced by date in the individual code. If referenced documents are not

specifically identified in the applicable code(s), reference to those documents shall indicate the latest version of the documents available at the time of Advertisement for Bids, Invitation to Bid, or the effective date of the Agreement if there were no Bids. If referenced documents have been discontinued by the issuing organization, reference to those documents shall mean the latest version of replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. For questions, refer to Engineer.

- C. ACI-562 – Assessment, Repair and Rehabilitation of Existing Concrete Structures and Commentary.
- D. ACI-563 – Repair of Concrete in Buildings.

1.05 PRECONSTRUCTION MEETING

- A. Contractor to organize and conduct a preconstruction meeting, at Project site prior to start of work related to this Section. Include representatives from Contractor, Subcontractor, repair product representatives, Coating manufacturer's representative, Engineer, and Owner.
- B. Review methods and procedures related to concrete repairs and protective coating including, but not limited to, the following:
 - 1. Verify Contractor's personnel, equipment, and facilities needed to perform Work and avoid delays.
 - 2. Materials, surface preparation, material application, environmental conditions, curing, sequencing, tolerances, and required clearances.
 - 3. Coordination of Work, including schedule to include provisions for mockup of surface preparation, repair mortar, finish coatings, and testing.
 - 4. Quality-Control program, including required notifications and scheduling of inspections by Contractor, product manufacturers, Engineer, and Owner's testing agency.

1.06 ACTION SUBMITTALS

- A. Concrete Repair Schedule.
 - 1. Include proposed dates for bypass pumping, draining of structures, cleaning, inspection, and completion of Work.
- B. Concrete Repair Plan
 - 1. Concrete repair plan to detail full scope of concrete repair work for each structure. Include plans, sections, sketches and photos as required.
 - 2. Include quantities for each type of repair material based on field inspection.
- C. Product Data:
 - 1. Include product data for each product to be used, based on recommendations of product manufacturers.
 - 2. Include construction details, material data sheets, chemical composition, physical properties, test data, and mixing information.

3. Include custom, project specific selections with preparation and application instructions for repair materials per manufacturer's recommendations.
4. Coordinate repair materials with protective coating submittals per Section 09 90 00 and provide written confirmation from coating manufacturer regarding compatibility of coating with selected repair products.
5. Standard submittal documents are required, marked up to indicate selected products and applicable information. Indicate locations of Contractor requested substitutions. Do not submit full catalogs. Do not submit MSD sheets.

1.07 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Specialty concrete repair Contractor and manufacturers, plus Specialty coating Contractor and manufacturer, based on Quality Assurance requirements below.
- B. Product Test Reports: For each manufacturer and each product, including: bonding agent, cementitious patching mortar, joint-filler, crack-injection adhesive, and structural reinforcement; for tests performed by manufacturer and witnessed by a qualified testing agency.
- C. Quality-Control Program: Submit before work begins; to include product manufacturer approval of installation personnel.
- D. Field quality-control tests and observation reports provided by Contractor and product manufacturer representatives. Include pH testing, maximum and minimum surface temperature records, daily maximum and minimum ambient air temperature and humidity readings, and wind speeds prior to and for 48 hours after product installation.

1.08 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Each product manufacturer shall employ factory-authorized service representatives who are available for consultation and Project-site inspection and assistance.
 1. Coordinate services of the repair/coating product manufacturer's representative(s) to: attend the preconstruction meeting, provide additional field training, be on-site to monitor mockup, examine surfaces after preparation, mixing of products and application; and be available as-needed thereafter during repair/coating production, provide follow-up observation of curing and finished repair/coating, provide on-site trouble shooting and corrective procedures.
 2. A single source Manufacturer shall provide all products used in the "system" for restoration of concrete surface including protective coatings per Section 09 90 00. Where more than one manufacturer's products are used in the "system", each manufacturer shall provide a complete list of all products in the "system", including the selected products from other manufacturer's and provide a statement regarding acceptance of compatibility.
- B. Specialty Concrete Repair Contractor Qualifications: Engage an experienced specialty concrete-repair firm that employs installers and supervisors who are trained and approved by the manufacturer to perform Work of this Section. The firm shall have completed Work similar in material, design, and extent to that indicated for this Project and shall demonstrate a record of successful in-service performance.

1. Concrete repair Contractor shall have at least 5-years' experience using product(s) being installed (or similar) and demonstrate a history with projects of similar size and complexity as the Work intended for this Project.
 - a. Provide evidence (certificates or letter) of Contractor training by manufacture.
 2. Field Supervision: Concrete repair firm shall maintain experienced full-time supervisors on Project site during times that concrete-repair Work is in progress.
- C. Quality Control Program: Prepare a written plan for concrete repair to systematically demonstrate the ability of selected personnel to properly perform the Work. Include each phase or process, protection of surrounding materials during operations, and control of debris and runoff during the Work. Describe in detail, using outline format: materials, methods, equipment to be used; how environmental conditions will be monitored; testing, and sequence of operations to be used for each phase of Work.
- D. Provide pH testing (including written documentation) of prepared concrete surface to determine required depth of removal to obtain a pH neutral surface prior to application of repair materials. Reference ASTM D4262.
- E. A third-party testing agency hired by Contractor shall spot check the pH of prepped surfaces and perform the following test in the mock-up area prior to application of protective coatings.
1. Direct-tension bond testing of prepared surface.
 2. Direct-tension bond testing of completed repair.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer's written instructions, including minimum and maximum temperature requirements and other requirements.
- B. Store materials off ground, under cover, and in a dry location.

1.10 FIELD CONDITIONS

- A. General: Install products according to manufacturer's instructions. Consult product manufacturer for environmental limitations. Plan Work and install products only during permissible temperature range specified by manufacturer's instructions.
- B. Cold-Weather Requirements: Do not apply unless concrete-surface and air temperatures are above 40 deg F and will remain so for at least 48 hours after completion of Work or as directed by manufacturer.
 1. If mean daily air temperature falls below 40 deg F, cover completed Work with weather-resistant insulating blankets for 48 hours after repair or provide enclosure and heat to maintain temperatures above 40 deg F within the enclosure for 48 hours after repair.
- C. Hot-Weather Requirements: Protect repair work when temperature and humidity conditions produce excessive evaporation of water from patching materials. Provide artificial shade, wet cure methods, wind breaks, and use cooled materials as required. Do not apply to substrates with temperatures of 90 deg F and above.

PART 2 PRODUCTS

2.01 GENERAL

- A. Source Limitations: For repair products, where practical, obtain each grade, finish, type, and variety of product from single source and from single manufacturer with resources to provide products of consistent quality in appearance and physical properties.
- B. All materials shall be free of chlorides and other chemicals causing corrosion.

2.02 REINFORCEMENT PROTECTION

- A. Bonding and Anti-corrosion Agent: Manufactured product that consists of an extended open time, water-insensitive epoxy adhesive/primer solution of corrosion-inhibiting chemicals that forms a protective film on steel reinforcement.
 - 1. BASF Corporation, MasterProtect P 8100AP.
 - 2. Sika Corporation, Armatec 110 EpoCem.
 - 3. Simpson Strong-Tie FX-406.
 - 4. Approved equal.

2.03 SPRAY (OR TROWEL APPLIED) MORTAR SYSTEM (VERTICAL SURFACE REPAIR)

- A. Mortar: One component, cementitious-based, fiber reinforced, shrinkage compensated, gray in color, with a minimum working time of 30-minutes.
 - 1. Sprayable and trowel-able, extremely low permeability, sulfate resistant, easy to use and requiring only the addition of manufacturer's specialty liquid admixture.
- B. Manufacturer and Products:
 - 1. A.W. Cook Cement Products, Inc, Silatec MSM Microsilica Mortar.
 - 2. BASF Corporation, MasterEmaco S 488CI with Concreactive liquid (LPL).
 - 3. Euclid Chemical Company, Tamms Structural Mortar.
 - 4. Sauereisen Inc, Restokrete No. F-121.
 - 5. Sika Corporation, SikaRepair 224 with Latex R.
 - 6. Simpson Strong-Tie, CSS-CM or FX-263.
 - 7. Tnemec Company, Mortarcrete series 217.
 - 8. Approved equal.

2.04 POLYMER-MODIFIED REPAIR MORTAR (VERTICAL SURFACE REPAIR)

- A. Mortar: two components, polymer-modified, cementitious based, chloride resistant, gray in color, minimum working time of 20 minutes.
 - 1. Hand applied, extremely low permeability, easy to use and requiring only the addition of water or manufacturer's specialty liquid admixture.
- B. Manufacturers and Products:
 - 1. BASF Corporation, MasterEmaco N 425.
 - 2. Sika Corporation, SikaTop 123 Plus.
 - 3. Simpson Strong-Tie, FX-263.

4. Approved equal.

2.05 POLYMER-MODIFIED REPAIR MORTAR (HORIZONTAL SURFACE REPAIR)

- A. Mortar: two components, polymer-modified, cementitious based, gray in color, minimum working time of 20 minutes.
 1. Hand applied, extremely low permeability, easy to use and requiring only the addition of water or manufacturers specialty liquid admixture.
- B. Manufacturers and Products:
 1. BASF Corporation, MasterEmaco T 310CI.
 2. Sika Corporation, SikaTop 122 Plus.
 3. Simpson Strong-Tie, FX-261S (form and pour).
 4. Approved equal.

2.06 EPOXY CRACK-INJECTION MATERIALS

- A. Epoxy Crack-Injection Adhesive: ASTM C 881, bonding system, free of VOCs.
 1. Type IV at structural locations and where indicated or as directed by Engineer.
 2. Type I at other locations.
- B. Manufacturers and Products:
 1. BASF Corporation, MasterInject 1380.
 2. Sika Corporation, Sikadur 35 Hi-Mod LV LPL.
 3. Simpson Strong-Tie, ETI-LV.
 4. Capping Adhesive: Product for use with crack-injection adhesive by same manufacturer.
 5. Approved equal.

2.07 HYDRO-ACTIVE: CRACK-INJECTION MATERIALS

- A. Manufacturers and Products:
 1. 3M Specified Construction Products Department, Scotch-Seal Chemical Grout 5610 (Gel), hydrophilic, urethane.
 2. BASF Chemical Company, Concrex 1230 IUG, hydrophobic polyurethane.
 3. de neef Construction Chemicals, Inc., Hydro Active Flex, hydrophobic polyurethane.
 4. Simpson Strong-Tie, Crack-Pac Flex H20.
 5. Approved equal.

2.08 COATING MATERIALS

- A. [Specifically designed for use in a waste water environment to protect concrete from H2S corrosion, submerged and/or above water surface. Refer to Section 09900.]
- B. [Two component, high molecular weight, methacrylate resin crack healer/penetrating sealer, non-vapor barrier, specifically designed for broadcast application.
 1. Sika corporation, Sika Pronto 19 TF.

2. Approved equal.]

2.09 [CONCRETE JOINT SEALANT

- A. Use a polyurethane sealant designed for submerged conditions.
- B. Manufacturers and Products:
 1. Sika Corporation, Sikaflex-1a or Sikaflex-2c
 2. Euclid Chemical Company, Tammsflex NS
 3. Approved equal.]

PART 3 EXECUTION

3.01 CONCRETE REPAIR

- A. Comply with manufacturers' written instructions for surface preparation, environmental conditions, product application, and product curing/protection requirements.
 1. Damaged or defective concrete includes surface defects, honeycomb, rock pockets, indentations greater than 3/16 inch, spalls, chips, air bubbles greater than 1/2 inch diameter, pinholes, bugholes, embedded debris, lift lines, sand lines, bleed lines, leakage from form joints, fins, projections, form popouts, texture irregularities, and stains or other color variation that cannot be removed by cleaning.

3.02 EXAMINATION

- A. Notify Engineer seven days in advance of date when mockup areas of deteriorated concrete and deteriorated reinforcing bars will be cleaned for inspection and initial pull-off tensile bond strength test.
 1. Use 15-pound chipping and/or bush hammers, abrasive blast, followed by pressure water blasting to remove debris, foreign material, and/or loose concrete from designated areas to be inspected and repaired. Verify depth of surface removal by sounding and pH testing.
 2. Follow surface preparation by vacuum and low-pressure water blasting to remove loose debris, foreign material, and/or concrete dust from areas to be inspected and repaired.
 3. Upon completion of surface cleaning, Engineer and Contractor shall observe surfaces and test results.
- B. Perform visual surveys of the existing structure as Work progresses to detect hazards resulting from concrete repair Work. Notify Engineer of damage prior to making repairs.

3.03 PREPARATION

- A. Ensure that supervisory personnel are on-site when concrete repair work begins and during its progress.
- B. Protect persons, motor vehicles, surrounding surfaces of structure being repaired, and surrounding buildings and facilities from harm resulting from concrete repair Work.

1. Comply with each product manufacturer's written instructions for protections and precautions. Protect against adverse effects of products and procedures on people and adjacent materials, components, and vegetation.
 2. Use only proven protection methods appropriate to each area and surface being protected.
 3. Provide temporary barricades, barriers, and directional signage to exclude people from areas where concrete repair Work is being performed.
 4. Contain dust and debris generated by concrete repair Work in accordance with OSHA standards and prevent dust and debris from reaching public or adjacent surfaces.
 5. Protect slabs and other surfaces along haul routes from damage, wear, and staining.
 6. Protect adjacent surfaces and equipment by covering them with heavy polyethylene film and waterproof masking tape. If practical, remove items, store, and reinstall after potentially damaging operations are complete.
 7. Neutralize and collect alkaline and acid wastes for legal disposal off property.
 8. Dispose of debris and runoff from operations by legal means and in a manner that prevents soil erosion, undermining of paving and foundations, damage to landscaping, and water penetration into building interiors.
- C. Prevent solids such as aggregate or cementitious material from migrating from the work area. Clean deposited sand or other materials resulting from concrete repair Work prior to reintroducing flow.
- D. Preparation for Concrete Removal: Examine areas to be repaired to determine best methods to safely and effectively perform concrete repair Work. Examine adjacent areas to determine what protective measures will be necessary. Make explorations, probes, and inquiries as necessary to determine condition of construction to be removed.
1. Verify that affected utilities have been disconnected and capped.
 2. Inventory and record conditions of items to be removed for reinstallation or salvage.
- E. Reinforcing-Bar Preparation: Remove rust from exposed reinforcing bars by abrasive blast cleaning in accordance with SSPC SP-6.
1. Where section loss of reinforcing bar is more than 25 percent, or 20 percent in two or more adjacent bars, splice in new reinforcing bars and/or notify Engineer to determine appropriate repair method.
- F. Surface Preparation for Concrete Surfaces:
1. Remove delaminated and deteriorated concrete surface material by chipping, bush hammer, and/or pressure water blasting.
 2. Sweep and vacuum roughened surface to remove debris.
 3. Roughen surface of concrete to a minimum ¼-inch amplitude.
 4. Provide final cleaning of concrete to remove dirt, oils, films, and other materials detrimental to patching mortar.

3.04 EXTENT OF CONCRETE REMOVAL

- A. Do not overload structural elements with debris.

- B. Provide 1/4-inch deep saw cut at perimeter of repair areas resulting in a defined repair area with a neat, rectangular, area.
- C. Remove deteriorated and delaminated concrete by breaking up and dislodging from reinforcement.
- D. Remove additional concrete where necessary to provide a depth of removal of at least 1/4 inch over entire defined repair area.
- E. Where half or more of the perimeter of reinforcing bar is exposed, bond between reinforcing bar and surrounding concrete is broken, or reinforcing bar is corroded, remove concrete from entire perimeter of bar and to provide at least 3/4-inch clearance around bar.
- F. Test areas where concrete has been removed by tapping with hammer; remove additional concrete until unsound and dis-bonded concrete is completely removed. Provide a pH test of concrete surface to assure enough deteriorated concrete is removed to obtain a pH neutral surface.
- G. Acceptable surface preparation must produce a concrete surface with a minimum pH of 9.0 to be confirmed by surface pH testing. If after surface preparation, the surface pH remains below 9.0, perform additional water blasting, cleaning, or abrasive blast cleaning until additional pH testing indicates an acceptable pH level.
- H. Clean removal areas of loose concrete, dust, and debris.
- I. Notify Engineer for observation of surface following cleaning and surface preparation in advance of surface mortar application. Allow at least 48 hours for observation by Engineer and/or inspection by Owner's testing agency for soundness testing, pull-off tensile bond strength testing, and pH testing.
- J. Where required by Contract Documents, coordinate with Engineer and Owner's testing agency to provide up to six (6) smooth test areas for pull-off testing. Test areas are prepared by grinding smooth. The first test area shall be provided at the mockup area with the remaining five (5) areas to be selected after remaining surface preparation is completed.

3.05 REINFORCING PROTECTION APPLICATION

- A. Where reinforcing bar is less than 1/2 exposed and there are no signs of corrosive products, do not apply anti-corrosion inhibitor.
- B. Where reinforcing bar is 1/2 or more exposed or there are signs of corrosive products, remove concrete clear all around as specified above. Apply anti-corrosion inhibitor to the entire bar circumference.
- C. Application of anti-corrosion inhibitor shall be made to reinforcing bars by stiff brush and according to manufacturer's instructions. Use care not to spill over or coat concrete and partially exposed reinforcing bar surfaces.

- D. Apply anti-corrosion inhibitor to reinforcing bars in two coats. Allow first coat to dry two to three hours before applying second coat. Allow second coat to completely dry before placing repair mortar.

3.06 REINFORCING REPAIR

- A. After preparation and prior to application of anti-corrosion inhibitor (where applicable), inspect existing reinforcing bars for deterioration. Notify Engineer where section loss of reinforcing bar is more than 25 percent, or 20 percent in two or more adjacent bars.
- B. As directed by Engineer, add supplemental and/or replacement reinforcing.
 - 1. Install new reinforcing by tying to existing remaining reinforcing.
 - 2. Provide final touchup protection by re-application of anti-corrosion inhibitor to reinforcing surfaces, scratches, damaged areas, etc.

3.07 SURFACE MORTAR APPLICATION

- A. Apply mortar according to manufacturer's written instructions.
- B. For hand troweled or spray applied applications, work material firmly into the sides and bottom of repair area. Apply a scrub coat prior to full depth application. Build up prepared areas in multiple lifts as required by product manufacturer limitations.
- C. For hand troweled or spray applied applications, follow manufacturer's recommendations for maximum lift thickness, additional surface preparation, and subsequent reapplication time.
- D. Finish surface to match existing adjacent concrete surfaces and/or as required per coating manufacture's recommendations.
- E. Moist cure mortar repair for a minimum of 5-days or in accordance with manufacturer's recommendations.
- F. Notify Engineer for observation after repair mortar has been applied at the initial mockup area and after the repair has cured. Notify Engineer again at intervals specified or as subsequent repair mortar is applied and cured. Once scheduled, allow at least 48 hours for observation by Engineer and/or inspection by Owner's testing agency for pull-off tensile bond strength testing.
- G. Coordinate with Engineer and Owner's testing lab to provide up to six (6) smooth test areas for pull-off testing at the completed mortar repair areas. Test areas shall be prepared by Contractor by grinding smooth. The first completed repair area shall be provided at the mockup area with the remaining five (5) areas to be selected after the mortar repair application is completed.
- H. Contractor to provide follow up repairs to pull-off test areas.

3.08 EPOXY CRACK INJECTION

- A. Expose identified cracks by lightly grinding along length of crack. Clean crack and adjacent areas with oil-free compressed air or low-pressure water to remove loose particles. Do not use acids or corrosives for cleaning. Notify Engineer for observation of

crack repair areas prior to epoxy crack injection. Allow at least 48 hours advance notice for observation by Engineer.

- B. Apply surface seal in accordance with Manufacturer's instructions to designated crack face prior to injection to prevent escape of injection epoxy.
- C. Place injection ports as recommended by epoxy manufacturer, spacing no farther apart than thickness of member being injected. Seal injection ports in place with capping adhesive. Seal entire crack length and allow to cure prior to injection.
- D. Injection Procedure: Store epoxy at minimum of 70 °F.
 - 1. Start injection into each crack at lowest elevation entry port.
 - 2. Continue injection at first port until adhesive begins to flow out of next higher port.
 - 3. Plug first port and start injection at second port until adhesive flows from next port.
 - 4. Inject entire crack with same sequence.
- E. Finishing Procedure:
 - 1. Cure epoxy adhesive after cracks have been filled to allow surface seal removal without draining or runback of epoxy material from cracks.
 - 2. Remove surface seal from cured injection adhesive.
 - 3. Indentations or protrusions caused by placement of entry ports shall be filled with surface mortar or ground smooth with the adjacent surface.
 - 4. Remove surface seal material and injection adhesive from concrete surfaces.

3.09 HYDRO-ACTIVE CRACK INJECTION

- A. For Cracks, Wet and/or Leaking – repair utilizing a low viscosity, hydrophobic, closed cell polyurethane foam injection system.
- B. Lightly grind crack surface as needed to remove efflorescence and to expose/open up face of the crack.
- C. Starting 6 inches away from crack, drill injection holes at 45 degrees to intersect crack at a minimum of 6 inches deep from the crack surface.
- D. Provide temporary entry ports in these drilled holes spaced 12 to 18 inches or as required to allow movement of fluid between ports. Provide temporary paste-over seal at concrete surface to prevent seepage of injected material.
- E. Inject water into crack to flush out crack and to remove dirt, dust, and contaminants. Inject urethane foam with accelerating catalyst as required after the water flush.
- F. Inject material into prepared ports under pressure using automated equipment that is appropriate for this application.
- G. Start injection at the lowest elevation entry port. Continue injection until repair material appears in adjacent entry port. Repeat this process and continue from port to port until entire crack is filled.

- H. Remove surface paste-over seal and excess adhesive by grinding or other approved method.

3.10 CONCRETE JOINTS (CONSTRUCTION AND EXPANSION)

- A. Remove old sealant by mechanical means. Do not use solvents.
- B. Abrasive blast to clean previously sealed concrete joint surfaces.
- C. Install backer rod or tape to control sealant depth as recommended by manufacturer.
- D. Apply sealant, tool, and cure as recommended by manufacturer.

3.11 COATING

- A. Verify substrate has cured and dried out according to coating manufacturer's requirements for surface preparation.
- B. Verify that all Work in the area to be coated has been completed and installed such that no additional penetrations or holes will be drilled through the final coating, include support framing, gate frames, pipe penetrations, etc.
- C. Apply filler/surfacer, abrasive blast, and clean surface prior to coating application according to Section 09 90 00.
- D. Cracks and adjacent substrate to be sealed must be clean, sound, and free of surface moisture or frost. Remove laitance, curing compounds, and other bond inhibiting materials by abrasive blasting. Prior to application, blow cracks out with oil-free compressed air.
- E. At larger cracks where underside of slab is accessible, seal cracks with an epoxy resin adhesive paste to act as a dam to hold liquid methacrylate until cured, to minimize excessive dripping and loss of product.
- F. Mix and apply liquid methacrylate resin according to manufacturer's instructions. Pour mixed methacrylate resin onto substrate and allow to pond over cracks until cracks are sealed. Spread material out over substrate, before it starts to set, using squeegees and/or rollers.
- G. Continue to apply material until cracks and surface is sealed. The surface should be wet looking with no visible surface film.
- H. After at least 20 minutes, cover the treated area with a broadcast of dry 8/20 sand at a rate of 15 to 20 pounds per 100 square feet. Remove loose sand after drying (at least 4 hours).

3.12 FIELD QUALITY CONTROL

- A. Manufacturers Field Service: Engage manufacturers' factory-authorized service representatives to provide Project-site training and inspections to observe progress and quality of Work.

- B. Manufacturer's factory-authorized services representatives should also be available for consultation and to provide on-site assistance when requested by Contractor and/or Engineer.
- C. Provide manufacturer's test and inspection reports to Engineer for record.
- D. Coordinate with Engineer and Owner's testing agency for spot verification of substrate soundness, surface pH, and pull-off testing.

END OF SECTION

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SECTION 03 20 00
CONCRETE REINFORCING

PART 1 GENERAL

1.01 DESCRIPTION

- A. Section includes: Reinforcing steel for use in reinforced concrete.

1.02 REFERENCES:

- A. The references listed below are a part of this section. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
ACI 117	Specification for Tolerances for Concrete Construction and Materials
ACI 315	Details and Detailing of Concrete Reinforcement
ACI 318	Building Code Requirements For Structural Concrete
ACI SP-66	ACI Detailing Manual
ASTM A615	Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A706	Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A775	Epoxy-Coated Steel Reinforcing Bars
ASTM A884	Epoxy-Coated Steel Wire and Welded Wire Reinforcement
ASTM A1064	Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
AWS D1.4	Structural Welding Code - Reinforcing Steel
CRSI-PRB	Placing Reinforcing Bars
CRSI-MSP	Manual of Standard Practice
FEDSPEC QQ-W-461H	Wire, Steel, Carbon (Round, Bare, and Coated)

1.03 SUBMITTALS

- A. Action Submittals
1. Procedures: Section 01 33 00.
 2. A copy of this specification section with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.
 3. Check-marks (✓) shall denote full compliance with a paragraph as a whole. Deviations shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Include a detailed, written justification for each deviation. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
 4. Mill certificates of mill analysis, tensile, and bend tests for all reinforcing.

5. Manufacturer and type of proprietary reinforcing steel splices. Submit a current ICC Report and manufacturer's literature that contains instructions and recommendations for each type of coupler used.
6. Qualifications of welding operators, welding processes and procedures.
7. Reinforcing steel shop drawings showing reinforcing steel bar quantities, sizes, spacing, dimensions, configurations, locations, mark numbers, lap splice lengths and locations, concrete cover and reinforcing steel supports. Reinforcing steel shop drawings shall be of sufficient detail to permit installation of reinforcing steel without reference to the contract drawings. Shop drawings shall not be prepared by reproducing the plans and details indicated on the contract drawings but shall consist of completely redrawn plans and details as necessary to indicate complete fabrication and installation of reinforcing steel, including large scale drawings at joints detailing bar placement in congested areas. Placement drawings shall be in accordance with ACI 315. Reinforcing details shall be in accordance with ACI SP-66.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Ship reinforcing steel to the jobsite with attached plastic or metal tags having permanent mark numbers which match the shop drawing mark numbers. All reinforcing shall be supported and stored above ground. Use only plastic tags secured to the reinforcing steel bars with nylon or plastic tags for epoxy coated reinforcing steel bars.

PART 2 PRODUCTS

2.01 BAR REINFORCEMENT

- A. Reinforcing steel bars shall be deformed billet steel in conformance with ASTM A615, Grade 60. Bars to be welded shall be deformed billet steel conforming to ASTM A706. Where specified, reinforcing steel shall be epoxy-coated in conformance with ASTM A775.

2.02 WIRE FABRIC

- A. Wire fabric shall be welded steel mesh conforming to ASTM A1064.

2.03 WIRE AND PLAIN BARS

- A. Wire used as reinforcement and bars used as spiral reinforcement in structures shall be cold drawn steel conforming to ASTM A1064.

2.04 SMOOTH DOWEL BARS

- A. Smooth dowel bars shall conform to ASTM A615, Grade 60, with a metal end cap at the greased or sliding end to allow longitudinal movement.

2.05 EPOXY COATED BARS

- A. Epoxy coated bars shall conform to ASTM A775 and ASTM A884.

2.06 EPOXY COATED REINFORCING STEEL BAR PATCHING MATERIAL

- A. Epoxy coated reinforcing steel bar patching material shall be compatible with coating material, inert in concrete, obtained from manufacturer of the epoxy resin used to coat the reinforcing steel bars and meet the requirements of ASTM A775.

2.07 REINFORCING STEEL MECHANICAL SPLICES

- A. Reinforcing steel mechanical splices shall be a positive connecting threaded type mechanical splice system manufactured by Erico, Inc., Dayton Superior, Williams Form Engineering Company, or approved equal.
- B. Type 1 mechanical splices shall develop in tension or compression a strength of not less than 125 percent of the ASTM specified minimum yield strength of the reinforcement and shall meet all other ACI 318 requirements. Where splices at the face of wall are shown or approved, form saver-type mechanical couplers may be used. Form-saver couplers shall have integral plates designed to positively connect coupler to formwork. Type 1 mechanical splices are typical except for locations noted below where Type 2 mechanical splices are required.
- C. Type 2 mechanical splices shall meet the requirements for a Type 1 mechanical splice, plus develop the ASTM specified tensile strength of the reinforcement. Type 2 mechanical splices shall be provided at locations specifically noted on the design drawings.

2.08 TIE WIRE

- A. The wire shall be minimum 16 gage annealed steel conforming to FEDSPEC QQ-W-461H.

2.09 BAR SUPPORTS

- A. Bar supports coming into contact with forms shall be CRSI Class 1 plastic protected or Class 2 stainless steel protected and shall be located in accordance with CRSI-MSP and placed in accordance with CRSI-PRB. Plastic coating on legs shall extend at least 0.5-inch upward from form surface.
- B. Provide precast concrete blocks, four inches square in plan, with embedded tie wires (wire dobies) as specified by CRSI 1 MSP for footing and slabs on grade. Do not use brick, broken concrete masonry units, spalls, rocks, construction debris, or similar material for supporting reinforcing steel. Precast concrete blocks shall have same or higher compressive strength as specified for concrete in which they are located.
- C. Provide stainless steel or plastic protected plain steel supports for other work.

2.10 FABRICATION:

- A. Fabricate reinforcing steel bars in accordance with ACI 315 and the following tolerances:
 - 1. Sheared lengths: +/-1 inch.
 - 2. Overall dimensions of stirrups, ties, and spirals: +/-1/2 inch.
 - 3. All other bends: +0 inch, -1/2 inch
 - 4. Minimum diameter of bends of reinforcing steel bars: Per ACI 318.

PART 3 EXECUTION

3.01 PLACEMENT TOLERANCE

- A. Reinforcing steel placement tolerance shall conform to the requirements of ACI 117, ACI 318, and the following:
 - 1. Reinforcing steel bar clear distance to formed surfaces shall be within $\pm 1/4$ inch of specified clearance and minimum spacing between bars shall be a maximum of $1/4$ inch less than specified.
 - 2. Reinforcing steel top bars in slabs and beams shall be placed $\pm 1/4$ inch of specified depth in members 8 inches deep or less and $-1/4"$, $+1/2$ inch of specified depth in members greater than 8 inches deep.
 - 3. Reinforcing steel spacing shall be placed within \pm one bar diameter or ± 1 inch, whichever is greater.
 - 4. The minimum clear distance between reinforcing steel bars shall be equal to the greater of 1 inch or the reinforcing steel bar diameter for beams, walls and slabs, and the greater of $1 1/2$ inches or 1.5 times the reinforcing steel bar diameter for columns.
 - 5. Beam and slab reinforcing steel bars shall be threaded through column vertical reinforcing steel bars without displacing the column reinforcing steel bars and still maintain clear distances for beam and slab reinforcing steel bars.

3.02 CONCRETE COVER

- A. Unless specified otherwise on the Drawings, reinforcing steel bar cover shall conform to the following:
 - 1. Reinforcing steel bar cover shall be 3 inches for concrete cast against earth.
 - 2. Reinforcing steel bar cover shall be 2 inches for reinforcing steel bars for formed concrete surfaces exposed to earth and weather.
 - 3. Reinforcing steel bar cover shall be 2 inches for any formed surfaces exposed to or above any liquid.
 - 4. Reinforcing steel bar cover shall be $1 1/2$ inches for reinforcing not in the above categories unless noted otherwise on the design drawings.

3.03 SPLICING

- A. Reinforcing steel splicing shall conform to the following:
 - 1. Use Class B splice lengths in accordance with ACI 318 for all reinforcing steel bars unless shown otherwise on the drawings.
 - 2. Unless noted otherwise on the Drawings, splices in circumferential reinforcement in circular walls shall be Class B tension splices and shall be staggered. Adjacent hoop reinforcement splices shall be staggered horizontally by not less than one lap length (center of lap below to center of lap above) or 3 feet, whichever is greater, and shall not coincide in vertical arrays more frequently than every third bar.
 - 3. Splicing of reinforcing elements noted as "tension tie" members on the Drawings shall be avoided whenever possible. If splices cannot be avoided, the splices shall be made with full mechanical or full welded splice capable of developing at least 125 percent of the specified yield strength of the bar. Splices in adjacent bars shall be staggered at least 30 inches.

4. For welded wire fabric the splice lap length measured between the outermost cross wires of each fabric sheet shall not be less than one spacing of cross wires plus 2 inches, nor less than 1.5 times the development length nor less than 6 inches.
5. Splices of reinforcement steel bars not specifically indicated or specified shall be subject to the approval of the Owner's Representative. Mechanical proprietary splice connections may be used when approved by the Owner's Representative or as indicated on the drawings.
6. Welding of reinforcing steel bars is not allowed unless approved by the Owner's Representative.

3.04 CLEANING

- A. Reinforcing steel bars at time of concrete placement shall be free of mud, oil, loose rust, or other materials that may affect or reduce bond. Reinforcing steel bars with rust, mill scale or a combination of both may be accepted without cleaning or brushing provided dimensions and weights including heights of deformation on a cleaned sample are not less than required by applicable ASTM standards.

3.05 PLACEMENT

- A. Reinforcing steel bar placement shall conform to the following:
 1. Uncoated reinforcing steel bars shall be supported and fastened together to prevent displacement by construction loads or concrete placement. For concrete placed on ground, furnish concrete block supports or metal bar supports with non-metallic bottom plates. For concrete placed against forms furnish plastic or plastic coated metal chairs, runners, bolsters, spacers and hangers for the reinforcing steel bar support. Only tips in contact with the forms require a plastic coating.
 2. Fasten coated reinforcing steel bars together to prevent displacement. Use plastic or nylon ties to hold the coated reinforcing steel bars rigidly in place. Support coated reinforcing steel bars with plastic or plastic coated chairs, runners, bolsters, spacers and supports as required.
 3. Support reinforcing steel bars over cardboard void forms by means of concrete supports which will not puncture or damage the void forms nor impair the strength of the concrete member.
 4. Where parallel horizontal reinforcement in beams is indicated to be placed in two or more layers, reinforcing steel bars in the upper layers shall be placed directly over the reinforcing steel bars in the bottom layer with the clear distance between each layer to be 2 inches unless otherwise noted on the Drawings. Place spacer reinforcing steel bars at a maximum of 3'-0" on center to maintain the minimum clear spacing between layers.
 5. Extend reinforcement to within 2 inches of formed edges and 3 inches of the concrete perimeter when concrete is placed against earth.
 6. Reinforcing steel bars shall not be bent after embedding in hardened concrete unless approved by the Owner's Representative.
 7. Tack welding or bending reinforcing steel bars by means of heat is prohibited.
 8. Where required by the contract documents, reinforcing steel bars shall be embedded into the hardened concrete utilizing an adhesive anchoring system specifically manufactured for that application. Installation shall be per the manufacturer's written instructions.

9. Bars with kinks or with bends not shown shall not be used.
10. Heating or welding bars shall be performed in accordance with AWS D1.4 and shall only be permitted where specified or approved by the Owner's Representative. Bars shall not be welded at the bend.

3.06 REPAIR OF EPOXY COATING

- A. Epoxy coating damage need not be repaired in cases where the damaged area is 0.1 square inch or smaller. Repair all damaged areas larger than 0.1 square inch in conformance with ASTM A775.

3.07 FIELD QUALITY CONTROL

- A. Field quality control shall include the following:
 1. Notify the Owner's Representative whenever the specified clearances between the reinforcing steel bars cannot be met. The concrete shall not be placed until the Contractor submits a solution to the congestion problem and it has been approved by the Owner's Representative.
 2. The reinforcing steel bars may be moved as necessary to avoid other reinforcing steel bars, conduits or other embedded items provided the tolerance does not exceed that specified in this section. The Engineer's approval of the modified reinforcing steel arrangement is required where the specified tolerance is exceeded. No cutting of the reinforcing steel bars shall be done without written approval of the Owner's Representative.
 3. Coated reinforcing steel bars will be inspected on the jobsite for handling defects, coating abrasion, coating thickness and continuity of coating. The Owner's Representative may defer final inspection of the coated reinforcing steel bars until bar erection and handling is complete. Repair coated areas as directed by the Owner's Representative and completed prior to concrete placement.
 4. An independent laboratory shall be employed to review and approve Contractor welding procedures and qualify welders in accordance with AWS D1.4. The laboratory shall visually inspect each weld for visible defects and conduct non-destructive field testing (radiographic or magnetic particle) on not less than one sample for each 10 welds. If a defective weld is found, the previous 5 welds by the same welder shall also be tested.

END OF SECTION

SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Cast-in-place concrete, which consists of providing material, mixing, transporting equipment, and labor for the proportioning, mixing, transporting, placing, consolidating, finishing, curing, and protection of concrete in the structure.

1.02 RELATED SECTIONS

- A. This section contains specific references to the following related specification sections. Additional related sections may apply that are not specifically listed below.
1. Section 03 01 00 Concrete Repair
 2. Section 03 60 00 Grouting
 3. Section 05 50 00 Metal Fabrications
 4. Section 07 91 26 Joint Fillers
 5. Section 09 90 00 Painting and Coating

1.03 REFERENCES:

- A. The references listed below are a part of this section. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
ACI 117	Specification for Tolerances for Concrete Construction and Materials
ACI 211.1	Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete
ACI 214R	Guide to Evaluation of Strength Test Results in Concrete
ACI 301	Specifications for Structural Concrete
ACI 305.1	Specification for Hot Weather Concreting
ACI 306.1	Standard Specification for Cold Weather Concreting
ACI 318	Building Code Requirements for Structural Concrete
ACI 350	Code Requirements for Environmental Engineering Concrete Structures
ACI 350.1	Specification for Tightness Testing of Environmental Engineering Concrete Containment Structures
ACI 503.7	Specification for Crack Repair by Epoxy Injection
ASTM A126	Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM C31	Making and Curing Concrete Test Specimens in the Field
ASTM C33	Concrete Aggregates
ASTM C39	Compressive Strength of Cylindrical Concrete Specimens
ASTM C42	Obtaining and Testing Drilled Cores and Sawed Beams of Concrete

Reference	Title
ASTM C94	Ready-Mixed Concrete
ASTM C117	Materials Finer Than 75- μ m (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C131	Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C136	Sieve Analysis of Fine and Coarse Aggregates
ASTM C143	Slump of Hydraulic Cement Concrete
ASTM C150	Portland Cement
ASTM C157	Length Change of Hardened Hydraulic-Cement Mortar and Concrete
ASTM C172	Sampling Freshly Mixed Concrete
ASTM C192	Making and Curing Concrete Test Specimens in the Laboratory
ASTM C231	Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C260	Air-Entraining Admixtures for Concrete
ASTM C309	Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C494	Chemical Admixtures for Concrete
ASTM C511	Mixing Rooms, Moist Cabinets, Moist Rooms, and Water Storage Tanks Used in the Testing of Hydraulic Cements and Concretes
ASTM C595	Blended Hydraulic Cements
ASTM C618	Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C881	Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C989	Slag Cement for use in Concrete and Mortars
ASTM C1059	Latex Agents for Bonding Fresh to Hardened Concrete
ASTM C1077	Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation
ASTM C1240	Silica Fume Used in Cementitious Mixtures
ASTM C1260	Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
ASTM C1293	Determination of Length Change of Concrete Due to Alkali-Silica Reaction
ASTM C1315	Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete
ASTM C1567	Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)
ASTM C1602	Mixing Water Used in the Production of Hydraulic Cement Concrete
ASTM D75	Sampling Aggregates
ASTM D2419	Sand Equivalent Value of Soils and Fine Aggregate
ASTM E329	Agencies Engaged in Construction Inspection, Testing, or Special Inspection
CRD-C572	U.S. Corps of Engineer's Specifications for Polyvinylchloride Waterstop
IBC	International Building Code with local amendments

1.04 SUBMITTALS

A. Action Submittals:

1. Procedures: Section 01 33 00.
2. A copy of this specification section with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.
3. Check-marks (✓) denote full compliance with a paragraph as a whole. Deviations shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined signify

compliance with the specification. Include a detailed, written justification for each deviation. Failure to include a copy of this marked-up specification section, along with justification(s) for requested deviations, with the submittal, is cause for rejection of the entire submittal with no further consideration.

4. Each proposed mix design showing:
 - a. Expected strength at 7 and 28-days
 - b. Slump, before and after introduction of high-range water-reducing admixture
 - c. Water/cement ratio
 - d. Weights and test results, certifications, and mill reports of the ingredients
 - e. Chemical analysis report and report of other specified test analyses for supplementary cementitious material
 - f. Aggregate gradation and documentation of test results classifying aggregate as non-potentially reactive
 - g. Test results of mix design prepared by an independent testing laboratory
 - h. Shrinkage test results for liquid containing structures
 - i. Other physical properties necessary to review each mix design for conformance with these specifications
5. Mix designs proposed shall be sealed by a Professional Engineer registered in the state where the project is located.
6. Product literature and technical data for aggregates, cement, and pozzolan.
7. Product literature, technical data, and dosage of proposed admixtures including, but not limited to, air entraining, water reducing, retarding, shrinkage reducing, crystalline waterproofing, etc.
8. Anticipated average delivery time from batch plant to site. If this time exceeds the limit specified in Part 3, include proposed method to extend set time without deleterious effects on final product. Owner's Representative reserves the right to accept or reject such proposed methods.
9. Lift Drawings: Submit shop drawings for concrete placements on the project before on-site construction begins. The drawings shall be organized by structure and submitted as a complete set for the Engineer's review. The drawings shall be drawn to scale and show dimensions, forming details, and placement volumes. Show location of construction joints, details of surface preparation, scheduled finish, embedments (including conduits, inserts, and anchor bolts), penetrations (including pipe sleeves), openings, keyways, blockouts, bulkheads, etc. The drawings shall clearly show the placement sequence and will be accompanied by a schedule that shows the schedule dates for forming, placement, and stripping for each section of concrete placed within each structure.
10. Curing program description in sufficient detail to demonstrate that the Contractor will provide acceptable strength, finish, and crack control within the completed structure. Detailed plan for curing and protection of concrete in cold and hot weather.
11. Product literature and technical data for waterstops, curing and sealing compounds, bonding compounds, epoxy and chemical grout for crack injection, retardant, bearing pads.
12. Sample panels at least 12-inches by 12-inches by three inches thick to demonstrate formed wall surface finishes as specified in Part 3.

13. Samples of concrete floor and slab for each finish specified in Part 3 approximately four feet square and a minimum of four inches thick, with one construction joint and one expansion joint, if used.
14. Concrete delivery truck tickets showing the information listed in ASTM C94, section 14.
15. Neoprene bearing pad sample, 4 inches x 4 inches; material data sheets verifying conformance with specification; shop drawing of each bearing pad showing splice locations, if any, and description of manufacturing and splice procedure.

1.05 QUALITY ASSURANCE

A. Quality Control By Owner:

1. Special Inspection of concrete work shall be performed by the Special Inspector under contract with the Owner and in conformance with the IBC Chapter 17. Special Inspection of concrete is in addition to, not replacing, other inspections and quality control requirements specified herein. Where sampling and testing specified herein conforms to Special Inspection standards, such sampling and testing need not be duplicated.
2. All structural concrete work shall receive Special Inspection in accordance with IBC Chapter 17. Structural concrete includes elements which resist code-defined loads and whose failure would impact life safety. Non-structural site work concrete does not require Special Inspection. Anchor bolts and anchors installed in hardened concrete require Special Inspection.
3. Refer to Section 01 45 23 Testing and Inspection Services for Owner provided testing.

B. Quality Control By Contractor:

1. Where required to demonstrate conformance with the specified requirements for cast-in-place concrete, the Contractor shall provide the services of an independent testing laboratory which complies with the requirements of ASTM E329 and ASTM C1077. The testing laboratory shall sample and test concrete materials as specified in this section. Costs of testing laboratory services shall be borne by the Contractor.
2. Concrete testing laboratory personnel shall be certified in accordance with the ACI Concrete Laboratory Testing Technician – Level 1 Certification Program or the ACI Concrete Strength Testing Technician Certification Program, or an equivalent program.
3. Refer to Section 01 45 00 Contractor Quality Control.

C. Basis For Quality:

1. Cast-in-place concrete shall conform to the requirements of ACI 301, except as modified herein.

PART 2 PRODUCTS

2.01 MATERIALS

A. Cement:

1. Portland cement shall be ASTM C150, Type II or Type V, low alkali, containing less than 0.60 percent alkalis. In addition to standard requirements, cement shall satisfy

optional chemical and physical requirements of ASTM C150, Tables 2 and 4, respectively.

2. If low alkali portland cement is not available, test results shall be submitted showing aggregates meet the alkali-silica reactivity criteria in 2.01.D.1.b below.
 3. Portland-pozzolan cement shall be ASTM C595, Type IP (MS), interground, low alkali.
 4. Portland blast-furnace slag cement shall be ASTM C595, Type IS (<70) (MS), interground, low alkali.
 5. Hydraulic cements meeting the performance specifications of ASTM C1157 are not permitted.
 6. Use cementitious materials that are of the same brand and type and from the same plant of manufacture as the cementitious materials used in the concrete represented by the submitted field test records or used in the trial mixtures. See Change of Materials paragraph below.
- B. Ground granulated blast-furnace slag (GGBFS), if used in conjunction with portland cement, shall be per ASTM C989, Grade 100 or Grade 120, limited to 50 percent of the weight of cementitious materials. If GGBFS is combined with pozzolans and/or silica fume, the total weight of GGBFS, pozzolans, and silica fume shall not exceed 50 percent of the weight of cementitious materials.
- C. Silica fume, if used in conjunction with portland cement, shall be per ASTM C1240, limited to 10 percent of the weight of cementitious materials. Silica fume shall be used with a high-range water-reducing admixture.
- D. Aggregates:
1. General:
 - a. Except as modified herein, fine and coarse aggregates shall conform to ASTM C33. Fine and coarse aggregates are regarded as separate ingredients. Aggregates shall be non-reactive and washed before use.
 - b. Check aggregates for alkali-silica reactivity to meet the following criteria. Aggregates or combinations of cementitious materials and aggregates shall have less than 0.10% expansion at 16 days when tested in accordance with ASTM C1260 or ASTM C1567. Alternatively, aggregate tested independently in accordance with ASTM C1293 shall have less than 0.04% expansion at one-year, or combinations of aggregate and cementitious materials tested in accordance with ASTM C1293 shall have less than 0.04% expansion at two years. Test results shall be no older than two years.
 - c. Tests for size and grading of fine and coarse aggregates shall be in accordance with ASTM C136. Combined aggregates shall be well and uniformly graded from coarse to fine sizes to produce a concrete that has optimum workability and consolidation characteristics. Establish the final combined aggregate gradation during mix design.
 - d. Aggregates used in the project production concrete shall be obtained from the same sources and have the same size ranges as the aggregates used in the concrete represented by the submitted historical data or trial mixtures. See Change of Materials paragraph below.
 2. Fine Aggregate:
 - a. Fine aggregate shall be hard, dense, durable particles of either sand or crushed stone regularly graded from coarse to fine. Gradation shall conform to ASTM C33.

For classes of concrete which will be used in liquid retaining structures, fine aggregate shall not exceed 40 percent by weight of combined aggregate total, except for concrete with coarse aggregate of less than maximum size 1/2 inch.

- b. Variations from the specified gradations in individual tests will be acceptable if the average of three consecutive tests is within the specified limits and the variation is within the permissible variation listed below:

U.S. standard sieve size	Permissible variation in individual tests, percent
30 and coarser	2
50 and finer	0.5

- c. Other tests shall be in accordance with the following specifications:

Test	Test method	Requirements
Amount of material	ASTM C117	3 percent passing No. 200 sieve maximum by weight
Sand equivalent	ASTM D2419	Minimum 70 percent

3. Coarse Aggregate:

- a. Coarse aggregate shall be hard, dense and durable gravel or crushed rock free from injurious amounts of soft and friable particles, alkali, and organic matter. Other deleterious substances shall not exceed the limits listed in ASTM C33, Table 4 for Class Designation 4S. Gradation of each coarse aggregate size specified shall conform to ASTM C33, Table 3.
- b. Variations from the specified gradations will be acceptable in individual tests if the average of three consecutive tests is within the specified limits.

E. Pozzolan:

1. Pozzolan shall be Class F fly ash conforming to ASTM C618. Class C fly ash is not allowed. Pozzolan supplied during the life of the project shall have been formed at the same single source. See Change of Materials paragraph below.
2. The pozzolan color shall not substantially alter the resulting concrete from the normal gray color and appearance.
3. Use pozzolan materials that are of the same brand and type and from the same plant of manufacture as the materials used in the concrete represented by the submitted field test records or used in the trial mixtures.
4. The loss on ignition shall be a maximum of four percent.
5. The maximum percent of sulfur trioxide (SO₃) shall be 4.0

F. Admixtures:

1. General:
 - a. Admixtures shall be compatible with the concrete and with each other. Calcium chloride or admixtures containing calcium chloride are not acceptable. Use admixtures in accordance with the manufacturer's recommendations and add separately to the concrete mix. Water reducing retarders and admixtures shall reduce the water required by at least 11 percent for a given concrete consistency and shall comply with the water/cement ratio standards of ACI 211.1. Retarder dosage shall result in set time consistent with requirements specified in Part 3.
2. Water Reducing Admixtures:

- a. Conform to ASTM C494, Type A. Acceptable products include: BASF Corporation "MasterPozzolite Series"; Sika Chemical Corp. "Plastocrete 161"; Euclid Chemical Co. "Eucon WR 91"; or approved equal.
 3. Water Reducing and Retarding Admixtures:
 - a. Conform to ASTM C494, Type D. Acceptable products include: BASF Corporation "MasterSet R Series"; Sika Chemical Corp. "Plastiment"; Euclid Chemical Co. "Eucon Retarder 75"; or approved equal.
 4. High Range Water Reducing (Superplasticizing) Admixtures:
 - a. Conform to ASTM C494, Type F. Acceptable products include: BASF Corporation "MasterGlenium" Series; Sika Chemical Corp. "Viscocrete 2100" or "Viscocrete 2110" (Hot Weather) or "Viscocrete 6100" (Cold Weather); Euclid Chemical Co. "Eucon 37"; GCP Applied Technologies "ADVA 195"; or approved equal.
 5. High Range Water Reducing And Retarding Admixtures:
 - a. Conform to ASTM C494, Type G. Acceptable products include: GCP Applied Technologies "Daracem 100"; Sika Chemical Corp. "Sikaplast 200"; Euclid Chemical Co. "Eucon 537"; or approved equal.
 6. Air Entraining Agent:
 - a. Conform to ASTM C260 and produce air entrained concrete as specified in the Mix Proportioning table below. Acceptable products include: BASF Corporation "MasterAir Series"; Sika Chemical Corp. "Sika AEA-14" or "Sika AIR"; Euclid Chemical Co. "Eucon AEA-92"; or approved equal.
 7. Shrinkage Reducing Admixture:
 - a. Select admixture for compatibility with air entrainment admixture and other ingredients in the concrete mix. Acceptable products include: BASF Corporation "MasterLife SRA Series"; GCP Applied Technologies "Eclipse 4500"; or approved equal.
 8. Crystalline Waterproofing Admixture:
 - a. Select admixture for compatibility with other ingredients in the concrete mix. Acceptable products include: Penetron International "PENETRON ADMIX SB", Xypex "Admix C-Series", Kryton "Krystol Internal Membrane (KIM)", BASF Corporation "MasterLife 300D", or approved equal.
- G. Water:
1. For washing aggregate, mixing, and for curing shall be free from oil and deleterious amounts of acids, alkalis, and organic materials; comply with the requirements of ASTM C1602. Additionally, water used for curing shall not contain an amount of impurities sufficient to discolor the concrete.
- H. Change of Materials:
1. After each concrete mix design is approved, no changes of any sort or source will be allowed without prior written approval from the Engineer. When brand, type, size, or source of cementitious materials, aggregates, water, ice, or admixtures are proposed to be changed, new field data, data from new trial mixtures, or evidence that indicates that the change will not affect adversely the relevant properties of the concrete shall be submitted for approval by the Engineer before use in concrete.

2.02 CONCRETE CHARACTERISTICS

A. Mix Proportioning:

1. Concrete shall be normal weight concrete composed of cement, pozzolan, admixtures, aggregates, and water; proportioned and mixed to produce a workable, strong, dense, and impermeable concrete. It is acceptable to substitute interground Portland-pozzolan cement conforming to ASTM C595, containing the specified amount of pozzolan in lieu of Portland cement and pozzolan. Water-cementitious material (w/cm) ratio is based on the combined contents of cement and pozzolan.
2. Add crystalline waterproofing admixture to Class C-1 concrete used for liquid containing structures and below-grade walls and slabs which are common with rooms, tunnels, and galleries to be occupied by equipment, piping, conduit, or personnel. Dosage rates in accordance with manufacturer's recommendations.
3. Add corrosion inhibiting admixture to Class A, C-1, and C-2 mixes.
4. Provide concrete mix designs in accordance with the following guidelines:

Concrete class	Minimum ^a 28-day compressive strength, psi	ASTM coarse aggregate size	Maximum water- cementitious materials (w/cm) ratio	Minimum cementitious materials content (pounds/CY)	Pozzolan, percent by weight of cementitious materials	Air content (percent)	Slump range ^f (inches)
B	3000	57 or 67	0.45	560	15-25 ^d	4-6	3-5
C-1	4500	57 or 67	0.40	560	15-25	4-6	3-5
C-2	5000	57 or 67	0.42	560	15-25 ^d	4-6	3-5
D-1	4000	8	0.42	600	15-25 ^d	4-6	3-5
D-2	4500	8	0.40	600	15-25	4-6	3-5
E ^c	2000	57	--	-	15-25 ^d	Not Required	4-8
F	500 ^e	-	--		15-25 ^d	Not Required	4-8

^a Determine compressive strength at the end of 28 days based on test cylinders made and tested in accordance with ASTM C39.

^b Compressive strength of Class A concrete may be determined at 56 days.

^c Concrete encasement for electrical conduit shall contain 3 pounds of red oxide per sack of cement.

^d Pozzolan use is optional for this class of concrete.

^e Minimum 28-day compressive strength shall be 500 psi and maximum 28-day compressive strength shall be 1,000 psi.

^f Slump before addition of high range water reducing admixture (superplasticizer). Maximum slump after addition of high range water reducing admixture shall be 8".

B. Use:

1. Provide concrete by class for the uses listed below.

Concrete class	Type of use
B	Non-structural concrete (sidewalks, curbs, pavers, etc.), electrical conduit encasement (duct banks).
C-1	Typical cast-in-place structural concrete
C-2	Precast concrete

D-1	Topping concrete (Precast Concrete Topping), flume interstitial "grout", and 2" concrete topping at clarifiers
D-2	Wall starter course
E ^a	Pipe bedding and encasement and concrete fill
F	Encasement of reinforcement extension for future construction

^a Contractor's option to use the same concrete mix for pipe encasement as the concrete slab above.

C. Control Tests:

1. General:

- a. Select and adjust proportions of ingredients in accordance with ACI 211.1. Verification of mix characteristics for submittal may be achieved using either the Trial Mix Design method or Field Experience Data method. Do not place concrete prior to submittal and acceptance of proposed mix.

2. Trial Mix Design:

- a. Mixes verified by this method shall have the samples produced for testing, manufactured at the batch plant which will supply concrete to the project, using materials proposed for the Work and material combinations listed above. Testing, data, and reporting shall conform to ACI 318 and the following:
 - 1) Required compressive strength used as the basis for selecting concrete proportions (f'_{cr}) shall be the specified concrete strength (f'_c) + 1000 psi for specified concrete strengths less than 3,000 psi and f'_c + 1200 psi for specified concrete strengths between 3000 psi and 5000 psi.
 - 2) Make at least three different trial mixtures for each class of concrete qualified by the Trial Mix Design. Each trial mixture shall have a different w/cm ratio or different cementitious materials content that will produce a range of compressive strengths encompassing f'_{cr} .
 - 3) Design trial mixtures to produce a slump within $\frac{3}{4}$ inch of the maximum specified and an air content within 0.5 percent of the maximum specified.
 - 4) For each w/cm ratio or cementitious materials content, cast and cure at least twelve standard test cylinders in accordance with ASTM C192. Four cylinders from each batch tested at age 7-days, 14-days, and 28-days or as required to comply with ACI 318.
 - 5) From results of the cylinder tests, plot a curve showing the relationship between w/cm ratio and compressive strength.
 - 6) From the curve of w/cm ratio versus compressive strength, select the w/cm ratio that will produce f'_{cr} . This is the maximum w/cm ratio to be used unless a lower w/cm ratio is specified above.

3. Field Experience Data:

- a. When sufficient test data for a particular mix design is available which is identical or substantially similar to that proposed for use, Contractor may substitute use of this data in lieu of a trial mix design. Field data, reports, and analysis shall conform to ACI 318, except as modified herein.
 - 1) Historical mix design proportions for which data are submitted may vary from the specified mix within the following limits:
 - a) f'_c as specified or up to 500 psi above

- b) w/cm ratio as specified or lower
 - c) pozzolan content within 5 percent of that specified
 - d) maximum coarse aggregate size may not vary smaller, but gradation of coarse aggregate may vary
 - e) slump after introduction of admixtures +0/-1 inch.
- b. Use of historical Field Experience Data does not allow modification of the project mix specifications herein without review and acceptance by the Engineer.
- 4. Shrinkage:
 - a. Liquid containing structures using Class C-1 concrete mix are intended to be watertight. Provide test results for Class C-1 concrete mix meeting the following requirement: drying shrinkage limit of 0.038 percent in the laboratory at 35-days (7-days moist cure and 28-days drying) as tested in accordance with ASTM C157 and the following modifications:
 - 1) Wet cure specimens for a period of 7-days (including the period of time the specimens are in the mold). Wet cure may be achieved either through storage in a moist cabinet or room in accordance with ASTM C 511, or through storage in lime saturated water.
 - 2) Slump of concrete for testing shall match job requirements and need not be limited to restrictions as stated in ASTM C 157 section 8.4.
 - 3) Report results in accordance with ASTM C 157 at 0, 7, 14 & 28-days of drying.
 - b. Concrete shall not be placed in the field prior to acceptance of the concrete mix. To meet the drying shrinkage limit, it is recommended that a shrinkage reducing admixture be considered for use in concrete for liquid containing structures.

2.03 SEALANTS AND JOINT FILLERS

- A. Preformed joint fillers are specified in Section 07 91 26.

2.04 BONDING COMPOUNDS

- A. Epoxy resin bonding compounds for use in wet areas shall conform to ASTM C881 Types IV or V, Class A, B, or C depending on temperature at use. Acceptable products include: BASF Corporation "MasterEmaco ADH 327RS"; Sika Chemical Corporation "Sikadur 32"; or approved equal.
- B. Non-epoxy bonding compounds for use in dry areas for non-structural bonding or as noted on the drawings shall conform to ASTM C1059 Type II. Acceptable products include: Penetron Specialty Products "Acrylic Bondcrete"; ChemMasters "Cretelox"; or approved equal.
- C. Apply bonding compounds in accordance with the manufacturer's instructions.

2.05 EPOXY FOR CRACK INJECTION

- A. Use a two-component, moisture insensitive, high modulus, injection grade, 100 percent solids, epoxy-resin blend. Consistency as required to achieve complete penetration into cracks. Material shall conform to ASTM C881 Type 1 Grade 1. Acceptable products

include: Sika Corporation “Sikadur 52”; Adhesives Technology Corporation “Crackbond SLV302”; or approved equal.

- B. Use epoxy injection for structural crack repairs except as noted below for non-structural cracks in liquid-containing concrete structures. The Engineer shall determine whether a crack is classified as structural or non-structural.

2.06 CHEMICAL GROUT FOR CRACK INJECTION

- A. Use hydrophobic polyurethane grout at the Engineer's discretion as an alternative for sealing non-structural cracks in concrete structures intended to be watertight. Acceptable products for sealing hairline cracks include: GCP Applied Technologies “DE NEEF Flex SLV PRe” (must be used with DE NEEF Flex Cat PRe); or Sika Corporation “SikaFix HH LV” as appropriate for crack width; or approved equal. Coordinate with product supplier to verify and select appropriate product for crack widths to be injected.

2.07 SURFACE RETARDANT

- A. Retardant for exposing aggregate for unformed surfaces in construction joints shall be Sika Corporation “Rugasol-S”; GCP Applied Technologies “Top-Cast”; or approved equal.
- B. Apply retardant in accordance with manufacturer's instructions sufficient to assure a minimum penetration of 1/4 inch.

2.08 CURING AND SEALING COMPOUNDS

- A. Acceptable products include: BASF Corporation “MasterKure CC 250SB”; Dayton Superior “Cure & Seal 25% J22UV”; or approved equal, conforming to ASTM C1315.
- B. Compound shall be clear and applied in accordance with the manufacturer's instructions.
- C. Curing and sealing compound shall be certified compliant with final finish system if applicable, including compatibility with floor hardeners in areas where floor hardeners are specified to be used.
- D. Acceptable products include: Dayton Superior “Resin Cure with Dye J11WD”; W.R. Meadows “1100-CLEAR” with red dye formulation; or approved equal, conforming to ASTM C309, Type 1D.
- E. Compound shall be clear with a fugitive dye and applied in accordance with the manufacturer's instructions.
- F. Curing compound shall be certified compliant with final finish system if applicable, including compatibility with floor hardeners in areas where floor hardeners are specified to be used.

PART 3 EXECUTION

3.01 GENERAL

- A. Use only truck-mixed, ready-mixed concrete conforming to ASTM C94. Proportion materials by weighing.

- B. Introduce pozzolan into the mixer with cement and other components of the concrete mix; do not introduce pozzolan into a wet mixer ahead of other materials or with mixing water.
- C. Introduce water at the time of charging the mixer; additional water may be introduced within 45 minutes from charging the mixer, provided the specified w/c ration and slump is not exceeded and the maximum total water per the approved mix design is not exceeded.
- D. Arrange with the testing laboratory for inspection as required to comply with these specifications.
- E. Deliver concrete to the site and complete discharge within 90 minutes after introduction of water to the mixture. Extension of allowable time beyond this limit requires a Contractor proposed remedial action plan to be reviewed and accepted by the Owner's Representative.

3.02 CONVEYING AND PLACING CONCRETE

- A. Convey concrete from the mixer to the forms in accordance with ACI 301. Remove concrete that has segregated in conveying from the site of the work.
- B. Placing Concrete:
 - 1. General:
 - a. Place concrete in accordance with ACI 301. Do not permit concrete to drop freely more than 4-ft (6-ft when superplasticizer is used).
 - 2. Placing Concrete By Pumping:
 - a. Concrete placed by pumping is at Contractor's discretion and shall not be the cause to change or relax specified mix design characteristics. Concrete shall possess the specified characteristics at the point of placement.
 - b. Measure slump at the hose discharge, except as follows: Initial slump testing in each placement shall occur at both the pumping unit inlet hopper and hose discharge. Slump loss in pumping, measured between the inlet hopper and the hose discharge, shall not exceed 1 inch. After these criteria have been satisfied, slump may be measured at the inlet hopper with allowable slump increased by the earlier measured difference, not to exceed 1 inch.
 - c. Measure air content at the hose discharge, except as follows: Initial air content testing shall occur at both the pumping unit inlet hopper and the hose discharge. Loss of air content shall be measured between the inlet hopper and the hose discharge. Increase the air content of the delivered concrete at the inlet hopper to provide the specified air content at the hose discharge. After these criteria have been satisfied, air content may be measured at the inlet hopper.
 - d. Before starting each pumping operation, prime the pump and line with a cement slurry to lubricate the system. Waste cement slurry outside the forms. Equip hose tip with a safety chain for recovery in case of hose blowout during pumping. Hose or accessories shall not remain in the freshly placed concrete.
 - e. Use tremie placing techniques and equipment for pump placed concrete. Pump discharge system shall remain full of concrete from pump to discharge point at all times. Concrete pumping shall not occur until Owner's Representative has verified equipment including the tremie plug. Should the discharge line become open, with zones empty of concrete, cease pumping and re-primed with tremie plug installed before continuing.

3. Placing Concrete In Hot Weather:
 - a. In temperatures above 80 degrees F, place concrete in accordance with ACI 305.1.
4. Placing Concrete In Cold Weather:
 - a. In temperatures below 40 degrees F, place concrete in accordance with ACI 306.1.

3.03 CONSOLIDATING CONCRETE:

- A. Consolidate concrete in accordance with ACI 301. If evidence of inadequate consolidation is observed, concrete placement will be suspended until Contractor provides a revised plan to achieve proper consolidation.

3.04 CURING AND SEALING

- A. General:
 1. Cure concrete using water (including form curing and use of moisture retaining covers), a clear membrane curing compound, or by a combination of both methods. Coordinate repairs or treatment of concrete surfaces so that interruption of curing will not be necessary.
 2. Maintain concrete surface temperature between 50 degrees F and 80 degrees F for at least 5 days. Cure concrete in hot weather (above 80 degrees F) in accordance with ACI 305.1. Cure concrete in cold weather (below 45 degrees F) in accordance with ACI 306.1.
- B. Water Curing:
 1. Keep concrete continuously wet for a minimum of 10-days after placement (14 days after placement for sections over 3-feet thick). Absorptive mats or fabric may be used to retain moisture during the curing period. Absorptive covers shall comply with AASHTO M182, Class 3, and moisture retaining covers shall comply with ASTM C171.
 2. Use water curing in hot weather for liquid containment structures. Cover forms and keep moist. Loosen forms as soon as possible without damage to the concrete, and make provisions for curing water to run down inside them. During form removal, take care to provide continuously wet cover to newly exposed surfaces.
- C. Curing Compound:
 1. When curing compound is allowed, apply it as soon as the concrete has set sufficiently so as not to be marred by the application or apply it immediately following form removal for vertical and other formed surfaces. Preparation of surfaces, application procedures, and installation precautions shall follow manufacturer's instructions. For liquid containing structures, apply curing compound at twice the manufacturer's recommended dosage rate, applied in two coats perpendicular to each other.
 2. Do not use curing compound on concrete surfaces to be coated, waterproofed, moisture-proofed, tiled, roofed, or where other coverings are to be bonded. In these cases, use water curing unless the curing compound is first removed or is compatible with the final finish covering.

3.05 PROTECTION

- A. Protect concrete from injurious action by sun, rain, wind, flowing water, frost, excessive vibration and mechanical means.
- B. Loading green concrete is not permitted. Green concrete is defined as concrete with less than 100 percent of the specified strength.
- C. Backfill shall not be placed against concrete walls until the concrete has reached the specified strength, connecting slabs and beams have been cast and have also reached the specified strength, and watertightness testing and repairs have been completed for liquid containing structures to the satisfaction of the Owner's Representative.
- D. Arrangements for covering, insulating, heating, and protecting concrete in cold weather shall be in accordance with ACI 306.1.

3.06 CONSTRUCTION JOINTS

- A. General:
 - 1. Place concrete in each unit of construction continuously. Before new concrete is placed on or against concrete which has set, retighten forms and clean foreign matter from the surface of the set concrete. Provide waterstops as specified.
- B. Construction:
 - 1. Form construction joints by producing a rough surface of exposed aggregates using a surface retardant; include joints between the slab and topping concrete. The limit of the treated surfaces shall be 1 inch away from the joint edges. Within 24 hours after placing, remove retarded surface mortar either by high pressure water jetting or stiff brushing or combination of both so as to expose coarse aggregate. A rough surface of exposed aggregate may also be produced by sandblasting followed by high pressure water jetting. Sandblasting, if used, shall remove 1/4 inch of laitance film and expose coarse aggregate to ensure adequate bond and watertightness at the construction joints.
- C. Locations:
 - 1. Provide construction joint locations as follows:
 - a. Cast walls exceeding 50 feet in length in panels not to exceed 30 feet in length. Cast adjoining panels only after 5-days have elapsed. Joints are not allowed within the lesser of 10 feet or 25 percent of the wall length from a corner unless specifically detailed thus on the drawings.
 - b. Locate joints in beams or girders at or near the quarter point between supports.
 - c. Make joints in the members of a floor system at or near the quarterpoint of the span.
 - d. Make joints in walls and columns at the underside of floors, slabs, beams or girders and at the tops of footings or floor slabs.
 - e. Cast slab panels in checkerboard patterns not to exceed 40 feet in length and not to exceed 900 square feet in area, with maximum 1 1/2 to 1 ratio of side lengths. Minimum lapsed time between placing adjacent panels shall be 3-days. The requirements for size of slab panel is waived if joints are located on the Drawings.

2. Vertical construction joints shall have edges grooved or beveled at faces exposed to view including interior faces of basins and tanks. Seal grooves subjected to wetting or weather with joint sealant.
3. Continue reinforcing steel and welded wire reinforcement through construction joints. Beams, girders, and floor slabs shall not be constructed over columns or walls until at least one day has elapsed to allow for initial shrinkage in the column or wall. No joint will be allowed between a slab and a beam or girder unless otherwise shown. Joints shall be perpendicular to the main reinforcement. Provide waterstops in construction joints as specified.

3.07 INSERTS AND EMBEDMENTS

A. Inserts:

1. Where pipes, castings, or conduits are to pass through structures, position in forms before placing concrete; or where shown on Drawings or approved by the Owner's Representative, provide openings in the concrete for subsequent insertion of such pipes, castings, or conduits. Provide waterstops and a slight flare in the form to facilitate grouting and permit the escape of entrained air during grouting.
2. Provide additional reinforcement around openings. Use non-shrink grout to infill around inserts.
3. Place horizontal conduits and pipes, in slabs and beams, between the top and bottom layers of reinforcement. Spacing and size limitations shall conform to ACI 318.
4. Conduits and pipes shall not run directly beneath a column or base plate.
5. Position conduit, pipe, and other ferrous items such that there will be a minimum of 2-inches clearance between said item and concrete reinforcement. Welding inserts to reinforcement is not permitted.
6. The outside diameter of conduit or pipe shall not exceed one-fourth the slab or beam thickness.

B. Embedments:

1. Gate frames, gate thimbles, special castings, channels, grating frames, or other miscellaneous metal parts to be embedded in concrete shall be secured in the forms prior to concrete placement.
2. Embed anchor bolts and inserts in concrete as shown. Provide inserts, anchors, or other bolts necessary for the attachment of piping, valves, metal parts, and equipment.
3. Provide nailing blocks, plugs, strips, and the like necessary for the attachment of trim, finish, and similar work. Voids in sleeves, inserts, and anchor slots shall be filled temporarily with readily removable material to prevent entry of concrete. Do not use continuous anchor slots or strips in concrete intended to be watertight.
4. Position operators or sleeves for gate or valve stems to clear reinforcing steel, conduit, and other embedments, and to align accurately with equipment.

3.08 EXPANSION JOINTS

- #### **A.**
- Expansion joints shall be as shown. Do not extend reinforcement or other embedded metal items through expansion joints. Provide waterstops where indicated.

3.09 MODIFICATION OF EXISTING CONCRETE

A. General:

1. Verify structural dimensions related to or controlled by previously constructed or existing structures prior to concrete work.

B. Cutting or Coring Concrete:

1. Saw cut concrete to a depth of 1 inch to form straight outlines of concrete areas to be removed. Where reinforcement is exposed due to saw cutting or core drilling and no new material is to be placed on the cut surface, provide a protective epoxy coating to the entire cut surface.
2. Coat surfaces of oversized openings with an epoxy bonding compound prior to re-finishing with profiling mortar to the required opening size.
3. Grind existing joint edges to create a chamfer matching those used on adjacent construction.
4. Investigate concrete to be drilled, cored, or sawcut to determine location of reinforcing steel. Locate penetrations to clear existing reinforcing steel. Where not possible to avoid reinforcing steel, consult the Engineer as to acceptability of cutting reinforcing steel and provide new reinforcing systems as directed.
5. Locating methods include chipping to expose reinforcing steel, ground penetrating radar, X-ray, or magnetic flux devices. Locates of existing reinforcing shall be by the Contractor.

C. Joining New Concrete To Existing:

1. Existing concrete surfaces to be joined with new concrete shall be cleaned and roughened by abrasive blasting, bush hammering, or other method to achieve $\frac{1}{4}$ -inch amplitude surface. Remove existing metalwork, embeds, or other interfering items. Coat existing surface with epoxy bonding compound prior to placement of new concrete.

D. Post-Installed Anchors and Dowels:

1. Use non-destructive methods for locating reinforcement prior to drilling operations. For anchor and dowel locations that interfere with reinforcement, attempt to relocate to avoid drilling through the reinforcement if possible.
2. For situations that do not allow relocation, cutting of reinforcement for installation is subject to the following:
 - a. Prior to drilling through reinforcement, the Contractor shall consult the Owner's Representative or Engineer.
 - b. Drill holes with a hammer drill and carbide bit (core drilled holes are not allowed), followed by brushing and air-cleaning with oil-free compressed air.
 - c. Holes drilled through reinforcement must be in compliance with adhesive anchor assumptions for roughened hole surface typical of a hammer drill and carbide bit. No smooth hole surfaces are allowed.
 - d. Do not cut slab rebar within 24 inches of a supporting wall, column, or an opening in the slab.
 - e. No cutting of rebar is allowed in the middle third of slab spans for anchors with diameters equal to or greater than $\frac{3}{4}$ inch.
 - f. Maximum of two rebar may be cut in any 10 foot width of slab.

- g. Maximum of two rebar may be cut within any 10 foot width of concrete wall.
- h. Maximum of one rebar may be cut within any 8 foot width of CMU wall.
- 3. For anchors that cannot be moved and that conflict with the above requirements, consult Engineer for direction. It is not acceptable to cut reinforcement in beams, columns, precast members, or stairs.
- 4. Use a pre-manufactured, self-mixing, injectable, two-component, epoxy adhesive, as per Section 03 60 00. Follow manufacturer's recommendations and ICC Evaluation Report for installation.

E. Waterstops:

- 1. Where a waterstop between new and existing concrete is required, install a hydrophilic waterstop, or a retrofit waterstop as indicated.

3.10 FORMED SURFACE FINISHES

A. Repair Of Surface Defects:

- 1. Repair surface defects, including tie holes, minor honeycombing, or otherwise defective concrete in accordance with ACI 301. Clean areas to be repaired. Cut and chip out honeycombed or otherwise defective areas to solid concrete, to a depth of at least 1-inch. If defective area includes exposed reinforcing steel, correct by removing concrete a minimum of 1-inch beyond the reinforcing. Make edges of the cut perpendicular to the surface of the concrete in a neat rectangular pattern.
- 2. Joints shall be grooved to a radius or bevel of $\frac{3}{4}$ -inch depth.
- 3. Finish patches on exposed surfaces to match and blend with adjoining work. Cure patches as specified for the concrete. Protect finished surfaces from stains and abrasions.

B. Formed Surface Finishes:

- 1. Finish A - Grout Rubbed Finish
 - a. After repair of surface defects, apply a grout rubbed finish in accordance with ACI 301 except that all form fins and other protrusions shall be completely removed. Lightly sandblast surfaces prior to sacking. Sandblasting shall occur after the specified curing period.
 - b. Add a PVA bonding compound to the mix water used in sacking mortar; as recommended by the manufacturer.
 - c. Provide Finish A at uncoated surfaces of stair wells, at interior surfaces of equipment rooms, galleries, tunnels, operations areas, exposed channels and tanks from 1 foot below minimum water surfaces and up, at exposed exterior surfaces to 1 foot below grade, and at permanently exposed vertical and sloped surfaces such as pipe chases.
 - d. Do not provide Finish A at concrete surfaces receiving a coating.
- 2. Finish B - Smooth Surface Finish
 - a. Initial surface preparation is the same as Finish A; repair surface defects and remove all form fins.
 - b. Provide Finish B at surfaces to be coated, at interior surfaces of exposed channels and tanks from 1 foot below minimum water surfaces and down (Finish A applied above this level), and full height at surfaces of wet wells, tanks, and

channels not exposed to view. See Section 09 90 00 for additional concrete surface preparation, including filling of bug holes, and coating requirements.

3. Finish C - Rough Form Finish

- a. Repair surface defects and imperfections greater than 3/8 inch in any dimension. Remove form fins and protrusions down to less than 3/8 inch projection.
- b. Provide Finish C or smoother at exterior surfaces from 1 foot below grade and down, at other vertical surfaces not exposed to view and not specified above to receive Finish A or B.
- c. Also apply Finish C to unoccupied interior areas not otherwise specified.

4. Finish D – Unfinished Surface

- a. Repair surface defects and otherwise leave the surfaces as they come from the forms, except plug tie holes and repair or remove defects greater than 1/2 inch in any dimension.

C. Sample Of Formed Surface Finish A:

1. Provide a sample concrete panel, minimum 4 feet by 4 feet; representative of formed surface Finish A. The panel shall be representative of the workmanship and finish required, including repair of defects, filling of tie holes, sandblasting, and rubbing.
2. The sample shall be approved by the Owner's Representative prior to the start of production work. The sample shall be on display at the job site, and finished surfaces shall match sample.

3.11 SLAB FINISHES

A. General:

1. The finishes specified herein include surface finishes, treatments and toppings for floors and slabs. Do not use dry cement on new concrete surfaces to absorb excess moisture. Round edges to a radius of 1/2 inch.
2. Slope floors to drain uniformly within a room or space. Unless otherwise specified, slope shall be a minimum of 1/8 inch per foot toward nearest drain. Restrict use of floor drains with only locally depressed slabs to locations specifically noted.
3. Immediately after final finish is applied, the surface shall be cured and protected as specified in Curing, Sealing, and Protection paragraphs above.
4. Where finish is not specified, floor slabs shall receive a Steel Trowel Finish.

B. Float Finish:

1. Perform floating with a hand or power-driven float in accordance with ACI 301. Begin floating when the bleed water sheen has disappeared and the surface has stiffened sufficiently. Float as required to meet tolerance requirements of ACI 117 for a conventional surface.
2. Floating shall close cracks and checks plus compact and smooth the surface. Refloat the slab to a uniform texture.
3. Apply float finish to surfaces of channels, tank bottom slabs, exterior below grade horizontal surfaces, including tops of footings, and surfaces to receive insulation or roofing.

C. Steel Trowel Finish:

1. Float the concrete surface as indicated above and then trowel in accordance with ACI 301.
2. Provide Steel Trowel Finish on interior exposed floors and slabs that will receive resilient flooring, carpet or ceramic tile, unless specified otherwise.

D. Broom Finish:

1. Float the concrete surface as indicated above, then immediately give the concrete a coarse transverse scored texture by drawing a broom or burlap belt across the surface in accordance with ACI 301.
2. Provide a Broom Finish for steps and ramps, exterior exposed horizontal surfaces, and where otherwise indicated.

E. Samples Of Concrete Slab Finishes:

1. Provide a sample concrete slab, minimum 4 feet by 4 feet, representative of workmanship and each specified finish.
2. Samples shall be approved by the Owner's Representative prior to the start of production work. The samples shall be on display at the job site, and finished surfaces shall match samples.

3.12 TOPPING CONCRETE (EXCEPT AS NOTED BELOW FOR CLARIFIER TOPPING CONCRETE)

A. Subfloor Finish:

1. Slabs to receive a topping concrete, topping grout, or tile; shall be float finished to required elevations. Immediately following the final finishing, either:
 - a. treat slab with a retardant and abrasive blast to create expose aggregate with $\frac{1}{4}$ inch amplitude, or
 - b. create the $\frac{1}{4}$ inch amplitude roughened surface by raking the freshly floated surface using a standard garden rake.
2. Immediately after finishing, proceed with required curing and protection of the slab as stated above.

B. Topping Concrete or Grout:

1. Remove dirt, laitance, and loose aggregate. Keep cleaned base slab saturated surface dry for a period of 24 hours prior to the application of topping. Remove excess water.
2. Apply and scrub a neat cement grout into the surface of the base slab using a stiff broom. The cement grout shall not be allowed to dry and shall be spread within 15 minutes ahead of the topping placement.
3. The topping shall then be placed, compacted, and floated. Test surface with a straight edge to detect and correct high and low spots to a tolerance of $\frac{1}{8}$ inch in 10 feet.
4. Incorporate float finish, surface hardener, steel trowel finish, etc as specified.

3.13 CLARIFIER TOPPING CONCRETE

A. Subfloor Finish:

1. Do not use dry cement on new concrete surfaces to absorb excess moisture.

2. Slabs to receive topping concrete at clarifiers shall be float finished to required elevations and then provided with light raked finish.
3. Immediately after finishing, proceed with required curing.
4. Do not use dry cement on new concrete surfaces to absorb excess moisture.

B. Float Finish:

1. Apply float finish to concrete topping by final spreading and turing of the topping using the clarifier equipment. 'Sweep-in' the concrete topping by first changing out the existing clarifier mechanism scraper blades with a similar temporary blade as recommended by the equipment manufacturer for this use.
2. After 'sweeping-in' the concrete topping, wait and begin final floating when the bleed water sheen has disappeared and the surface has stiffened sufficiently.
3. Floating shall close cracks and checks plus compact and smooth the surface. Float the concrete topping to a uniform texture using the existing clarifier mechanism.

C. Topping Concrete:

1. Remove dirt, laitance, and loose aggregate. Keep cleaned base slab saturated surface dry for a period of 24 hours prior to the application of topping. Remove excess water.
2. Apply and scrub a neat cement grout into the surface of the base slab using a stiff broom. The cement grout shall not be allowed to dry and shall be spread within 15 minutes ahead of the topping placement.
3. The topping shall then be placed, screeded with attachment to clarifier rakes, and floated. Test surface with a straight edge to detect and correct high and low spots to a tolerance of 1/8 inch in 10 feet.
4. Incorporate steel trowel finish.

3.14 RELATED SURFACES

A. Stair Treads:

1. Construct stair treads with a nonskid nosing as specified in Section 05 50 00.
2. Treads shall have a Float Finish followed by a Steel Trowel Finish with a slope of 1/8 inch toward the front.
3. Ends of treads shall have a 1/16 to 1/8 inch cut between concrete and metal tread to allow for expansion.

B. Finishing of Unformed Surfaces:

1. Adjacent Unformed Surfaces:
 - a. Tops of walls, buttresses, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces shall be struck smooth after concrete is placed and shall be Float Finished to a texture reasonably consistent with that of the adjacent formed surface.
 - b. Continue final treatment of formed surface uniformly across the top of the unformed surface.
2. Pavements and Sidewalks:
 - a. The surface of the concrete shall be screeded to grade and sloped to drain. After screeding, the surface shall be Float Finished followed by a Broom Finish.

- b. Round edges and expansion joints to a radius of 1/2 inch. Control joints shall be grooved or sawcut to a minimum depth of 1/4 the slab thickness.

3.15 FIELD SAMPLING AND TESTS

A. General:

1. Field sampling and tests shall be performed by an independent testing laboratory. Samples of aggregates and concrete will be obtained at such times to represent the quality of the materials and work throughout the project.
2. The laboratory shall provide necessary labor, materials and facilities for sampling aggregate and for casting, handling, and initially storing the concrete samples at the work site.
3. The minimum number of samples and tests are specified in Testing paragraph below.

B. Sampling:

1. Aggregates:

a. General:

- 1) Sample fine and coarse aggregates in accordance with ASTM D75 not less than 30 days prior to the use of such aggregates in the work.
- 2) Take samples at the discharge gates of the bins feeding the weigh hopper. Repeat sampling when the source of material is changed or when unacceptable deficiencies or variations from the specified requirements of materials are found.
- 3) Aggregate samples shall be tagged and their sources identified.

b. Coarse Aggregate:

- 1) Take a sample weighing between 50 and 60 pounds after the batch plant is brought up to full operation.
- 2) Take samples to obtain a uniform cross section, accurately representing the materials on the belt or in the bins for sieve analysis.

c. Fine Aggregate:

- 1) Take samples as specified for coarse aggregate.
- 2) Take samples of sand when the sand is moist for sieve analysis and specific gravity tests.

2. Concrete:

- a. Take samples of plastic concrete in accordance with ASTM C172.
- b. Take samples at the hopper of mixing equipment or transit mix truck, except as noted in the Placing Concrete by Pumping subparagraph of the Conveying and Placing article above.

C. Testing:

1. Aggregate:

- a. A minimum of one test of coarse aggregate per 400 cubic yards of concrete used and a minimum of one test of fine aggregate per 200 cubic yards of concrete used shall be made to confirm continuing conformance with specifications for gradation, cleanliness and sand equivalent.
- b. A maximum of one test per day of each aggregate is required.
- c. Repeat of the entire concrete mix design test program is required before source changes will be accepted.

2. Concrete:

a. Strength Tests:

- 1) The strengths specified for the design mix shall be verified by the independent testing laboratory during placement of the concrete. Verification shall be accomplished by testing standard cylinders of concrete samples taken at the job site. Cylinders shall be 4 by 8 inch or 6 x 12 inch.
- 2) Concrete samples shall represent the concrete placed in the forms. One set of six standard 6 x 12 inch (or nine 4 x 8 inch) cylinders shall be cast of each class of concrete for each 100 cubic yards or less, or for each 5,000 square feet of slab or wall surface area placed per day. Provide additional cylinders when an error in batching is suspected. Each set of cylinders are cast from material taken from a single load of concrete.
- 3) Casting, handling and curing of cylinders shall be in accordance with ASTM C31. For the first 24 hours after casting, keep cylinders moist in a storage box constructed and located so that its interior air temperature will be between 60 and 80 degrees F. At the end of 24 hours, the testing laboratory will transport the cylinders to their laboratory.
- 4) Testing of specimens for compressive strength shall be in accordance with ASTM C39. Each test shall consist of two 6 x 12 inch (or three 4 x 8 inch) test cylinders from each group of six (or nine) specimens. Test at the end of 7 days and at the end of 28 days. The remaining cylinders shall be tested at the end of 56 days if the 28-day strength reports below specification.
- 5) A strength test shall consist of the average strength of two 6 x 12 inch (or three 4 x 8). If one cylinder shows evidence of low strength due to improper sampling, casting, handling, or curing, the result of the remaining cylinders may be used if approved by the Owner's Representative.
- 6) The average of any three consecutive 28-day strength test results of the cylinders representing each class of concrete for each structure shall be equal to or greater than the specified strength. Not more than 10 percent of the individual strength test results shall have values less than the specified 28-day strength for the total job concrete. No individual strength test result shall be less than the specified strength by more than 500 pounds per square inch.
- 7) Provide certified reports of the test results directly to the Owner's Representative and the Engineer. Test reports shall include sufficient information to identify the mix used, the stationing or location of the

concrete placement, and the quantity placed. Slump, water/cement ratio, air content, temperature of concrete, and ambient temperature shall be noted.

- 8) The 28-day strength test results shall be evaluated in accordance with ACI 214R. Quality control charts showing field test results shall be included with the test results for each class of concrete in each major structure. Charts shall be prepared in accordance with ACI 214R. Quality control charts shall be maintained throughout the entire project and shall be available for the Owner's Representative's inspection at any time.
- 9) If the 28-day test results fall below the specified compressive strength for the class of concrete required for any portion of the work, adjustment in the proportions, water content, or both, shall be made as necessary at the Contractor's expense. Report changes and adjustments in writing to the Owner's Representative.
- 10) If compressive test results indicate concrete in place may not meet structural requirements, tests shall be made to determine if the structure or portion thereof is structurally sound. Tests may include, but not be limited to, cores in accordance with ASTM C42 and any other analyses or load tests acceptable to the Engineer. Costs of such tests and/or analysis shall be borne by the Contractor.

b. Tests for Consistency of Concrete:

- 1) Measure slump in accordance with ASTM C143. Take samples for slump determination from concrete during placement. Tests shall be made at the beginning of concrete placement operation, whenever test cylinders are cast, and at subsequent intervals to ensure that the specification requirements are met.
- 2) For pumped concrete, measure slump in accordance with the Placing Concrete by Pumping subparagraph of the Conveying and Placing article above.
- 3) When high range water reducer is added at the site, slump tests shall be taken before and after addition of the admixture.

c. Tests for Temperature and Air Content:

- 1) Temperature tests shall be made at frequent intervals during hot or cold weather conditions until satisfactory temperature control is established. Perform temperature tests whenever test cylinders are cast.
- 2) Measure air content in accordance with ASTM C231 whenever test cylinders are cast. For pumped concrete, measure air content in accordance with the Placing Concrete by Pumping subparagraph of the Conveying and Placing article above.

D. Final Laboratory Report:

1. The testing laboratory shall provide a final report at the completion of all concreting. This report shall summarize the findings concerning concrete used in the project and provide totals of concrete used by class and structure.
2. Include final quality control charts for compressive strength tests for classes of concrete specified in each major structure. Also include the concrete batch plant's coefficient of variation and standard deviation results for each class of concrete.

3.16 REPAIR OF DAMAGED AND CRACKED CONCRETE:

A. Acceptance Of Concrete:

1. Completed cast-in-place concrete work shall conform to the applicable requirements of ACI 301 and the Contract Documents. Concrete work that fails to meet these requirements shall be repaired, as approved by the Engineer, to bring the concrete into compliance. Repair methods shall be in accordance with ACI standards, including ACI 503.7, and are subject to the approval of the Engineer.
2. Concrete that cannot be brought into compliance by approved repair methods will be rejected. Remove and replace rejected concrete work.
3. The cost of repairs and replacement of defective concrete shall be borne by the Contractor.

B. Repair Methods:

1. Damaged/defective concrete or concrete with crack widths exceeding 0.004 inches at liquid-containing and conveying structures or crack widths exceeding 0.006 inches for other structures shall be repaired by one of the following methods (only the Engineer may determine that a defect or crack does not require repair):
 - a. Perform watertightness testing and repair as needed to meet leakage criteria in this specification even when liquid-containing and conveying structures meet the crack width criteria defined above.
 - b. Damaged or defective concrete includes surface defects, honeycomb, rock pockets, indentations greater than 3/16 inch, spalls, chips, air bubbles greater than 1/2 inch diameter, pinholes, bugholes, embedded debris, lift lines, sand lines, bleed lines, leakage from form joints, fins, projections, form popouts, texture irregularities, and stains or other color variation that cannot be removed by cleaning.
 - 1) Damaged or defective concrete is repaired according to procedures outlined above under finish requirements, Repair of Surface Defects.
2. Crack Repair Method 1:
 - a. Fill the joint or crack by drilling holes to the affected area (following the product manufacturer's details), install injection ports, and force epoxy or chemical grout (expanding urethane) into the joint under pressure.
 - b. Material type and repair procedures shall be approved by Engineer.
 - c. After injection and curing; ports, sealing mix, and surface shall be cleaned and worked to match the adjacent specified finish.
3. Crack Repair Method 2:
 - a. Fill cracks with low viscosity epoxy, applied by pouring/flooding crack zone until cracks are filled. Prepare surface, install, and cure according to manufacturer's recommendations.
 - b. At a minimum, prepare surface to be clean and dry with no visible detrimental material in cracks to be filled. Conform to temperature limitations of epoxy. Clean and refinish to match adjacent surfaces.
4. Crack Repair Method 3:
 - a. Cut a bevel groove 3/8 to 1/2 inch in width and depth, use backer rod or tape, and fill with sealant in accordance with manufacturer's instructions.
 - b. This repair method is only used where approved by Engineer.

- c. Groove and sealant shall be applied on wet or hydrostatic pressure side of surface.

C. Repair Method Use:

1. Repair Method 1: For cracks in walls, surfaces sloped 1:1 or greater, beams, columns, structural slabs, overhead surfaces, and liquid retaining surfaces. Need for repair depends upon crack width, location, and leakage.
2. Epoxy grout is used for repair of structural cracks and chemical grout (expanding urethane) for repair of non-structural cracks at liquid-containing structures. The Engineer shall determine whether a crack is classified as structural or non-structural.
3. Repair Method 2: Utilized in lieu of Method 1 for slabs when approved by Owner's Representative. Final finish shall match adjacent surfaces.
4. Repair Method 3: Limited to dry-surface slabs, walls subject to less than three feet of liquid pressure, or as approved by Engineer. Repair Method 3 is not an equivalent repair method to Repair Methods 1 or 2, which shall be considered the standards.

3.17 NOT USED

3.18 WATERTIGHTNESS TESTING AND REPAIR

A. Liquid Containing Concrete Tanks And Channels:

1. Watertightness testing shall comply with ACI 350.1 and the following requirements.
2. Concrete tanks, basins, reservoirs and channels which have walls or slabs subjected to hydrostatic pressure shall be tested for watertightness. The tests shall be made after the structure is complete and the concrete has achieved its specified 28-day strength, but prior to application of waterproof coating or backfill.
3. Filling of the tank for watertightness testing shall not exceed a rate of 4 feet/hour. Fill with water to the maximum operating water surface. Keep water at this level for at least 72 hours prior to start of test.
4. Testing includes visual inspection of the dry sides of all walls, wall base construction joint at top of the slab, and the soffit of elevated slabs for evidence of leakage. Damp spots, leakage, or seepage revealed by the test, including those caused by shrinkage of concrete, honeycombed areas, construction joints, or other sources shall be repaired by Repair Method 1 (see Repair Methods paragraph in the Repair of Damaged Concrete and Cracking article above).
5. Damp spots are defined as areas from which water that can be picked up on dry hand and smeared across the dry concrete surface.
6. Re-test tanks or channels which have been repaired to check the suitability of repairs.
7. Provide water required for testing and re-testing and dispose of in an approved manner.
8. After repair of visual leakage, liquid containing or conveying concrete structures supported on soil must also meet maximum leakage criteria into the soil through their base slab or mat foundation as follows:

Structure Type	Tightness Criterion
Containment structures fully lined prior to hydrostatic test	No measurable loss
Cylindrical water and wastewater storage tanks and reservoirs other than digesters	0.050 percent per day
Digesters	0.050 percent per day (surcharged hydrostatic test)
Rectangular basins and tanks	0.050 percent per day
Concrete paved reservoirs and channels	0.10 percent per day

Note: All damp spots and/or leakage through walls, wall-to-slab joints, and elevated slabs shall first be repaired as described above.

9. Record volume loss by measuring the vertical distance from the water surface to a fixed point on the tank above the water surface. Account for evaporation from open surfaces.
10. If the drop in water surface during the test period exceeds the values given in the table above, exclusive of evaporation, the leakage is considered excessive and shall be remedied. The test period shall be per ACI 350.1.

3.19 CLEANUP

- A. Upon completion of the work and prior to final inspection, clean all concrete surfaces as follows: Sweep with a broom to remove loose dirt, then mop and/or flush with clean water. Scrub by hand or machine as required to remove and blend stains or discolored areas .
- B. Clean floors that have curing and sealing compound as stated above, followed by the final application of curing and sealing compound.

END OF SECTION

SECTION 03 60 00

GROUTING

PART 1 GENERAL

1.01 DESCRIPTION

- A. Section includes: Grout for column base plates, other structural supports, equipment bases, reinforcing bar dowels, surface repair, grout toppings, patching of fresh concrete, and uses other than masonry. Adhesive anchor bolt grouting is specified in Section 05 05 20. Topping concrete over precast elements and clarifier topping concrete is specified in Section 03 30 00.

1.02 RELATED SECTIONS

- A. This section contains specific references to the following related sections. Additional related sections may apply that are not specifically listed below.
1. Section 03 30 00 Cast-In-Place Concrete
 2. Section 03 01 00 - Concrete Repair
 3. Section 05 05 20 Anchor Bolts
 4. Section 43 05 13 Rigid Equipment Mounts

1.03 REFERENCES:

- A. The references listed below are a part of this section. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
ASTM C109	Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2 inch or 50 mm Cube Specimens)
ASTM C230	Flow Table for Use in Tests of Hydraulic Cement
ASTM C307	Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacing
ASTM C939	Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method)
ASTM C531	Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes
ASTM C579	Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing and Polymer Concretes
ASTM C882	Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear
ASTM C942	Standard Test Method for Compressive Strength of Grouts for Preplaced-Aggregate Concrete in the Laboratory

Reference	Title
ASTM C1107	Packaged Dry, Hydraulic-Cement Grout (Non-shrink)
ASTM C1181	Standard Test Methods for Compressive Creep of Chemical-Resistant Polymer Machinery Grouts
ASTM E329	Agencies Engaged in Construction Inspection, Testing, or Special Inspection
COE CRD-C611	Flow of Grout for Preplaced Aggregate Concrete
COE CRD-C621	Non-shrink Grout
IBC	International Building Code

1.04 SUBMITTALS

A. Action Submittals

1. Procedure: Section 01 33 00:
2. A copy of this specification section with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.
3. Check-marks (✓) shall denote full compliance with a paragraph as a whole. Deviations shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Include a detailed, written justification for each deviation. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
4. Complete product literature, including mixing, handling and placement instructions for the following: Cementitious non-shrink grout, epoxy grout, adhesive for reinforcing bar dowel grouting, concrete repair mortar, and prepackaged cement grout products to be used on the project.
5. Mix design for cement grout that is not prepackaged, including product data for aggregates and cement in accordance with Section 03 30 00.
6. Current ICC Evaluation Service reports for adhesives used for reinforcing dowels.
7. Installer certification in accordance with ACI/CRSI Adhesive Anchor Installer Certification Program for installers of horizontal or upwardly inclined reinforcing bar dowels grouted using adhesive.
8. Certified test results verifying the compressive strength, shrinkage and expansion requirements specified herein.

1.05 QUALITY ASSURANCE

A. Quality Control by Owner

1. The Owner will provide the services of a qualified Special Inspector in accordance with Section 01 45 23.
2. Adhesive anchors installed in horizontal or upwardly inclined orientations to resist sustained tension loads shall be continuously inspected during installation by a Special Inspector.

- a. The Special Inspector shall furnish a report to the Engineer, Owner's Representative and Building Official that the work covered by the report has been performed and that the materials used and the installation procedures used conform with the approved Project Manual and the Manufacturer's Printed Installation Instructions (MPII).
- B. Quality Control by Contractor
 - 1. Provide the services of an independent testing laboratory which complies with the requirements of ASTM E329 if a product other than those listed below is proposed and test data is not available from the supplier to demonstrate equivalence to the specified grout. The testing laboratory shall sample and test the proposed grout materials. Costs of testing laboratory services shall be borne by the Contractor.
- C. Certifications
 - 1. Installer certification shall be in accordance with ACI/CRSI Adhesive Anchor Installer Certification Program for installers of horizontal or upwardly inclined reinforcing bar dowels grouted using adhesive.
- D. Compression test specimens will be taken during construction from the first placement of each type of grout and at intervals thereafter as selected by the Engineer to insure continued compliance with these Specifications.
 - 1. Compression tests and fabrication of specimens for epoxy grout will be performed as specified in ASTM C579, Method B, at intervals during construction as selected by the Engineer. A set of three specimens will be made for testing at seven days and any other time period as appropriate.
 - 2. Compression tests and fabrication of specimens for cement grout and non-shrink grout will be performed as specified in ASTM C109 at intervals during construction as selected by the Engineer. A set of three specimens will be made for testing at seven days, 28 days and any additional time period as appropriate.
- E. Manufacturer Qualifications
 - 1. Manufacturer shall have a minimum of five years experience of producing products substantially similar to that required and shall be able to submit documentation of at least five satisfactory installations that have been in successful operation for at least five years each.
 - 2. When required, provide services of manufacturer's full-time employee, factory-trained in handling, use, and installing the products required, with at least five years of experience in field applications of the products required.

PART 2 PRODUCTS

2.01 CEMENTITIOUS NON-SHRINK GROUT

- A. The grout material shall be an approved ready to use mixture requiring only water for use at the job site. The 2-inch cubes shall have a minimum compressive strength of 3,000 psi at 7 days and 7,000 psi at 28 days.
- B. Cementitious non-shrink non-metallic aggregate grout shall be:
 - 1. BASF, Masterflow 928
 - 2. Euclid Chemical Company, Hi-Flow Grout

3. Five Star Products, Inc., Five Star Grout
 4. Sika Corporation, SikaGrout 212
 5. Approved Equal
- C. Non-shrink grout shall conform to CRD-C 621 and ASTM C1107, Grade B or C when tested at a maximum fluid consistency of 30 seconds per ASTM C939 at temperature extremes of 45 degrees Fahrenheit and 90 degrees Fahrenheit and an extended working time of 15 minutes.
- D. Fluid grout shall pass through the flow cone, with continuous flow, one hour after mixing.

2.02 EPOXY GROUT FOR EQUIPMENT MOUNTING:

- A. Epoxy grout shall be a pourable, non-shrink, 100-percent solids system.
- B. Epoxy grout for equipment mounting shall be a non-cementitious, resin based, multi-component formulation. Epoxy grout shall be flowable, with shrinkage minimized to achieve minimum 98% effective bearing area. Epoxy grout shall be:
1. BASF, Masterflow 648
 2. Euclid Chemical Company, E3-G
 3. Sika Corporation, Sikadur 42
 4. Approved Equal.
- C. The following properties shall be attained with the minimum quantity of aggregate allowed by epoxy grout manufacturer.
1. Length change after hardening shall be less than 0.0006-inch per inch and coefficient of thermal expansion shall be less than 0.00003-inch per inch per degree F when tested in accordance with ASTM C531.
 2. Compressive creep at one year shall be less than 0.001-inch per inch when tested under a 400-psi constant load at 140 degrees F in accordance with ASTM C1181.
 3. Minimum seven-day compressive strength shall be 14,000 psi when tested in accordance with ASTM C579
 4. Grout shall be capable of maintaining at least a flowable consistency for minimum of 30 minutes at 70 degrees F.
 5. Shear bond strength to portland cement concrete shall be greater than shear strength of concrete when tested in accordance with ASTM C882/C882M.

2.03 ADHESIVE FOR GROUTING REINFORCING BAR DOWELS

- A. Adhesive for setting dowels in concrete shall be an injectable two-component epoxy adhesive. Adhesive shall be approved for the intended use per the product ICC Report. Adhesive shall be:
1. Hilti, HIT-RE 500v3
 2. Simpson Strong Tie, SET XP
 3. Approved Equal (equivalent product must have ICC approval for use in cracked concrete in areas with high seismic risk).

- B. Adhesive for setting dowels in concrete masonry shall be an injectable two-component epoxy adhesive. Adhesive shall be approved for the intended use per the product ICC Report or IAPMO Report. Adhesive shall be:
 - 1. Hilti, HIT-HY 70
 - 2. Simpson Strong Tie, SET XP
 - 3. Approved Equal acceptable per ICC Report or IAPMO Report for resisting earthquake loads

2.04 CONCRETE REPAIR MORTAR

- A. Horizontal Applications: Repair mortars shall be:
 - 1. BASF, MasterEmaco S 466CI
 - 2. Sika Corporation, SikaTop 111 Plus
 - 3. Approved Equal
- B. Vertical and Overhead Applications: Repair mortars shall be:
 - 1. BASF, MasterEmaco 1500HCR Vertical Overhead
 - 2. Sika Corporation, SikaTop 123 Plus
 - 3. Approved Equal

2.05 CEMENT GROUT

- A. Cement grout shall be comprised of cement, fine aggregate, coarse aggregate, water, and admixtures proportioned and mixed in accordance with this Section.
 - 1. Minimum Compressive Strength: 4,500 psi at 28 days.
 - 2. Maximum Water Cement Ratio: 0.42 by weight.
 - 3. Coarse Aggregate: ASTM C33/C33M, No. 8 size.
 - 4. Fine Aggregate: ASTM C33/C33M, approximately 60 percent by weight of total aggregate.
 - 5. Air Content: Five percent (plus or minus one percent).
 - 6. Minimum Cement Content: 564 pounds per cubic yard.
 - 7. Slump for grout fill shall be adjusted to match placing and finishing conditions, and shall not exceed four inches.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine and accept existing conditions before beginning work.

3.02 CEMENTITIOUS NONSHRINK GROUT

- A. Non-shrink, cementitious, nonmetallic aggregate grout shall be used for column base plates, structural bearing plates, and all locations where the general term “non-shrink grout” is indicated on the Drawings. Use of this grout to support the bearing surfaces of machinery shall be as specified in Section 43 05 13 or as detailed on the Drawings for specific locations or pieces of equipment. If guidance is not provided in locations noted above, use of non-shrink grout for equipment mounting shall be limited to equipment

less than 25 horsepower or 750 pounds. Grout shall be placed and cured in accordance with the manufacturer's instructions.

- B. Non-shrink cementitious grout shall not be used as a surface patch or topping. Non-shrink cementitious grout must be used in confined applications only.

3.03 EPOXY GROUT FOR EQUIPMENT MOUNTING

- A. Prepare concrete surfaces of equipment pads as indicated in details on the Drawings and as required by the epoxy grout manufacturer. Epoxy grout for equipment mounting shall be placed and cured in accordance with the requirements of Section 43 05 13, details on the Drawings, and in conformance with manufacturer's recommendations.

3.04 ADHESIVE FOR GROUTING REINFORCING BAR DOWELS

- A. Follow manufacturer's instructions.

3.05 CONCRETE REPAIR MORTAR

- A. Concrete repair materials and procedures shall be submitted for review to the Owner's Representative and shall be accepted prior to commencement of the repair work.
- B. Follow all manufacturer's instructions, including those for minimum and maximum application thickness, surface preparation and curing. Add aggregate as required per manufacturer's recommendations. Any deviations from the manufacturer's instructions shall be submitted for review to the Owner's Representative and shall be accepted prior to commencement of the work.

3.06 CEMENT GROUT

- A. Cement grout shall be used for grout toppings less than four inches thick and for patching of fresh concrete.
- B. Grouting shall comply with temperature and weather limitations in Section 03 30 00, Cast-In-Place Concrete.
- C. Cure grout in accordance with grout manufacturer's instructions for prepackaged grout and Section 03 30 00, Cast-In-Place Concrete, for non-prepackaged cement grout.

END OF SECTION

SECTION 05 05 14
HOT-DIP GALVANIZING

PART 1 GENERAL

1.01 DESCRIPTION

- A. Section includes: Hot-dip galvanizing of steel materials.

1.02 RELATED SECTIONS

- A. This section contains specific references to the following related sections. Additional related sections may apply that are not specifically listed below.
1. Section 01 30 00 – Submittal Procedures
 2. Section 09 90 00 Painting and Coating

1.03 REFERENCES:

- A. The references listed below are a part of this section. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
ASTM A123	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A143	Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement
ASTM A153	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A384	Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies
ASTM A385	Providing High-Quality Zinc Coatings (Hot-Dip)
ASTM A780	Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM B6	Zinc
ASTM D6386	Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting
ASTM E536	Test Methods for Chemical Analysis of Zinc and Zinc Alloys
DOD-P-21035A	Paint, High Zinc Dust Content, Galvanizing Repair

1.04 SUBMITTALS

- A. Action Submittals
1. Procedure: Section 01 33 00:
 2. A copy of this specification section with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.
 3. Check-marks (✓) shall denote full compliance with a paragraph as a whole. Deviations shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Include a

detailed, written justification for each deviation. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

4. Coating applicator's Certificate of Compliance that the hot-dip galvanized coating meets or exceeds the specified requirements of ASTM A123 or A153, as applicable.
5. Evidence that the galvanized coating applicator is a member of the American Galvanizing Association.

1.05 QUALITY ASSURANCE

- A. Hot-dip galvanized coating applicator shall be a member of the American Galvanizing Association.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Zinc used for galvanizing shall conform to ASTM B6, and shall be at least equal to the grade designated as Prime Western.
- B. Maximum amount of aluminum added to a galvanizing bath shall not exceed 0.01 percent.
- C. Hot-Dip Galvanized Coating: Conform to ASTM A123 and A153, as applicable.
- D. Repair: Zinc dust-zinc oxide coating conforming to DOD-P-21035A and containing 95 percent zinc in the dry film. Acceptable product is ZRC Cold Galvanizing Compound by ZRC Worldwide, or approved equal.

2.02 FABRICATION REQUIREMENTS

- A. Fabrication practices for products to be galvanized: In accordance with applicable portions of ASTM A143, A384 and A385. Avoid fabrication techniques that could cause steel distortion or embrittlement.
- B. Coordinate with steel detailer to provide vent and drain holes of sufficient size and quantity to achieve specified galvanized coating.

PART 3 EXECUTION

3.01 PREPARATION

- A. Casting surfaces to be galvanized shall be sand blasted or ground smooth. When a smooth cast is required, castings shall be tumbled and all high spots ground flush. Castings shall be normalized to prevent cracking. Malleable iron shall be safeguarded against embrittlement by pre-annealing.
- B. Steel work shall be precleaned utilizing a caustic bath, acid pickle and flux or shall be blast cleaned and fluxed to obtain an acceptable surface for quality hot dip galvanizing.

3.02 APPLICATION

- A. Steel Members, Fabrications, and Assemblies: Hot-dip galvanize after fabrication in accordance with ASTM A123.
- B. Steel Bolts, Screws, Nuts, Washers and Hardware Components: Hot-dip galvanize in accordance with ASTM A153.

3.03 COATING REQUIREMENTS

- A. Hot-dip Coating Thickness: Conform to ASTM A123 or ASTM A153, as applicable.

3.04 TESTING

- A. Chemical analysis for impurities in the bath shall be made in conformity with ASTM E536.
- B. Test Requirements and Methods: In accordance with ASTM A123 or ASTM A153, as applicable.

3.05 GALVANIZED SURFACES TO BE PAINTED

- A. Where galvanized surfaces are specified to be painted in Section 09 90 00 or elsewhere in the Project Manual, conform to ASTM D6386.

3.06 REPAIR OF DEFECTIVE GALVANIZED COATING

- A. Where zinc coating has been damaged after installation, clean substrate surface and repair with zinc dust-zinc oxide coating in accordance with ASTM A780. Apply zinc dust-zinc oxide coating in accordance with manufacturer's recommendation. Apply multiple coats to achieve a minimum film thickness of 8 mils.
- B. Remove items not physically damaged, but which have insufficient or deteriorating zinc coatings, and items damaged in shipment or prior to installation, from the project site for repair by the hot-dip zinc coating method.

END OF SECTION

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SECTION 05 05 20
ANCHOR BOLTS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Bolts and all-thread rods used to attach structural elements and equipment to concrete. Included are cast-in-place and post-installed anchors (adhesive systems and wedge type expansion anchors), nuts and washers.
- B. Cast-in-place and post-installed anchors shall be Type 316 stainless steel unless noted otherwise.

1.01 RELATED SECTIONS

- A. This section contains specific references to the following related sections. Additional related sections may apply that are not specifically listed below.
 - 1. Section 01 73 24 Design Requirements for Nonstructural Components and Nonbuilding Structures
 - 2. Section 03 30 00 Cast-In-Place Concrete
 - 3. Section 03 60 00 Grouting
 - 4. Section 43 05 13 Rigid Equipment Mounts

1.02 REFERENCES

- A. The references listed below are a part of this section. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
ACI 318	Building Code Requirements for Structural Concrete
ASTM A193	Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
ASTM A194	Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
ASTM A320	Alloy-Steel and Stainless Steel Bolting for Low-Temperature Service
ASTM A563	Carbon and Alloy Steel Nuts
ASTM F593	Stainless Steel Bolts, Hex Cap Screws, and Studs
ASTM F594	Stainless Steel Nuts
ASTM F844	Washers, Steel, Plain (Flat), Unhardened for General Use
ASTM F1554	Anchor Bolts, Steel, 36, 55, 105-ksi Yield Strength
IBC	International Building Code with local amendments

1.03 SUBMITTALS

A. Action Submittals

1. Procedures: Section 01 33 00.
2. A copy of this specification section with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.
3. Check-marks (✓) shall denote full compliance with a paragraph as a whole. Deviations shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Include a detailed, written justification for each deviation. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
4. Anchor bolt placement plans.
5. Anchor bolt, nut, and washer material information, including material certifications.
6. Record copy of design calculations and details showing the required diameter, length, embedment, edge distance, confinement, anchor reinforcement, anchor bolt sleeves, connection redesign, and other conditions, stamped and signed by a Professional Engineer currently registered in the state of Utah. Calculations shall comply with the provisions of ACI 318-19, Chapter 17. Base anchor capacity determination on cracked concrete condition and compressive strength of new concrete per Section 03 30 00. Assume compressive strength of existing concrete is 3,000 psi unless otherwise noted.
7. Submit record copy of proof loading test results within five days after test.
8. Product Data:
 - a. ICC Evaluation Service Reports for post-installed adhesive type anchors and expansion (wedge type) anchors when allowed. Products shall be ICC approved for use in cracked concrete in high seismic areas (Seismic Design Category D, E and F).
 - b. Product data indicating load capacity charts/calculations.
 - c. Chemical resistance.
 - d. Temperature limitations.
 - e. Manufacturers written installation instructions.
9. Installer certification for horizontal or upwardly inclined adhesive anchors in accordance with ACI/CRSI Adhesive Anchor Installer Certification Program.

1.04 QUALITY ASSURANCE

A. Quality Assurance By Owner

1. Special inspection of anchor bolts shall be performed by the Special Inspector under contract with the Owner and in accordance with IBC Chapter 17.
2. [A [five] percent sample of installed post-installed anchors shall be proof-loaded by an independent laboratory contracted by the Contractor. The quantity of samples and locations shall be coordinated with the Owner's Representative.]

3. Adhesive anchors installed in horizontal or upwardly inclined orientations to resist sustained tension loads shall be continuously inspected during installation by a Special Inspector.
 4. The Special Inspector shall furnish a report to the Engineer, Owner's Representative, and Building Official that the work covered by the report has been performed and that the materials used and the installation procedures used conform with the approved Project Manual and the Manufacturer's Printed Installation Instructions (MPII).
- B. Certifications
1. Installer certification shall be in accordance with ACI/CRSI Adhesive Anchor Installer Certification Program for installers of horizontal or upwardly inclined adhesive anchors.

PART 2 PRODUCTS

2.01 GENERAL

- A. Anchor bolt holes in equipment support frames shall not exceed the bolt diameters by more than 1/4 inch. Minimum anchor bolt diameter shall be 1/2 inch.
- B. Tapered washers shall be provided where mating surface is not square with the nut.
- C. Anchor bolts shall be cast-in-place anchors unless post-installed anchors are specified or shown on the Drawings. Substitution of post-installed anchors will not be permitted unless specifically requested by the Contractor and approved by the Engineer.

2.02 PERFORMANCE/DESIGN CRITERIA

- A. Anchor bolts for equipment shall be designed by the equipment manufacturer to include equipment operational loads combined with seismic and wind forces when applicable. Design criteria provided in Section 01 73 24.
- B. Design anchor bolts for support and bracing of non-structural components and non-building structures for loading specified in Section 01 73 24.

2.03 MATERIALS

- A. Anchor bolt materials shall be as specified in the following table:

Material	Specification
Stainless Steel Anchor Bolts	ASTM A193 or A320, Type 316
Stainless Steel Threaded Rods	ASTM F593, Type 316
Stainless Steel Nuts	ASTM A194 Heavy Hex Nuts, Type 316 ASTM F594 Heavy Hex Nuts at Adhesive Anchors, Type 316
Stainless Steel Washers	Type 316 to match bolt material
Carbon Steel Anchor Bolts	ASTM F1554, Grade 36, Hot Dip Galvanized
High-Strength Carbon Steel Anchor Bolts	ASTM F1554, Grade 55, Weldable per Supplementary Requirement S1, Hot Dip Galvanized

Material	Specification
Carbon Steel Nuts and Washers	ASTM A563 and F844, Heavy Hex, Hot-Dip Galvanized
Concrete Adhesive Anchors	Hilti "HIT-RE 500v3", Simpson Strong-Tie "SET-XP", or approved equal, with Type 316 Stainless Steel threaded rods
Concrete Masonry Adhesive Anchors	Hilti "HIT-HY 70", Simpson Strong-Tie "SET-XP", or approved equal, with Type 316 Stainless Steel threaded rods
Concrete Masonry Expansion (wedge) Anchors*	Hilti "KWIK BOLT 3", or approved equal, Type 316 Stainless Steel
Concrete Expansion (wedge) Anchors *	Hilti "KWIK BOLT TZ", or approved equal, Type 316 Stainless Steel

**Post installed anchors shall always be an adhesive type anchor system except where noted otherwise or when Contractor makes a request for a specific application and Engineer approves.*

2.04 STAINLESS STEEL FASTENER LUBRICANT (ANTI-SEIZING)

A. Anti-seizing Lubricant for Stainless Steel Threaded Connections:

1. Formulated to resist washout.
2. Acceptable manufacturers are Bostik, Saf-T-Eze, or equal.

2.05 ANCHOR BOLT SLEEVES

- ### A. Provide anchor bolt sleeves as shown on design drawings and as required by equipment manufacturer's design.
1. Provide high density polyethylene plastic sleeves of single unit construction with deformed sidewalls such that the concrete and grout lock in place.
 2. The top of the sleeve shall be self-threading to provide adjustment of the threaded anchor bolt projection.
 3. Acceptable manufacturers are Contec, Wilson, or equal.

PART 3 EXECUTION

3.01 GENERAL

- A. Anchor bolts shall be cast-in-place anchors unless post-installed anchors are specified or shown on the Drawings.
- B. Grouting of anchor bolts using plastic sleeves with non-shrink or epoxy grout, where specified, shall be in accordance with Section 03 60 00.
- C. The threaded end of anchor bolts and all-thread rods shall be long enough to project through the entire depth of the nut and if too long, shall be cut off at ½-inch beyond top of nut and ground smooth.

3.02 CAST-IN-PLACE ANCHOR BOLTS

- A. Anchor bolts to be embedded in concrete shall be placed accurately and held in correct position using templates while the concrete is placed.

- B. After anchor bolts have been embedded, their threads shall be protected by grease and the nuts run on.

3.03 ADHESIVE ANCHOR BOLTS

- A. Note that adhesive anchors shall not be substituted for cast-in-place anchor bolts unless the adhesive anchors have been specified or shown on the Drawings, or approval has been obtained from the Engineer that substitution of adhesive anchors is acceptable for the specific use and location. Use of adhesive anchors shall be subject to the following conditions:
 - 1. Limit to locations where intermittent or continuous exposure to the following is extremely unlikely:
 - a. Acid concentrations higher than 10 percent
 - b. Chlorine gas
 - c. Machine or diesel oils
 - 2. Limit to applications where exposure to the following is extremely unlikely:
 - a. Fire
 - b. Concrete or rod temperature above 120 degrees F
 - 3. Overhead applications (such as pipe supports) shall not be allowed unless approved by the Engineer and installation is by an Installer specially certified for overhead applications.
 - 4. Approval from Engineer for specific application and from supplier of equipment to be anchored, if applicable.
 - 5. Anchor diameter and material shall be per Contract Documents or equipment manufacturer's specifications. Anchor shall be threaded or deformed the full length of embedment and shall be free of rust, scale, grease, and oils.
 - 6. Embedment depth shall be as specified or as required by the equipment manufacturer.
 - 7. Follow the anchor system manufacturer's installation instructions.
 - 8. Holes shall have rough surfaces created by using a hammer drill with carbide bit. Core drilled holes are not allowed.
 - 9. Holes shall be blown clean with oil-free compressed air and be free of dust or standing water prior to installation. Follow additional requirements of the adhesive manufacturer.
 - 10. Concrete and air temperature shall be compatible with curing requirements of adhesives per adhesive manufacturer's instructions. Anchors shall not be placed in concrete when the temperature is below 25 degrees F.
 - 11. Anchors shall be left undisturbed and unloaded for full adhesive curing period, which is based on temperature of the concrete.

3.04 EXPANSION ANCHORS

- A. Expansion (wedge type) anchors shall not be substituted for cast-in-place anchor bolts or adhesive anchors unless approved by the Engineer for a specific application. Use of expansion anchors shall be subject to conditions [4 through 9] as specified above for adhesive anchors. Expansion anchors shall not be used in a submerged condition or in mounting of equipment subject to vibration or cyclic motion.

3.05 REINFORCING STEEL CONFLICTS WITH POST-INSTALLED ANCHOR INSTALLATION

- A. When reinforcing steel is encountered in the drill path, slant drill to clear obstruction and provide beveled washer to match angle of anchor. Drill shall not be slanted more than 10 degrees.
- B. Where slanting the drill does not resolve the conflict, notify the Owner's Representative and resolve the conflict to the satisfaction of the Owner's Representative in consultation with the Engineer.
- C. Abandoned post-installed anchor holes shall be cleaned and filled with non-shrink grout and struck off flush with adjacent surface.
- D. The costs of determining and executing the resolution shall be borne by the Contractor. The determination and execution of the resolution shall not result in additional cost to the Owner.
- E. Reinforcing steel in masonry shall not be damaged.
- F. In order to avoid or resolve a conflict, locate embedded reinforcing steel using non-destructive methods and/or redesign the attachment.
 - 1. Redesign shall be done by the Contractor's Professional Engineer currently registered in the state of Utah.
 - 2. Calculations and details for redesign shall be submitted.

END OF SECTION

SECTION 05 10 00
STRUCTURAL METAL FRAMING

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Structural metals consisting of standard shapes, hollow sections, fasteners, and plates that are used in structural framing and connections.

1.02 RELATED SECTIONS

- A. This section contains specific references to the following related sections. Additional related sections may apply that are not specifically listed below.
1. Section 01 33 00 Submittal Procedures
 2. Section 05 05 20 Anchor Bolts
 3. Section 05 05 14 Hot Dip Galvanizing
 4. Section 09 90 00 Painting

1.03 REFERENCES

- A. The references listed below are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.
- B. The references listed below indicate those documents in effect at the time of Advertisement for Bids, Invitation to Bid, or on the effective date of the Agreement if there were no Bids. Where documents are referenced in applicable local, state, or federal codes, use the version reference by date in the individual code. If referenced documents are not specifically identified in the applicable code(s), reference to those documents shall indicate the latest version of the documents available at the time of Advertisement for Bids. If referenced documents have been discontinued by the issuing organization, reference to those documents shall mean the latest version of replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. When document dates are given in the following listing that are not specifically referenced in an applicable code, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced. For questions, refer to Engineer.

Reference	Title
Aluminum Association ADM	Aluminum Design Manual
AISC 207	Certification Programs
AISC 303	Code of Standard Practice for Steel Buildings and Bridges

Reference	Title
AISC 313	Code of Standard Practice for Structural Stainless Steel Buildings
AISC 325	Steel Construction Manual
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
AISC 370	Specification for Structural Stainless Steel Buildings
AISC DG 10	Erection Bracing of Low-Rise Structural Steel Buildings
AISC DG 27	Structural Stainless Steel
ASTM A6	General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
ASTM A36	Carbon Structural Steel
ASTM A53	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A193	Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
ASTM A194	Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
ASTM A276	Stainless Steel Bars and Shapes
ASTM A312	Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
ASTM A320	Alloy-Steel and Stainless Steel Bolting for Low Temperature Service
ASTM A380	Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems
ASTM A384	Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies
ASTM A480	General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip
ASTM A484	General Requirements for Stainless Steel Bars, Billets, and Forgings
ASTM A500	Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A554	Welded Stainless Steel Mechanical Tubing
ASTM A529	High-Strength Carbon Manganese Steel of Structural Quality
ASTM A563	Carbon and Alloy Steel Nuts
ASTM A572	High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A999	General Requirement for Alloy and Stainless Steel Pipe
ASTM A992	Structural Steel Shapes
ASTM A1069	Laser and Laser Hybrid Welded Stainless Steel Bars, Plates, and Shapes
ASTM A1085	Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS)
ASTM B209	Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B241	Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube
ASTM B308	Aluminum-Alloy 6061-T6 Standard Structural Profiles
ASTM F959	Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners, Inch and Metric Series
ASTM F3125	High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength
ASTM F436	Hardened Steel Washers Inch and Metric Dimensions
ASTM F593	Stainless Steel Bolts, Hex Cap Screws, and Studs
ASTM F594	Stainless Steel Nuts

Reference	Title
AWS-B2.1	Welding Procedure and Performance Qualification
AWS D1.1	Structural Welding Code – Steel
AWS D1.2	Structural Welding Code – Aluminum
AWS D1.6	Structural Welding Code – Stainless Steel
AWS D1.8	Structural Welding Code – Seismic Supplement
RCSC	Structural Joints Using High Strength Bolts
IBC	International Building Code with local amendments
Local Code	Local building code if differs from IBC

1.04 SUBMITTALS

A. Action Submittals:

1. Procedures: Section 01 33 00.
2. A copy of this specification section with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.
3. Check-marks (✓) shall denote full compliance with a paragraph as a whole. Deviations shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Include a detailed, written justification for each deviation. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
4. Shop drawings for approval prior to fabrication. Shop drawings shall not be reproductions of the Drawings. Include complete information for the fabrication and erection of the structure's components, including the location, type, and size of bolts, welds, member sizes and lengths, coatings, connection details, blocks, copes, and cuts. Substitutions of details shown on the Drawings shall be clearly highlighted on the fabrication drawings. Explain the reasons for any deviations from the Drawings.
5. Certification that steel Fabricator is approved to perform steel fabrication without special inspection.
6. AISC quality certification: Evidence that steel Fabricator has AISC 207 Certification as a AISC Certified Plant, Category BU (Certified Building Fabricator). Certificate to show name and address of certified firm, effective date, and category of certification.
7. Welding procedures, qualifications, and inspection report.
8. Certified mill test reports for structural steel and high-strength bolts and nuts.
9. In accordance with IBC Chapter 17, Fabricator at the completion of fabrication to submit Certification of Compliance stating that the fabrication was performed in accordance with the design documents.
10. Certified copies of all surveys conducted by a registered professional engineer or surveyor showing elevations and locations of base plates and anchor bolts to receive structural steel or aluminum, and final elevations and locations for major members. Indicate discrepancies between actual installation and contract documents.

1.05 QUALITY ASSURANCE

A. Quality Control by Owner:

1. Special Inspection of structural metals work shall be performed by the Special Inspector under contract with the Owner and in conformance with the IBC Chapter 17. Special Inspector(s) and laboratory shall be acceptable to the Owner in their sole discretion. Special Inspection of structural metals is in addition to, but not replacing, other inspections and quality control requirements herein. Where sampling and testing required herein conforms to Special Inspection standards, such sampling and testing need not be duplicated.
2. All structural steel work shall receive Special Inspection in accordance with IBC, Chapter 17. Structural steel includes all steel elements that resist code-defined loads and whose failure would affect life safety. Items to be inspected include, but are not limited to, mechanical / electrical supports, beams, stringers, columns, access walkways, and stairways.

B. Fabricator Qualifications:

1. A qualified Fabricator must participate in the AISC 207 Certification program and be designated an AISC Certified Plant, Category BU (Certified Building Fabricator).

PRODUCTSMATERIALS

A. Steel:

1. Materials for structural steel shall be as specified in Table A.

Table A - Steel Materials

Material	Specification
M-shapes	ASTM A36
S-shapes	ASTM A36
Channels	ASTM A36
Angles	ASTM A36
Plates	ASTM A36
HP-shapes	ASTM A572 Grade 50
Rolled wide-flange sections (W-shapes) and WTs	ASTM A992
Pipe sections	ASTM A53, Type E or S, Grade B (Fy = 35 ksi)
Round Hollow Structural Sections (HSS)	ASTM A500, Grade C (Fy=46 ksi) ASTM A1085 Grade A
Square and Rectangular Hollow Structural Sections (HSS)	ASTM A500, Grade C (Fy = 50 ksi) ASTM A1085 Grade A
Stainless steel bolts (used at stainless steel and aluminum framing unless noted otherwise)	ASTM F593, Type 316
Stainless steel nuts and washers (used at stainless steel and aluminum framing unless noted otherwise)	ASTM F594, Type 316
Steel bolts (used at galvanized and painted steel framing)	Galvanized ASTM F3125 Gr. A325

Table A - Steel Materials

Material	Specification
Carbon steel nuts and washers	Galvanized ASTM A563 nuts and galvanized ASTM F436 washers
Anchor bolts	Refer to Section 05 05 20

B. Stainless Steel:

1. Materials for structural stainless steel shall be as specified in Table B. All stainless steel shall be passivated per ASTM A380.

Table B - Stainless Steel Materials

Material	Specification
Hot-rolled and extruded structural shapes	ASTM A276, Type 304, finish per ASTM A484
Hollow structural sections (HSS)	ASTM A554, Type 304, finish per ASTM A554
Welded round pipe	ASTM A312, Type 304, finish per ASTM A999
Built-up I-shape, channel, angle, tee, & box section shapes (laser & laser hybrid)	ASTM A276, Type 304, finish per ASTM A1069
Bolts	Use stainless steel bolts for stainless steel framing (see Table A above)
Plates	ASTM A480, Type 304, finish per ASTM A480
Anchor bolts	Refer to Section 05 05 20

C. Aluminum:

1. Materials for structural aluminum shall be as specified in Table C.

Table C - Aluminum Materials

Material	Specification
Structural shapes	Alloy 6061-T6 per ASTM B308
Bolts	Use stainless steel bolts for aluminum framing (see Table A above)
Guardrail and handrail pipe	Alloy 6061-T6 or 6063-T6 per ASTM B241
Plates	Alloy 6061-T6 per ASTM B209
Anchor bolts	Refer to Section 05 05 20

PART 3 EXECUTION**3.01 GOVERNING DOCUMENTS**

- A. The following paragraphs are primarily written to be applicable to structural steel. Where stainless steel or aluminum are utilized the applicable governing document(s) for that material shall be adhered to as necessary.

3.02 EXAMINATION

- A. Examine and accept conditions before beginning work.

3.03 FABRICATION

- A. Fabrication of steel shall be in accordance with the applicable provisions of the AISC Steel Construction Manual and AISC 360. Fabrication of stainless steel shall be in accordance with the applicable provisions of AISC 313 and AISC 370. Fabrication of aluminum shall be in accordance with Aluminum Design Manual. Fabrication and assembly shall be done in the shop to the greatest extent possible. The fabricating plant shall be certified under AISC 207 for Category BU.
- B. Compression joints depending on contact bearing shall have a surface roughness not more than 500 micro-inches and ends shall be square within the tolerances for milled ends specified in ASTM A6.
- C. Shop splices of members will be permitted only where indicated on the Drawings. Splices not indicated require the approval of the Owner's Representative.
- D. Verify measurements at the job site prior to fabrication. Fabricate to match job site measurements.
- E. Provide bolt holes as necessary for securing other work to structural framing, and passage of other work through steel framing members. Conform to AISC 325 and AISC 360 guidelines or contact Owner's Representative for approval for bolt holes not indicated on drawings.
- F. Other work shall be routed around structural steel framing members to the extent possible. Where not indicated on the design drawings, additional cuts, alterations, and holes for the passage of other work through steel framing members require the approval of the Owner's Representative and shall be addressed in accordance with AISC 303.

3.04 INSTALLATION

- A. General:
 - 1. Erection of structural steel shall be in accordance with the applicable provisions of AISC Steel Construction Manual (AISC 325). Erection plan shall conform to AISC 303. For low-rise structural steel buildings, 60 feet tall or less and a maximum of 2 stories, the structure shall be erected in accordance with AISC Design Guide 10.
 - 2. Coordinate installation of anchor bolts and other connectors required for securing structural steel in place. Refer to Section 05 05 20 for additional information regarding anchor bolts.
 - 3. Employ a registered professional engineer or surveyor for accurate erection of the structural framing. Check elevations of concrete and locations of anchor bolts before erection proceeds and report discrepancies to the Owner's Representative.
 - 4. Placement tolerances shall be in accordance with AISC 303 and AISC 360
 - 5. After final positioning of members, provide full bearing under base plates and bearing plates using non-shrink grout. Place non-shrink grout in accordance with the Manufacturer's instructions. Grout shall be cured prior to loading of the structure.
 - 6. Protect dissimilar metals from galvanic corrosion by means of pressure tapes, coatings, or isolators. Protect aluminum in contact with concrete or grout with a heavy coat of bituminous paint.
 - 7. Metalwork to be embedded in concrete shall be placed accurately and held in correct

position while the concrete is placed. The surfaces of metalwork in contact with or embedded in concrete shall be thoroughly cleaned without damaging any metalwork coatings (if applied).

8. Structural steel completely encased in concrete shall not be galvanized or painted and shall have a clean surface for bonding to concrete.
9. Metalwork which is bent, broken or otherwise damaged shall be repaired or replaced at the Contractor's expense.

B. Welding:

1. Welding shall be done by welders, welding operators, and tackers who have been qualified by tests as prescribed by AWS to perform the type of work required. The quality of welding shall conform to AWS Codes.
2. Develop and submit the Welding Procedure Specifications (WPS) for all welding, including welding done using prequalified procedures.
3. Provide continuous seal welds for plates or structural shapes that are exposed to or submerged in water or wastewater.

C. Bolted Connections:

1. Bolted connections, unless noted otherwise, shall conform to AISC 360 and the RCSC and shall be bearing type connections with bolts pretensioned unless connecting HSS shapes which shall be snug-tight. Punch, subpunch and ream, or drill bolt holes perpendicular to the surface of the member. Finished holes shall be 1/16 inch larger than the nominal size of the bolts, unless otherwise specified. Bolts, nuts, and washers shall be clean of dirt and rust and lubricated immediately prior to installation. No drifting of bolts or enlargement of holes will be allowed to correct misalignment. Holes shall not be cut or enlarged by burning. Mismatched holes shall be corrected with new material. Bolts may not be re-used. Specifics to bolted connection types are as follows:
 - a. Snug-tight: Typical bearing type connections per the requirements of the RCSC specification. Note that thru-bolted HSS connections are only allowed to be snug-tight.
 - b. Pretensioned: Where required as noted on design drawings. Bolts shall be pretensioned per the requirements of the RCSC specification.

3.05 CORROSION PROTECTION

- A. Unless otherwise specified, carbon steel shall be galvanized. If coatings are indicated on the Drawings or elsewhere in the Specifications, coat in accordance with Section 09 90 00. Coating surface preparation shall be as specified in Section 09 90 00 and shall include the following operations:
1. Grind the exterior and interior edges of all flame-cut plates or members to a smooth surface.
 2. Grind all sharp edges from sheared plates and punched holes.
 3. Grind uneven or rough welds with high beads to a smooth finish.

3.06 CLEANING

- A. After installation, damaged surfaces of shop primed metals shall be cleaned and touched up with the same material used for the shop coat. Damaged surfaces of galvanized metals

shall be repaired as specified in Section 05 05 14.

END OF SECTION

SECTION 05 50 00
METAL FABRICATIONS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
1. Custom fabricated metal items and certain manufactured units not otherwise indicated to be provided under work of other specification sections.
 2. Seat angle frames
 3. Fall arrest anchors
 4. Iron castings
 5. U-channel concrete inserts
 6. Cover plates and frames
 7. Pipe sleeves
 8. Clarifier bridge walkways
 9. Miscellaneous metal fabrications not covered elsewhere

1.02 RELATED SECTIONS

- A. This section contains specific references to the following related sections. Additional related sections may apply that are not specifically listed below.
1. Section 01 73 24 Design Requirements for Nonstructural Components and Nonbuilding Structures
 2. Section 05 05 14 Hot-Dip Zinc Coating
 3. Section 05 05 20 Anchor Bolts
 4. Section 05 10 00 Structural Metal Framing
 5. Section 05 52 10 Aluminum Railings
 6. Section 05 53 10 Metal Gratings and Stair Treads
 7. Section 09 90 00 Painting and Coating

1.03 REFERENCES

- A. The references listed below are a part of this section. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
Aluminum Design Manual	The Aluminum Association, Aluminum Design Manual with Specifications and Guidelines for Aluminum Structures
AISC 303	Code of Standard Practice for Steel Buildings and Bridges
AISC 360	Specification for Structural Steel Buildings
AISC Steel Construction Manual	American Institute of Steel Construction, Manual of Steel Construction

Reference	Title
ANSI A14.3	Standard for Ladders - Fixed - Safety Requirements
ASTM A36	Carbon Structural Steel
ASTM A48	Gray-Iron Castings
ASTM A53	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A108	Steel Bar, Carbon and Alloy, Cold-Finished
ASTM A123	Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A193	Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
ASTM A194	Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
ASTM A240	Chromium and Chromium Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM A276	Stainless Steel Bars and Shapes
ASTM A283	Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A307	Carbon Steel Bolts, Studs, and Threaded Rod 60000 psi Tensile Strength
ASTM A312	Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
ASTM A320	Alloy-Steel Bolting Materials for Low Temperature Service
ASTM A325	Structural Bolts, Steel, Heat Treated 120/105 ksi Minimum Tensile Strength
ASTM A380	Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems
ASTM A384	Standard Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies
ASTM A489	Carbon Steel Lifting Eyes
ASTM A500	Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A554	Welded Stainless Steel Mechanical Tubing
ASTM A563	Carbon and Alloy Steel Nuts
ASTM A572	High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A653	Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy Coated (Galvannealed) by the Hot Dip Process
ASTM A780	Repair of Damaged and Uncoated Areas of Hot Dip Galvanized Coatings
ASTM A786	Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates
ASTM A793	Rolled Floor Plate, Stainless Steel
ASTM A924	Steel Sheet, Metallic-Coated by Hot-Dip Process
ASTM A992	Structural Steel Shapes
ASTM A1011	Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
ASTM B209	Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B210	Aluminum and Aluminum-Alloy Drawn Seamless Tubes
ASTM B211	Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire
ASTM B221	Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B241	Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube
ASTM B308	Aluminum-Alloy 6061-T6 Standard Structural Profiles
ASTM B429	Aluminum-Alloy Extruded Structural Pipe and Tube
ASTM B632	Aluminum-Alloy Rolled Tread Plate

Reference	Title
ASTM D1056	Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM F436	Hardened Steel Washers
ASTM F468	Nonferrous Bolts, Hex Cap Screws, SocketHead Cap Screws and Studs for General Use
ASTM F593	Stainless Steel Bolts, Hex Cap Screws, and Studs
ASTM F594	Stainless Steel Nuts
AWS D1.1	Structural Welding Code - Steel
AWS D1.2	Structural Welding Code - Aluminum
AWS D1.6	Structural Welding Code - Stainless Steel
OSHA 29 CFR 1910.27	Fixed Ladders
OSHA 29 CFR 1926.502	Fall Protection Systems Criteria and Practices
SSPC SP5	White Metal Blast Cleaning
IBC	International Building Code

1.04 DEFINITIONS

A. Galvanize: Hot-dip galvanize per ASTM A123 or ASTM A153, per Section 05 05 14.

1.05 SUBMITTALS

A. Action Submittals:

1. Procedures: Section 01 33 00
2. A copy of this specification section with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.
3. Check-marks (✓) shall denote full compliance with a paragraph as a whole. Deviations shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Include a detailed, written justification for each deviation. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration
4. Manufacturer's product data.
5. Detailed Shop Drawings:
 - a. Fabrication drawings showing layouts, connections to structural system, and anchoring details.
 - b. Erection and installation drawings indicating thickness, type, grade, class of metal, coating system and dimensions.
 - c. Construction details, reinforcement, anchorage, and installation with relation to the building construction.
6. Welding procedures and welder certificates and qualifications.
7. U-Channel Concrete Inserts: Manufacturer's product description and allowable load tables.
8. Passivation method for stainless steel fabrications.
9. Fall Arrest Anchor Certificate:

- a. Certify fall arrest system is designed to meet OSHA 29 CFR 1926.502 specified performance requirements.
- b. Signed and sealed by a Professional Engineer licensed in the state in which the project is located.

1.06 QUALITY ASSURANCE

- A. Qualifications
 1. Fabricator shall have a minimum of five years experience in fabrication of metal specified.
- B. Certificates
 1. Certified welding procedures and welding operators in accordance with AWS. Welding operator certificates shall be no more than one-year old and the welder shall have used the welding process to be performed within the last six months.
- C. The use of salvaged, reprocessed or scrap materials will not be permitted.
- D. Shop Assembly: Items in the shop shall be preassembled to the greatest extent possible, so as to minimize field splicing and assembly of units. Units shall be disassembled only to the extent necessary for shipping and handling limitations. Units shall be clearly marked for reassembly and coordinated installation.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Avoid damage during delivery and handling of fabrications.
- B. Store off the ground on skids or other supports to keep items free of dirt and other foreign debris and to protect against corrosion.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Materials for miscellaneous metalwork are specified in the following table.

Material	Specification
Steel	
Sheets, plates and shapes (except W shapes)	ASTM A36
W shapes	ASTM A992
Pipe	ASTM A53, Grade B
Square/rectangular tubing	ASTM A500, Grade C
Headed Anchor Studs	ASTM A108
Carbon steel bolts	ASTM A307, Grade A
High strength bolts	ASTM A325 (Type 1)
Nuts	ASTM A563
Washers	ASTM F436

Material	Specification
Stainless Steel	
Sheet and Plates	ASTM A240, Type 304
Shapes, bars, and similar items	ASTM A276, Type 304
Pipe	ASTM A312, Type 304
Headed Anchor Studs	ASTM A276, Type 316L
Bolts	ASTM F593, Type 316
Nuts	ASTM F594, Type 316
Aluminum	
Sheets and plates	ASTM B209, Type 6061-T6
Bars, flats and similar items	ASTM B211 or B221, Type 6061-T6
Shapes	ASTM B308, Type 6061-T6
Round tubing and pipe	ASTM B241, Type 6061-T6
Square and rectangular tubing	ASTM B221, Type 6063-T52
Pipe	ASTM B211 or B241, Type 6061-T6
Bolts, Stainless Steel	ASTM F593, Type 316
Nuts, Stainless Steel	ASTM F594, Type 316
Checker Plate	
Steel	ASTM A786
Stainless steel	ASTM A793, Type 304
Aluminum	ASTM B632, Type 6061-T6
Other steel items	
Iron castings	ASTM A48
Eyebolts	ASTM A489
Threaded rods	ASTM A36

2.02 FABRICATION

A. General

1. Conform to AISC or Aluminum Association standards as applicable. Where Code defined loads apply, also conform to IBC requirements.
2. Shop and field welding shall conform to the requirements of AISC, the Aluminum Design Manual, and applicable AWS procedures and specifications as required by the material being welded.
3. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt, tight, flush, and hairline. Remove burrs and weld splatter. Ease exposed edges to small uniform radius.
4. Holes shall be punched 1/16 inch larger than the nominal size of the bolts, unless otherwise specified. Whenever needed, because of the thickness of the metal, holes shall be subpunched and reamed or shall be drilled.

5. Fabrication, including cutting, drilling, punching, threading and tapping required for fabrications or adjacent work, shall be performed prior to galvanizing.
- B. Seat Angle Frames
1. Provide recessed seat angle frames for grating and floor plates. Miter corners to ensure accurate fit. Match depth of recess with grating or floor plate thickness. Anchor frames in concrete with headed studs. Steel angle support frames shall be stainless steel, ASTM A276, Type 316, unless indicated otherwise.
- C. Fall Arrest Anchors
1. Fall arrest anchors shall meet requirements of OSHA 29 CFR 1926.502. Anchorages attached to personal fall arrest equipment shall be capable of supporting at least 5,000 pounds per employee attached, or shall be designed, installed, and used as part of a complete personal fall arrest system which maintains a safety factor of at least two. Type of anchor shall fit the application and substrate material.
 2. Fall arrest anchors shall be manufactured by:
 - a. Thaler Metal Industries
 - b. DBI-SALA
 - c. Approved Equal
- D. Iron Castings
1. Castings shall be as specified on the Drawings. Castings weighing less than 100 pounds shall be galvanized after machining. Castings weighing greater than 100 pounds shall be galvanized where specified.
- E. U-Channel Concrete Inserts
1. U-Channel Concrete Inserts shall be [galvanized or stainless steel] conforming to attachment hardware and materials attached. Channels shall be 1 5/8 inch wide by 1 3/8 inch deep with a minimum thickness of 0.105 inches. Channels shall be open-bottom with curved or lipped flange edges to engage standard nuts and connection hardware. Load rating shall meet or exceed a 2,000 pound point load at 12 inch minimum spacing. Provide standard accessories and hardware per manufacturers recommendations.
- F. Pipe Sleeves
1. Unless otherwise indicated on the Drawings, fabricate pipe sleeves from schedule 40 steel pipe with 3/16 inch thick by 3 feet wide seep ring continuously seal welded to the outside of the pipe. Galvanize after fabrication in accordance with ASTM A123.
- G. Other Miscellaneous Steel Metalwork
1. Other miscellaneous steel metalwork including embedded and non-embedded steel metalwork, hangers and inserts shall be as specified or shown on the Drawings, and shall be galvanized after fabrication unless otherwise noted.

2.03 FINISHES

A. Galvanizing

1. Galvanize items specified to be zinc-coated, after fabrication where practicable. Galvanizing in accordance with ASTM A123, ASTM A153, ASTM A653 or ASTM A924,

Z275 G90, as applicable. Galvanize anchor bolts, grating fasteners, washers, and parts or devices necessary for proper installation, unless indicated otherwise.

2. Repair damaged Zinc-Coated surfaces with galvanizing repair method and paint conforming to ASTM A780 or by application of stick or thick paste material specifically designed for repair of galvanizing, as approved by Owner's Representative.
3. Safeguard against warpage and distortion during galvanizing of steel in accordance with ASTM A384. Straighten items after galvanizing so that they are straight, free of racking and distortion.

B. Shop Painting

1. Prepare and coat surfaces in accordance with Section 09 90 00.
2. Steel to be embedded in concrete shall be free of dirt and grease.

C. Aluminum Surfaces

1. Surface condition aluminum before finishes are applied. Remove roll marks, scratches, rolled-in scratches, kinks, stains, pits, orange peel, die marks, structural streaks, and other defects which will affect uniform appearance of finished surfaces.
2. Aluminum finishes for unexposed sheet, plate and extrusions may have mill finish as fabricated.
3. Provide other aluminum items with a standard mill finish.
4. Provide a coating thickness not less than that specified for protection.
5. Provide decorative type finishes for items used in interior occupied locations or architectural type finish for items used in exterior locations.
6. Provide a polished satin finish on items to be anodized.

D. Stainless Steel Passivation

1. Stainless steel to be cleaned, descaled, and passivated after fabrication in accordance with ASTM A380. Passivate to remove iron compounds from the surface of the stainless steel.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify measurements at the site. Include field dimensions in shop drawings.
- B. Examine and accept existing conditions before beginning work.

3.02 PREPARATION

- A. Make provisions for erection loads with temporary bracing. Keep work in alignment.
- B. Supply items required to be cast into concrete or embedded in masonry with setting templates.

3.03 INSTALLATION

- A. Install items plumb, level and square, accurately fitted, and free from distortion or defects. Install rigid, substantial, and neat in appearance.
- B. Allow for erection loads and provide temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- C. Fieldwork shall not be permitted on galvanized items. Drilling of bolts or enlargement of holes to correct misalignment will not be allowed.
- D. Protect encased or embedded dissimilar metals (both metals must be encased or embedded) from galvanic corrosion by means of pressure tapes, coatings or isolators.
- E. Place metalwork to be embedded in concrete accurately and hold in correct position while the concrete is placed or, if indicated, form recesses or blockouts in the concrete. Thoroughly clean the surfaces of metalwork in contact with or embedded in concrete.
- F. Seat angles, supports and guides: Set seat angles for grating and supports for floor plates so that they maintain the grating and floor plates flush with the floor.
- G. Ladder Safety Post: Comply with manufacturer's installation instructions.
- H. Pipe Sleeves: Provide where pipes pass through concrete or masonry. Holes drilled with a rotary drill may be provided in lieu of sleeves in existing walls. Provide a center flange for water stoppage on sleeves in exterior or water bearing walls. Provide a rubber caulking sealant or a modular mechanical unit to form a watertight seal in the annular space between pipes and sleeves.
- I. U-Channel Concrete Inserts: Provide as indicated for pipe supports and where otherwise specified or shown on Drawings.
- J. Fastening to Construction-In-Place: Provide anchorage devices and fasteners where necessary for fastening fabricated items to construction-in-place. Design anchorage devices in accordance with Section 01 73 24. Anchor bolts to be in accordance with Section 05 05 20.
- K. Railing: Adjust railing systems before anchoring to ensure matching alignment at abutting joints. Space posts at spacing required by design loads and as limited on Drawings. Plumb posts in each direction.

3.04 REPAIR/RESTORATION

- A. Galvanized
 - 1. Maximum area to be repaired shall not be more than 1/2 of 1 percent of the surface area or 36 sq. in. per ton of piece weight, whichever is less. Damage in excess of this requirement shall be repaired by stripping and recoating entire piece.
 - 2. Clean damaged areas to SSPC-SP5. Repair with zinc-rich paint in accordance with the manufacturer's instructions and with ASTM A780, Annex A2. Minimum thickness requirements shall be in accordance with ASTM A123.
 - 3. Use zinc-rich repair paint. Acceptable manufacturers:

- a. LPS, Cold Galvanize
 - b. ZRC Worldwide, ZRC Galviline
 - c. Approved Equal
- B. Painted
 - 1. After installation, clean and touch up damaged areas with the same materials used for the shop coat.

3.05 FIELD QUALITY CONTROL

- A. Electrolytic Protection
- B. Protect dissimilar metals from galvanic corrosion by means of pressure tapes, coatings, or isolators. Aluminum in contact with concrete or grout shall be protected with a heavy coat of bituminous paint.
- C. Stainless Steel
 - 1. During handling and installation, take necessary precautions to prevent carbon impregnation of stainless steel members.
 - 2. After installation, visually inspect stainless steel surfaces for evidence of iron rust, oil, paint, and other forms of contamination.
 - 3. Remove contamination in accordance with requirements of ASTM A380.
 - 4. Brushes used to remove foreign substances shall utilize only stainless steel or nonmetallic bristles.

END OF SECTION

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SECTION 05 52 10
ALUMINUM RAILINGS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Prefabricated anodized aluminum component type guardrail and handrail systems; herein referred to as railing.

1.02 RELATED SECTIONS

- A. This section contains specific references to the following related sections. Additional related sections may apply that are not specifically listed below.
1. Section 03 30 00 Cast-in-Place Concrete.

1.03 REFERENCES

- A. The references listed below are a part of this section. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
Aluminum Design Manual	The Aluminum Association, Aluminum Design Manual with Specifications and Guidelines for Aluminum Structures
ASTM B209	Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B210	Aluminum and Aluminum-Alloy Drawn Seamless Tubes
ASTM B221	Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B429	Aluminum-Alloy Extruded Structural Pipe and Tube
ASTM B483	Aluminum and Aluminum-Alloy Drawn Tube and Drawn Pipe for General Purpose Applications
ASTM F593	Stainless Steel Bolts, Hex Cap Screws, and Studs
ASTM F594	Stainless Steel Nuts
AWS D1.2	Structural Welding Code, Aluminum
OSHA	U.S. Dept. of Labor, Occupational Safety and Health Administration
IBC	International Building Code with local amendments

1.04 SUBMITTALS

- A. Action Submittals:
1. Procedures: Section 01 33 00.
 2. A copy of this specification section with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.
 3. Check-marks (✓) shall denote full compliance with a paragraph as a whole. Deviations shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will

signify compliance on the part of the Contractor with the specifications. Include a detailed, written justification for each deviation. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

4. Layout, installation, and detail shop drawings for railing.
5. Design calculations stamped and signed by a licensed professional engineer in the State of Utah. Railing and base support connections to be designed by the Contractor incorporating specified criteria and provisions in the current building code with local governing amendments.

B. Informational Submittals:

1. Material certification for compliance with this specification for aluminum and stainless steel materials.

1.05 QUALITY ASSURANCE

A. General:

1. Railing shall conform to the standards of the Occupational Safety and Health Administration (OSHA) and International Building Code.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Cushion wrap complete rails, modules and components to prevent scratching and denting during shipment, storage, and installation.
- B. Leave wrap intact, insofar as possible, until railing is completely installed.

PART 2 PRODUCTS

2.01 PERFORMANCE/DESIGN CRITERIA

- A. Railing assembly and attachments shall resist a minimum uniform load of 50 pounds per linear foot on the top rail and a concentrated load of 200 pounds (not acting concurrently with the uniform load) applied in any direction. Contractor's supplier and engineer are responsible for designing the guardrail/handrail system along with its base support and anchor bolt size and embedment depth into concrete, or connection to metal framing, to resist the above loading condition taking into account anchor edge distances and concrete strengths at the point of attachment. Contractor shall submit calculations signed and sealed by a professional engineer in the State of Utah.
- B. Thermal Movements: Provide railing that allow for thermal movements resulting from the project site maximum range in ambient and surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime sky heat loss.

2.02 MANUFACTURERS

- A. Julius Blum & Co., Inc.
- B. Golden Railing Inc.

- C. Moultrie Manufacturing.
- D. American Railing Systems, Inc.
- E. Approved equal.

2.03 MATERIALS

Component	Material
Aluminum pipe	ASTM B210 Alloy 6060-T832; ASTM B 221 Alloy 6063-T5/T52; ASTM B 429, Alloy 6063-T832; ASTM B483, Alloy T832
Aluminum plate	ASTM B209, Alloy 6061-T6
Stainless steel bolts	ASTM A593, Type 316
Stainless steel nuts and washers	ASTM A594, Type 316

2.04 CONFIGURATION/COMPONENTS

- A. Guard Top Rails: Minimum 1 1/2 inch nominal diameter pipe, Schedule 40.
- B. Intermediate Rails: Minimum 1 1/2 inch nominal diameter pipe, Schedule 40.
- C. Handrails: 1 1/2 inch nominal diameter pipe, Schedule 40.
- D. Posts: Minimum 1 1/2 inch nominal diameter pipe, Schedule 80.
- E. Provide manufacturer's heavy-duty base fitting with stainless steel set screws.
- F. Provide aluminum toe boards at guardrails, except where concrete curbs are indicated. Aluminum toe boards shall be minimum 3/16-inch thick plate, connected to the posts.
- G. Bolts, including anchor bolts, shall be Type 316 stainless steel.
- H. Fittings:
 - 1. Fittings shall be cast aluminum elbows, T-shapes, post brackets and escutcheons. Provide adapter and anchor plugs as required for a complete installation.
 - 2. Floor sleeves for removable railing shall be stainless steel, embedded in concrete.

2.05 ASSEMBLY/FABRICATION

- A. Pipe cuts shall be clean, straight, square and accurate for minimum joint gap. Work shall be done in conformance with the guardrail and handrail manufacturer's instructions. Work shall be free from blemishes, defects, and misfits of any type which can affect durability, strength, or appearance.
- B. Guardrailing and handrailing shall be connected by screws or bolts or welding. Holes shall be punched 1/16 inch larger than the nominal size of the bolts, unless otherwise specified. Wherever needed because of the thickness of the metal, holes shall be subpunched and reamed or drilled. Components with mismatched holes shall be replaced. No drifting of bolts or enlargement of holes will be allowed to correct misalignment.

- C. Supply components required for anchorage of fabrications.
- D. Where shop welding is used, grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints tight and flush. Round exposed edges to small, uniform radius. Use filler alloy rods that will not discolor when anodized, such as ER 5154, ER 5254, ER 5183, ER 5356 or ER 5556 filler alloy rods.

2.06 ISOLATION COATING

- A. Isolation coating shall be applied to all aluminum surfaces in contact with concrete, masonry, or dissimilar metals. Use a heavy coat of bituminous paint.

2.07 FINISHES

- A. [Clear] anodized in accordance with the Aluminum Association [AA-M12-C22-A41]. Anodize exposed prefabricated components, except stainless steel fasteners, after fabrication.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine and accept existing conditions before beginning work.
- B. Field verify measurements for railings before fabrication.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's written instructions.
- B. Protect dissimilar metals from galvanic corrosion by means of pressure tapes, coatings, or isolators. Aluminum in contact with concrete or grout shall be protected with a heavy coat of bituminous paint.
- C. Accurately place metal to be embedded in concrete and hold in correct position while the concrete is placed. Where recesses or blockouts are formed in the concrete, grout metalwork in place after concrete has attained its design strength in accordance with Section 03 30 00.
- D. Unless otherwise indicated, field welding of railing is not permitted.

3.03 TOLERANCES

- A. Maximum variance from plumb: 1/4 inch.
- B. Maximum offset from true alignment: 1/4 inch.

END OF SECTION

SECTION 05 53 10
METAL GRATINGS AND STAIR TREADS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Aluminum, galvanized steel, and stainless steel bar grating.

1.02 RELATED SECTIONS

- A. This section contains references to the following related sections. Additional related sections may apply that are not specifically listed below.
1. Section 03 30 00 Cast-In-Place Concrete.
 2. Section 05 05 14 Hot-Dip Zinc Coating.
 3. Section 05 05 20 Anchor Bolts
 4. Section 05 52 10 Metal Fabrications

1.03 REFERENCES

- A. The references listed below are a part of this section. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
ASTM A123	Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A167	Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A380	Cleaning, Descaling, and Passivation of Stainless Steel
ASTM A666	Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
ASTM A1011	Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, and High-Strength Low-Alloy
ASTM B221	Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ANSI/NAAMM	Metal Bar Grating Design Manual

1.04 DEFINITIONS

- A. Galvanize: Hot-dip galvanize per ASTM A123 or ASTM A153, per Section 05 05 14.

1.05 SUBMITTALS

- A. Action Submittals:
1. Procedures: Section 01 33 00.

1. A copy of this specification section with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.
2. Check-marks (✓) shall denote full compliance with a paragraph as a whole. Deviations shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Include a detailed, written justification for each deviation. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
3. Shop drawings showing placing plans for grating.
 - a. Provide layout and fabrication details of support frames.
 - b. Provide panel layout with individual panel dimensions.
4. Manufacturer's product data with load tables.

PART 2 PRODUCTS

2.01 MATERIALS

Component	Material
Aluminum grating bearing and cross bars	ASTM B221, alloy 6061

2.02 ASSEMBLY/FABRICATION

- A. Welds:
 1. Grind smooth rough welds and sharp metal edges. Make welds exposed to view uniform and neat.
 2. Prior to galvanizing, sandblast welds.
- B. Clearance: provide 1/4 inch separation between panels and at bearing ends of panel to support frame.
- C. Grating:
 1. General
 - a. Provide serrated grating for slip resistance.
 - b. Bearing bars and cross bars are continuous.
 - c. Openings shall be banded with bars having the same dimensions as the bearing bars. Band perimeter edges with bars flush at the top surface of the grating and 1/4 inch clear of the bottom surface.
 - d. Bars terminating against edge bars shall be welded to the edge bars when welded construction is used.
 - e. When crimped or swaged construction is used, bars at edges shall protrude a maximum of 1/16 inch and be peened or ground to a smooth surface.
 - f. Fabrication methods employing bending or notching of bearing or cross bars is not permitted.
 - g. Maximum grating panel weight shall not exceed 80 pounds.

2. Aluminum Grating

- a. Fabricate grating with a mill class 1 clear anodize finish. Punch bearing bars to receive cross bars. After insertion in the bearing bars, cross bars are deformed by a hydraulic press or similar means to permanently lock the bars into the bearing bar openings.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine and accept existing conditions before beginning work.
- B. Field measure grating for proper cutouts and sizes prior to fabrication.

3.02 INSTALLATION

- A. Fieldwork is not permitted on galvanized items.
- B. Drilling of bolts or enlargement of holes to correct misalignment is not permitted.
- C. Protect dissimilar metals from galvanic corrosion by means of pressure tapes, coatings, or isolators. Protect aluminum in contact with concrete with a heavy coat of bituminous paint.
- D. Use stainless steel metalwork to be embedded in concrete. Clean surfaces in contact with or embedded in concrete and hold in correct position while concrete is placed. Or, provide formed recesses or blockouts in concrete and then, after concrete has attained design strength, grout metalwork in-place using non-shrink grout.

3.03 REPAIR

- A. Repair damaged surfaces of galvanized metals per Section 05 05 14.

END OF SECTION

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SECTION 06 71 10
FIBERGLASS REINFORCED PRODUCTS AND FABRICATIONS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Requirements for Contractor designed fiberglass reinforced products and fabrications. Provide labor, materials, and equipment necessary to install glass fiber and resin fabrications including fiberglass reinforced plastic (FRP) structural and miscellaneous framing members, corrugated feed well sidewalls. Bid alternates 7 and 8: weirs, scum baffles, current density (Stamford) baffles.

1.02 RELATED SECTIONS

- A. This section contains specific references to the following related sections. Additional related sections may apply that are not specifically listed below.
 - 1. Section 01 73 24 Design Requirements for Nonstructural Components and Nonbuilding Structures
 - 2. Section 05 05 20 Anchor Bolts
 - 3. Section 46 43 21.13: Circular Secondary Clarifier Equipment

1.03 REFERENCES

- A. The references listed below are a part of this section. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
ANSI A14.3	Standard for Ladders - Fixed - Safety Requirements
ASTM D570	Water Absorption of Plastics
ASTM D635	Rate of Burning and/or Extent and Time of Burning Plastics in a Horizontal Position
ASTM D638	Tensile Properties of Plastics
ASTM D695	Compressive Properties of Rigid Plastics
ASTM D696	Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30 °C and 30 °C with a Vitreous Silica Dilatometer
ASTM D790	Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
ASTM D792	Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
ASTM D2344	Short-Beam Strength of Polymer Matrix Composite Materials and Their Laminates
ASTM D2583	Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor
ASTM E84	Surface Burning Characteristics of Building Materials
IBC	International Building Code
OSHA 29 CFR 1910.23	Guarding floor and wall openings and holes

1.04 SUBMITTALS:

A. Action Submittals :

1. Procedures: Section 01 33 00.
2. A copy of this specification section with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.
 - a. Section 46 43 21.13: Circular Secondary Clarifier Equipment
3. Check-marks (✓) shall denote full compliance with a paragraph as a whole. Deviations shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Include a detailed, written justification for each deviation. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
4. Qualification statements for manufacturer and installer.
5. Completed Certificate of Unit Responsibility attesting that the Contractor has assigned, and that the manufacturer accepts unit responsibility in accordance with the requirements of this Section and Section 43 05 11-1.02. No other submittal material will be reviewed until the certificate has been received and found to be in conformance with these requirements.

6. Manufacturer and method of fabrication, including resins used, curing techniques, reinforcing, and filler material.
 7. Manufacturers catalog information, descriptive literature, and specifications.
 8. Manufacturer's shop drawings showing general arrangement, dimensions, method of attachment, including number, locations, and size of brackets and fasteners, and weight of fabrications.
 9. Installation procedures, including field techniques.
 10. Calculations and information to confirm design includes provisions for the expansion of FRP without warping or buckling or changing vertical elevation with the tank both empty and full of water.
 11. Certified test reports of the physical and mechanical properties of the materials.
 12. A list of at least 5 installations of similar size and scope that have been in continuous operation for 5 years.
 13. Post-Installation survey of all weir plates verifying installation at the proper elevation and within the allowable tolerances as required by this Section and the drawings.
 14. Shop drawings of fabricated members, anchors into concrete, and accessories showing dimensions, connections, frames, and details of installation.
 15. Shop drawings for manufacturer designed fabrications shall be sealed by a Professional Engineer licensed in the state of Utah.
 16. Structural calculations for, support structures, embedments, and other fabrications stamped by a Professional Engineer licensed in the state of Utah.
 17. Manufacturer's published literature, including structural design data, structural properties data, corrosion resistance tables, certificates of compliance, test reports as applicable, anchor systems and their allowable load tables.
- B. B. Closeout Submittals
1. Procedures: Section 01 33 00.
 2. Operating and maintenance submittals: Section 01 78 23.
 3. Copy of warranty certificate.
 4. Spare Parts:
 - a. Procedures: Section 01 33 00.
 - b. Provide the following spare parts for each clarifier:
 - 1) 2 extra sections of curved corrugated FRP feed well sidewall panels
 - 2) 4 extra sets of hardware and mounting brackets for feed well sidewall panels
 - 3) Bid Alternate: Weirs, scum baffles, current density (Stamford) baffles -
 - a) 2 extra FRP sections
 - b) 4 extra sets of hardware and mounting brackets

1.05 QUALITY ASSURANCE

- A. General:
1. FRP fabrications shall conform to the standards of the Occupational Safety and Health Administration (OSHA).
 2. FRP products and fabrications shall be furnished by a qualified manufacturer who is regularly engaged in the manufacturing and installation of FRP systems.

B. Qualifications

1. Fiberglass Reinforced Plastic (FRP) manufacturer is required to have a minimum of 10 years experience in manufacturing FRP products.
2. The FRP Manufacturer's Professional Engineer is to be currently licensed by the state of Utah, and have a minimum of five years experience as an Engineer for manufacturers of similar FRP systems. Supply the names and locations of five projects of similar size and scope for which the Engineer has provided engineering calculations using the manufacturer's products within the previous three years.

C. Installer

1. Engage a single installer skilled, trained, and with record of successful experience in installing FRP miscellaneous fabrications systems in accordance with recommendations and requirements of manufacturer (or who can submit written acceptance by manufacturer),

D. Component Supply and Compatibility

1. Obtain all components for each type of system and structural shapes and framing and supports, each from a single FRP miscellaneous fabrications manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Shipment:

1. Systems, sub-systems and structures shall be shop fabricated and assembled into the largest practical size suitable for transporting.
2. Feed well sidewall panels (and Bid Alternates 7 and 8: Weirs, scum baffles and current density (Stamford) baffles) shall be shipped fully shop fabricated.
3. Package and clearly tag parts and assemblies, that are of necessity shipped unassembled, in a manner that will protect materials from damage and facilitate identification and final assembly in the field.

- B. Storage and Handling:** Store and handle in accordance with manufacturer's recommendations and in such a manner as to prevent damage of any kind, including overexposure to sunlight.

1.07 SPECIAL WARRANTY

- A.** FRP manufacturer shall warrant FRP feed well sidewalls, (Bid Alternates 7 and 8: Weirs, scum baffles and current density (Stamford) baffles) against defects in materials and workmanship for 2 years, beginning from date of substantial completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A.** Candidate manufacturers are listed below. The manufacturer's standard product may require modification to conform to specified requirements:
1. American Grating, LLC
 2. Fibergrate Composite Structures Inc.
 3. Seasafe, Inc.

4. Strongwell Corp.
5. Approved Equal

2.02 TYPE

- A. Reinforcement
 1. Surface veils shall be chemical glass and strand mat shall be electrical glass. Glass reinforcement shall have a silane finish and a styrene-soluble binder.
- B. Clarifier feed well sidewall panels:
 1. 10 oz. corrugated FRP panels.
 2. Panel profile to be 4.2 x 1-1/16".
- C. Bid Alternates 7 and 8: (Weirs, scum baffles, current density (Stamford) baffles)
 1. Weirs, scum baffles and current density (Stamford) baffles shall be fabricated by the matched die process conforming to the Record Drawings (replace in kind).
 2. Weirs shall be V-notch as shown on the Record Drawings.

2.03 PERFORMANCE/DESIGN CRITERIA

- A. Service Conditions
 1. Fluid Type: The feed well sidewall panels, (Bid Alternates 7 and 8: Weirs, scum baffles, current density (Stamford) baffles), will be installed in the secondary clarifier tanks of a municipal wastewater treatment plant. The wastewater is expected to contain finely divided organic solids, dilute industrial solvents and petroleum products, animal fats and greases, vegetable oils, trace quantities of chlorine, dissolved hydrogen sulfide gas in concentrations up to 20 mg/l, and oxygen may be either present or absent. During the normal life of these laminates, they will be exposed to full submergence in wastewater, direct sunlight, a high humidity climate, and may be left in a dry condition for extended periods. It is possible that dilute sulfuric acid may be present and may collect on any surface.
 2. Fluid Temperature: Wastewater temperatures are expected to vary between 35 and 80 degrees F and ambient air temperatures may range between -30 and 120 degrees F.
- B. Design Requirements
 1. The feed well sidewall panels, (Bid Alternates 7 and 8: Weirs, scum baffles, current density (Stamford) baffles) shall be fabricated to the dimensions shown on the record drawings and shall be suitable for overflow from the secondary clarifiers. Contractor to field verify required dimensions.
 2. Design shall include provisions for the expansion of FRP without warping or buckling or changing vertical elevation with the tank both empty and full of water.

2.04 MATERIALS

- A. General:
 1. FRP systems shall be fabricated using an industrial grade, corrosion resistant vinyl ester resin with flame retardant to achieve a flame spread of 25 or less in accordance with ASTM E84. Polyester resin shall not be used.

2. Exterior exposed systems shall be manufactured with a ultra-violet (UV) inhibitor additive and synthetic surface veil as an outermost layer covering the exterior surface.
3. Exposed surfaces shall be smooth and true to form.
4. Clarifier feed well sidewalls are to be 10 oz. corrugated FRP panels, profile 4.2 x 1-1/16", approximate size of 35" x 96", and field trimmed as required.
5. After fabrication, cuts, drill holes, and abrasions, including field alterations, shall be sealed with a compatible resin coating to prevent intrusion of moisture.
6. Fasteners used for FRP assemblies shall be Type 316 stainless steel.
7. Color pigment shall be dispersed in resin system. Color shall be selected by Owner and Owner's Representative. Contractor to coordinate with the Owner and Owner's Representative regarding color selection.

B. Reinforcement

1. Surface veils shall be chemical glass and strand mat shall be electrical glass. Glass reinforcement shall have a silane finish and a styrene-soluble binder.

C. Hardware

1. Feed well sidewall panels:
 - a. Type 316 stainless steel self-drilling screws with neoprene washers are to be used for installation of corrugated FRP sidewall panels on clarifier feed wells.
2. Bid Alternates 7 and 8: (Weirs, scum baffles, current density (Stamford) baffles)
 - a. Hardware required to support and mount the weir plates shall be Type 316 stainless steel.
 - b. Support brackets and bolts for the scum baffles to be Type 316 stainless steel.
 - c. Neoprene gaskets shall be provided at all splices and connections.

D. Structural Shapes:

1. Manufacture by the pultrusion process with a glass content minimum of 45 percent, maximum of 55 percent (by weight) for maximum sunlight and chemical resistance. The structural shapes shall be composed of fiberglass reinforcement and resin in qualities, quantities, properties, arrangements, and dimensions as necessary to meet the design requirements and dimensions as specified in the Contract Documents.
2. Fiberglass reinforcement shall be a combination of continuous roving, continuous strand mat, and surfacing veil in sufficient quantities as needed by the application and/or physical properties required.
3. Resins shall be fire retardant vinyl ester with chemical formulation necessary to provide corrosion resistance and strength.
4. Pultruded structural shapes are to have the minimum mechanical properties listed below:

Material Properties	Test Method	Value
Pultruded Fiberglass Structural Shapes		
Ultimate tensile stress in longitudinal direction, psi	ASTM D638	30,000
Ultimate compressive stress in longitudinal direction, psi	ASTM D695	30,000
Ultimate flexural stress in longitudinal direction, psi	ASTM D790	30,000
Ultimate short beam shear in longitudinal direction, psi	ASTM D2344	4,500

Ultimate tensile stress in transverse direction, psi	ASTM D638	7,000
Ultimate compressive stress in transverse direction, psi	ASTM D695	15,000
Ultimate flexural stress in transverse direction, psi	ASTM D790	10,000
Modulus of elasticity, full section, psi	N/A	2,800,000
Density (lb/in. ³)	ASTM D792	0.060-0.070
Water absorption (25-hr immersion)	ASTM D570	0.60 max, percent by weight
Barcol hardness	ASTM D2583	45
Coefficient of thermal expansion 10 ⁻⁶ in./in./degrees C	ASTM D696	8.0
Flame-Retardant Properties		
Flammability test	ASTM D635	Self-extinguishing
Surface burning characteristics	ASTM E84	25 maximum
Flammability class	UL 94	VO
Temperature index	UL 94	130 degrees C

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine and accept existing conditions before beginning work.

3.02 FABRICATION

- A. Member cuts shall be clean, straight, square, and accurate for minimum joint gap. Work shall be done in conformance with the manufacturer's recommendations. Work shall be free from blemishes, defects, and misfits that can affect durability, strength, or appearance. Cuts and drill holes shall be sealed by application of manufacturer provided resin.
- B. Thermal Movements:
 - 1. Provide fabrications that allow for thermal movements resulting from the project site's maximum range in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, 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.
- C. Field Measurements:
 - 1. Verify field dimensions after construction of facilities and include in shop drawing submittal. Field verification of dimensions is a prerequisite for fabrication of railing. Any miss-fitting of railing will be the responsibility of the Contractor to rectify until railing complies with the Specifications.

3.03 INSTALLATION

- A. Install products in accordance with Contract Documents and manufacturer's instructions. Field cut and drill fiberglass reinforced plastic products with carbide or diamond tipped bits and blades. Seal shop and field cut or drilled surfaces using manufacturer provided resin. Fastening To Construction-In-Place:

1. Provide anchorage devices and fasteners where necessary for fastening fabricated FRP items to construction-in-place. Design anchorage devices in accordance with Section 01 73 24. Anchor bolts to be in accordance with Section 05 05 20.
- B. Use Type 316 stainless steel anchors for attachment of fabrications to clarifier structure.
- C. Bid Alternates 7 and 8 (Weirs, scum baffles, current density (Stamford) baffles):
1. Field cutting of weir notches shall not be permitted. All field cuts of FRP materials required for installation shall receive two sealing coats.
 2. Weirs shall be mounted, with gasket material, on the effluent troughs and leveled to a tolerance of plus or minus 0.01 foot during water testing when the tank contains water to the normal operating level. Provisions shall be made to accommodate thermal expansion and contractions through the use of expansion joints at each weir plate joint.
 3. Baffles shall be installed and adjusted to ensure a mating fit with the scum collection arms throughout their field of travel.
 4. Current density baffles shall be installed in kind and adjusted to ensure a mating fit with the clarifier sidewalls, prevention of buckling, minimize gaps to prevent flow short circuiting.

3.04 SYSTEMS START UP

- A. Pre-operational testing:
1. Feed well sidewall panels: Prior to placing the clarifier in service, survey the sidewall panels to confirm radius from the tank centerline, sidewall elevation is consistent and per clarifier manufacture design. Test feed well sidewalls in each secondary clarifier. Provide a post installation survey completed by a PLS registered in the state of Utah.
 2. Bid Alternates 7 and 8:
 - a. Weirs: Prior to placing the clarifier in service, fill the clarifier with water to the weir crest elevation. Inspect the weir plates for water tightness between plates and for uniform level. Test weirs in each secondary clarifier.
 - 1) Provide a post-installation survey completed by a PLS registered in the state of Utah of all weir plates verifying installation at the proper elevation and within the allowable tolerances required in this section and as shown on the drawings.
 - b. Scum Baffles: Prior to placing the clarifier in service, survey the scum baffle to confirm scum baffle radius from tank centerline and scum baffle elevation is consistent around entire tank. Test scum baffle in each secondary clarifier. Provide a post-installation survey completed by a PLS registered in the state of Utah.
 - c. Current Density (Stamford) Baffles: Prior to placing the clarifier in service, survey the current density baffles to confirm current density baffle radius from tank centerline and current density baffle elevation is consistent around entire tank. Test current density baffle in each secondary clarifier. Provide a post-installation survey completed by a PLS registered in the state of Utah.

3.05 FIELD QUALITY CONTROL

- A. Corrective actions: Replace or repair work to eliminate defects, deficiencies, and irregularities.

END OF SECTION

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SECTION 07 91 26

JOINT FILLERS

PART 1 GENERAL

1.01 DESCRIPTION

- A. This section specifies preformed joint fillers.

1.02 QUALITY ASSURANCE

- A. References:

1. This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.
2. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ASTM D994	Preformed Expansion Joint Filler for Concrete (Bituminous Type)
ASTM D1752	Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

PART 2 PRODUCTS

2.01 PREFORMED ASPHALT FIBERBOARD

- A. Preformed asphalt fiberboard joint filler shall be in accordance with ASTM D994 and shall be 1/2 inch thick unless otherwise specified.

2.02 PREFORMED RESIN-BONDED CORK

- A. Preformed resin-bonded cork joint filler shall be in accordance with ASTM D1752, Type II. Cork joint filler thickness shall match the specified joint width.

2.03 PRODUCT DATA

- A. The following information shall be provided in accordance with **Section 01 33 00**:
1. Manufacturer's recommendations for handling and installation of the material.

PART 3 EXECUTION

3.01 GENERAL

- A. Preformed joint fillers shall be placed into position before the concrete is poured. Where it is necessary for the filler to be fixed to existing concrete or other building materials, a suitable adhesive recommended by the filler manufacturer shall be used. Filler surfaces shall be clean and dry prior to the placement of the concrete.

3.02 PREFORMED ASPHALT FIBERBOARD

- A. Preformed asphalt fiberboard joint fillers shall be used for expansion joints in concrete sidewalks, curbs, and roadways.

3.03 PREFORMED RESIN-BONDED CORK

- A. Preformed resin-bonded cork joint filler shall be used for expansion joints in concrete structures. The expansion joint shall be sealed with backer rod and sealant as specified in Section 07 92 00.

END OF SECTION

SECTION 09 90 00
PAINTING AND COATING
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SECTION 09 90 00
PAINTING AND COATING

PART 1 GENERAL

1.01 DESCRIPTION

A. Scope:

1. This Section specifies coating systems, surface preparations, and application requirements for coating systems.

B. Definitions:

1. Specific coating terminology used in this Section is in accordance with definitions contained in ASTM D16, ASTM D3960, and the following definitions.

a. Definitions:

- 1) Abrasive: Material used for blast cleaning, such as sand, grit or shot.
- 2) Abrasive Blast Cleaning: Cleaning/surface preparation by abrasive propelled at high speed.
- 3) Anchor Pattern: Profile or texture of prepared surface(s).
- 4) ANSI: American National Standards Institute.
- 5) Bug Holes: Small cavities, usually not exceeding 15 mm in diameter, resulting from entrapment of air bubbles in the surface of formed concrete during placement and compaction.
- 6) Coating/Paint/Lining Thickness: The total thickness of primer, intermediate and/or finish coats.
- 7) Coating System Applicator (CSA): A generic reference to the specialty subcontractor or subcontractors retained by the Contractor to install the coating systems specified in this Section.
- 8) Coating System Manufacturer (CSM): Refers to the acceptable coating system manufacturer, abbreviated as the CSM.
- 9) Coating System Manufacturer's Technical Representative(s) (CTR): Refers to the technical representative(s) of the acceptable Coating System Manufacturer and is abbreviated as CTR.
- 10) Dew point: Temperature of a given air/water vapor mixture at which condensation starts.
- 11) Dry Film Thickness (DFT): Depth of cured film, usually expressed in mils (0.001 inch). Use this definition as opposed to existing definition.
- 12) Drying Time: Time interval between application and curing of material.
- 13) Dry to Recoat: Time interval between application of material and ability to receive next coat.
- 14) Dry to Touch: Time interval between application of material and ability to touch lightly without damage.
- 15) Feather Edging: Reducing the thickness of the edge of paint.
- 16) Feathering: Operation of tapering off the edge of a point with a comparatively dry brush.

- 17) Field Coat: The application or the completion of application of the coating system after installation of the surface at the site of the work.
- 18) Hold Point: A defined point, specified in this Section, at which work shall be halted for inspection.
- 19) Holiday: a discontinuity, skip, or void in coating or coating system film that exposes the substrate.
- 20) Honeycomb: Segregated condition of hardened concrete due to non-consolidation.
- 21) ICRI: International Concrete Repair Institute.
- 22) Incompatibility: Inability of a coating to perform well over another coating because of bleeding, poor bonding, or lifting of old coating; inability of a coating to perform well on a substrate.
- 23) Laitance: A layer of weak, non-durable concrete containing cement fines that is brought to the surface through bleed water because of concrete finishing and/or over-finishing.
- 24) Mil: 0.001 inch.
- 25) NACE: National Association of Corrosion Engineers.
- 26) Overspray: Dry spray, particularly such paint that failed to strike the intended surface.
- 27) Pinhole: A small diameter discontinuity in a coating or coating system film that is typically created by outgassing of air from a void in a concrete substrate resulting in exposure of the substrate or a void between coats.
- 28) Pot Life: Time interval after mixing of components during which the coating can be satisfactorily applied.
- 29) Resurfacer/Resurfacing Material: A layer of cementitious and/or resin-base material used to fill or otherwise restore surface continuity to worn or damaged concrete surfaces.
- 30) Shelf Life: Maximum storage time for which a material may be stored without losing its usefulness.
- 31) Shop Coat: One or more coats applied in a shop or plant prior to shipment to the site of the work, where the field or finishing coat is applied.
- 32) Spreading Rate: Area covered by a unit volume of paint at a specific thickness.
- 33) SSPC: The Society for Protective Coatings.
- 34) Stripe Coat: A separate coat of paint applied to all weld seams, pits, nuts/bolts/washers and edges by brush. This coat shall not be applied until any previous coat(s) have cured and, once applied, shall be allowed to cure prior to the application of the subsequent coat(s).
- 35) Surface Saturated Dry (SSD): Refers to concrete surface condition where the surface is saturated (damp) without the presence of standing water.
- 36) Tie Coat: An intermediate coat used to bond different types of paint coats. Coatings used to improve the adhesion of a succeeding coat.
- 37) Touch-Up Painting: The application of paint on areas of painted surfaces to repair marks, scratches, and areas where the coating has deteriorated to restore the coating film to an unbroken condition.
- 38) TPC: Technical Practice Committee.

- 39) Volatile Organic Compound (VOC) Content: The portion of the coating that is a compound of carbon, is photochemically reactive, and evaporates during drying or curing, expressed in grams per liter (g/l) or pounds per gallon (lb/gal).
- 40) Immersion: Refers to a service condition in which the substrate is below the waterline or submerged in water or wastewater at least intermittently if not constantly.
- 41) Weld Splatter: Beads of metal scattered near seam during welding.
- 42) Wet Film Thickness (WFT): The primer or coating film's thickness immediately following application. Wet film thickness is measured in mils or thousandths of an inch (0.001 inch) and is abbreviated WFT.

1.02 QUALITY ASSURANCE

A. References:

1. This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.
2. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued, or replaced.

Reference	Title
ANSI/ASC 29.4 Exhaust Systems	Abrasive Blasting Operations – Ventilation and Safe Practice
ANSI/NSF 61	Drinking Water System Components Health Effects
ANSI B74.18	Grading of Certain Abrasive Grain on Coated Abrasive Material
ASTM D16	Standard Terminology for Paint, Related Coatings, Materials, and Applications
ASTM D2200 (SSPC-VIS1)	Pictorial Surface Preparation Standards for Painting Steel Surfaces
ASTM D3960	Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings
ASTM D4262	Standard Test Method for pH of Chemically Cleaned or Etched Concrete Surfaces
ASTM D4263	Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method
ASTM D4414	Standard Practice for Measurement of Wet Film Thickness by Notch Gages
ASTM D4417	Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel
ASTM D4541	Standard Test Methods for Pull-Off Strength of Coatings On Metal Substrates Using Portable Adhesion Testers
ASTM D4787	Standard Practice for Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates

Reference	Title
ASTM D5162	Standard Practice for Discontinuity (Holiday) Testing of Nonconductive Protective Coating on Metallic Substrates
ASTM D7234	Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Adhesion Testers.
ASTM E337	Standard Test Method for Measuring Humidity With a Psychrometer
ASTM F1869	Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
FS 595b	Federal Standard Colors
ICRI 03732	Guideline for Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays
NACE Publication 6D-163	A Manual for Painter Safety
NACE Publication 6F-163	Surface Preparation of Steel or Concrete Tank/Interiors
NACE Publication 6G-164 A	Surface Preparation Abrasives for Industrial Maintenance Painting
NACE Standards	January 1988 Edition of the National Association of Corrosion Engineers, TPC.
NACE Standard RP0188	Standard Recommended Practice – Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates
NACE Standard RP0288	Standard Recommended Practice, Inspection of Linings on Steel and Concrete
NACE Standard RP0892	Standard Recommended Practice, Linings Over Concrete in Immersion Service
NACE Publication TPC2	Coatings and Linings for Immersion Service
NAPF 500-03	Surface Preparation Standard for Ductile Iron Pipe and Fittings in Exposed Locations Receiving Special External Coatings and/or Special Internal Linings
NAPF 500-03-04	Abrasive Blast Cleaning for Ductile Iron Pipe
NAPF 500-03-05	Abrasive Blast Cleaning for Cast Ductile Iron Fittings
OSHA 1910.144	Safety Color Code for Marking Physical Hazards
OSHA 1915.35	Standards – 29CFR - Painting
SSPC	Paint Application Specification No. 1.
SSPC-AB 1	Mineral and Slag Abrasives
SSPC-PA 1	Shop, Field, and Maintenance Painting of Steel
SSPC-PA 2	Measurement of Dry Coating Thickness with Magnetic Gages
SSPC-PA 9	Measurement of Dry Coating Thickness on Cementitious Substrates Using Ultrasonic Gages
SSPC-PA Guide 1	Guide for Illumination of Industrial Painting Project
SSPC-PA Guide 3	A Guide to Safety in Paint Application
SSPC-PA Guide 6	Guide for Containing Debris Generated During Paint Removal Operations
SSPC-PA Guide 11	Guide for Coating Concrete
SSPC SP1	Solvent Cleaning
SSPC SP2	Hand Tool Cleaning
SSPC SP3	Power Tool Cleaning
SSPC SP5	White Metal Blast Cleaning
SSPC SP6	Commercial Blast Cleaning
SSPC SP7	Brush-Off Blast Cleaning
SSPC SP10	Near-White Blast Cleaning
SSPC SP11	Power Tool Cleaning to Bare Metal
SSPC SP12	Surface Preparation and Cleaning of Steel and Other Hard Materials by High and Ultra-High Pressure Water Jetting Prior to Recoating
SSPC SP13	Surface Preparation of Concrete
SSPC-TR2	Wet Abrasive Blast Cleaning

Reference	Title
SSPC-TU-3	Overcoating
SSPC-TU-4	Field Methods for Retrieval and Analysis of Soluble Salts on Substrates.
SSPC V2	Systems and Specifications: Steel Structures Painting Manual, Volume 2
SSPC-VIS 1	Visual Standard for Abrasive Blast Cleaned Steel
SSPC-VIS 3	Visual Standard for Power and Hand – Tool Cleaned Steel
SSPC-VIS 4	Visual Standards (Waterjetting)
SSPC-VIS 5	Visual Standards (Wet Abrasive Blast Cleaning)
WPCF Manual of Practice No. 17	Paints and Protective Coatings for Wastewater Treatment Facilities. Guide and Paint Application Specifications.

B. Standardization:

1. Materials and supplies provided shall be the standard products of CSMs. Materials in each coating system shall be the products of a single CSM.
2. The standard products of CSMs other than those specified may be acceptable when it is demonstrated to the Construction Manager that they are equal in composition, durability, usefulness, and convenience for the purpose intended. Requests for consideration of CSMs other than those specified in this Section will be considered, provided the following minimum conditions are met. Such requests are not a substitution for submittals after the alternative CSMs have been considered and accepted.
 - a. The proposed coating system shall use an equal or greater number of separate coats to achieve the required total dry film thickness.
 - b. The proposed coating system shall use coatings of the same generic type as that specified including curing agent type.
 - c. Requests for consideration of products from CSMs other than those specified in this Section shall include information listed in paragraph 1.04, demonstrating that the proposed CSM's product is equal to the specified coating system.
 - d. The Contractor and the proposed alternative CSM shall provide a list of references for the proposed product where the coating of the same generic type has been applied. The reference list shall include the project name, city, state, owner, phone number of owner; coating system reference and number from this Section 09 90 00; type of facility in which it was used, generic type, and year coating was applied.

C. Quality Control Requirements:

1. The Contractor is responsible for the workmanship and quality of the coating system installation. Inspections by the Construction Manager or the CTR will not relieve or limit the Contractor's responsibilities.
2. The Contractor's methods shall conform to requirements of this specification and the standards referenced in this Section. Changes in the coating system installation requirements will be allowed only with the written acceptance of the Construction Manager before work commences.
3. Only personnel who are trained by the CTR specifically for this contract or who are approved by the CSM specifically for this contract shall be allowed to perform the coating system installation specified in this Section.

4. Contaminated, outdated, diluted materials, and/or materials from previously opened containers shall not be used.
5. For repairs, the Contractor shall provide the same products, or products recommended by the CSM, as used for the original coating.
6. The Contractor shall identify the points of access for inspection by the Owner or the Construction Manager. The Contractor shall provide ventilation, ingress and egress, and other means necessary for the Construction Manager's personnel to access safely the work areas.
7. The Contractor shall conduct the work so that the coating system is installed as specified and shall inspect the work continually to ensure that the coating system is installed as specified. Coating system work that does not conform to the specifications or is otherwise not acceptable shall be corrected as specified.
8. The Contractor shall complete the Coating System Inspection Checklist, Form 09 90 00-A, included in Section 01 99 90, for coating system installations. Follow the sequential steps required for proper coating system installation as specified and as listed in the Coating System Inspection Checklist. For each portion of the work, install the coating system and complete sign-offs as specified prior to proceeding with the next step. After completing each step as indicated on the Coating System Inspection Checklist, the Contractor shall sign the checklist indicating that the work has been installed and inspected as specified.
9. The Contractor shall provide written daily reports that present, in summary form, test data, work progress, surfaces covered, ambient conditions, quality control inspection test findings, and other information pertinent to the coating system installation.

D. Inspection at Hold Points:

1. The Contractor shall conduct inspections at Hold Points during the coating system installation and record the results from those inspections on Form 09 90 00-A. The Contractor shall coordinate such Hold Points with the Construction Manager such that the Construction Manager may observe Contractor's inspections on a scheduled basis. The Contractor shall provide the Construction Manager a minimum of two (2) hours of notice prior to conducting Hold Point Inspections. The Hold Points shall be as follows:
 - a. Environment and Site Conditions. Prior to commencing an activity associated with coating system installation, the Contractor shall measure, record, and confirm acceptability of ambient air temperature and humidity as well as other conditions such as proper protective measures for surfaces not to be coated and safety requirements for personnel. The acceptability of the weather and/or environmental conditions within the structure shall be determined by the requirements specified by the CSM of the coating system being used.
 - b. Conditions Prior to Surface Preparation. Prior to commencing surface preparation, the Contractor shall observe, record, and confirm that oil, grease, and/or soluble salts have been eliminated from the surface.
 - c. Monitoring of Surface Preparation. Spot checking of degree of cleanliness, surface profile, and surface pH testing, where applicable. In addition, the compressed air used for surface preparation or blow down cleaning shall be checked to confirm it is free from oil and moisture.
 - d. Post Surface Preparation – Upon completion of the surface preparation, the Contractor shall measure and inspect for proper degree of cleanliness and

surface profile as specified in this Section 09 90 00 and in the CSM's written instructions.

- e. Monitoring of Coatings Application – The Contractor shall inspect, measure, and record the wet film thickness and general film quality (visual inspection) for lack of runs, sags, pinholes, holidays, etc. as the application work proceeds.
- f. Post Application Inspection – The Contractor shall identify defects in application work including pinholes, holidays, excessive runs or sags, inadequate or excessive film thickness and other problems as may be observed.
- g. Post Cure Evaluation – The Contractor shall measure and inspect the overall dry film thickness. The Contractor shall conduct a DFT survey, as well as perform adhesion testing, holiday detection, or cure testing as required based on the type of project and the specific requirements in this Section 09 90 00 and/or in the CSM's written instructions.
- h. Follow-up to Corrective Actions and Final Inspection. The Contractor shall measure and reinspect corrective coating work performed to repair defects identified at prior Hold Points. This activity also includes final visual inspection along with follow-up tests such as holiday detection, adhesion tests, and DFT surveys.
- i. Visual acceptance requirement - Absent any more stringent guidance from the CTR, coating of hold-back areas and damaged coating repairs shall be completed such that the final result is not noticeable from an observation distance of 4 feet.

1.03 DELIVERY AND STORAGE

A. General:

- 1. Materials shall be delivered to the job site in their original, unopened containers. Each container shall be properly labeled. Materials shall be handled and stored to prevent damage to or loss of label.
- 2. Labels on material containers shall show the following information:
 - a. Name or title of product.
 - b. CSM's batch number.
 - c. CSM's name.
 - d. Generic type of material.
 - e. Application and mixing instructions.
 - f. Hazardous material identification label.
 - g. Shelf life expiration date.
- 3. Materials shall be stored in enclosed structures and shall be protected from weather and excessive heat or cold in accordance with the CSM's recommendations. Flammable materials shall be stored in accordance with state and local requirements.
- 4. Containers shall be clearly marked indicating personnel safety hazards associated with the use of or exposure to the materials.
- 5. Material Safety Data Sheets (MSDS) for each material shall be provided to the Construction Manager.
- 6. The Contractor shall store and dispose of hazardous waste according to federal, state and local requirements. This requirement specifically addresses waste solvents and coatings.

1.04 SUBMITTALS:

A. General:

1. Provide in accordance with **Section 01 33 00**:
 - a. A copy of this specification section, with addendum updates included, and referenced and applicable sections, with addendum updates included, with each paragraph check-marked (✓) to indicate specification compliance or marked to indicate requested deviations from specification requirements or those parts which are to be provided by the Contractor or others. Check marks shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined shall signify compliance on the part of the Contractor with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for requested deviations to the specification requirements shall be cause for rejection of the entire submittal and no further submittal material will be reviewed.
 - b. CSM's current printed recommendations and product data sheets for coating systems including:
 - 1) Volatile organic compound (VOC) data.
 - 2) Surface preparation recommendations.
 - 3) Primer type, where required.
 - 4) Maximum dry and wet-mil thickness per coat.
 - 5) Minimum and maximum curing time between coats, including atmospheric conditions for each.
 - 6) Curing time before submergence in liquid.
 - 7) Thinner to be used with each coating.
 - 8) Ventilation requirements.
 - 9) Minimum atmospheric conditions during which the paint shall be applied.
 - 10) Allowable application methods.
 - 11) Maximum allowable moisture content.
 - 12) Maximum shelf life.
 - c. Affidavits signed and sealed by an officer of the CSM's corporation, attesting to full compliance of each coating system component with current and promulgated federal, state, and local air pollution control regulations and requirements.
 - d. Material Safety Data Sheets (MSDS) for materials to be delivered to the job site, including coating system materials, solvents, and abrasive blast media.
 - e. List of cleaning and thinner solutions allowed by the CSMs.
 - f. Storage requirements including temperature, humidity, and ventilation for Coating System Materials as recommended by the CSMs.
 - g. CSM's detailed, written instructions for coating system treatment and graphic details for coating system terminations in the structures to be coated including pipe penetrations, metal embedments, gate frames, and other terminations to be

determined from the contract drawings. This information shall also include detail treatment for coating system at joints in concrete.

- h. The Contractor and CSA shall provide a minimum of five project references each including contact name, address, and telephone number where similar coating work has been performed by their companies in the past five years.
- i. The Contractor shall provide, for the Owner's future reference a list of the manufacturer's products use for this project including the make/series/type/batch numbers/names, type, and color of paint and each type of solvent and thinner used as required by the specification.

1.05 RESPONSIBILITIES OF THE CTR

A. General:

- 1. The Contractor shall retain or obtain the services of the CTR to be on site to perform the Contractor and/or CSA application training and to routinely inspect and verify in writing that the application personnel have successfully performed surface preparation, filler/surface application, coating system application, and Quality Control Inspection in accordance with this **Section 09 90 00** and to warrantable level of quality. This must include checking the required degree of cleanliness, surface pH for concrete substrates, surface profile of substrates, proper mixing of coating materials, application (including checking the wet and dry film thickness of the coating systems), proper cure of the coating systems, and proper treatment of coating systems at terminations, transitions, and joints and cracks in substrates. Refer to **paragraph 1.05 Coating System Installation Training**. for further details on these CTR requirements. This inspection is in addition to the inspection performed by the Contractor in accordance with this **Section 09 90 00**.

B. Coating System Installation Training:

- 1. Provide a minimum of 8 hours of classroom and off site training for application and supervisory personnel (both the Contractor's and CSA's). Provide training to a minimum of two supervisory personnel from the CSA and one supervisor from the Contractor. Alternatively, the CTR shall provide a written letter from the CSM stating that the application personnel (listed by name) who shall perform coating work are approved by the CSM without further or additional training.
- 2. One CTR can provide training for up to fourteen application personnel and three supervisory personnel at one time. The training shall include the following as a minimum:
 - a. A detailed explanation of mixing, application, curing, and termination details.
 - b. Hands-on demonstration of how to mix and apply the coating systems.
 - c. A detailed explanation of the ambient condition requirements (temperature and humidity) and surface preparation requirements for application of the coating system as well as a detailed explanation of re-coat times, cure times, and related ambient condition requirements.
 - d. When training is performed, the CTR shall provide a written letter stating that training was satisfactorily completed by the personnel listed by name in the letter.

C. Coating System Inspection:

1. While on site to routinely inspect and verify, the CTR shall perform the following activities to confirm acceptability and conformance with the specifications:
 - a. Inspect ambient conditions during various coating system installation at hold points for conformance with the specified requirements.
 - b. Inspect the surface preparation of the substrates where the coating system will terminate or will be applied for conformance to the specified application criteria.
 - c. Inspect preparation and application of coating detail treatment (for example, terminations at joints, metal embedments in concrete, etc.).
 - d. Inspect application of the filler/surface materials for concrete and masonry substrates.
 - e. Inspect application of the primers and finish coats including wet and dry film thickness of the coatings.
 - f. Inspect coating systems for cure.
 - g. Inspect coating systems for entrapped materials such as but not limited to spent abrasive, paint overspray, coating skips and misses, paint drips, runs and sags.
 - h. Review adhesion testing of the cured coating systems for conformance to specified criteria.
 - i. Review coating system continuity testing for conformance to specified criteria.
 - j. Inspect and record representative localized repairs made to discontinuities identified via continuity testing.
 - k. Conduct a final review of completed coating system installation for conformance to the specifications.
 - l. Prepare and submit a site visit report following each site visit that documents the acceptability of the coating work in accordance with the CSM's Recommendations.

D. Final Report:

1. Upon completion of coating work for the project, the CTR shall prepare a final report. That report shall summarize daily test data, observations, drawings, and photographs in a report to be submitted in accordance with paragraph 2.02. Include substrate conditions, ambient conditions, and application procedures, observed during the CTR's site visits. Include a statement that the completed work was performed in accordance with the requirements of this Section 09 90 00 and the CSM's recommendations.

PART 2 PRODUCTS

2.01 MATERIALS

A. General:

1. Notwithstanding the listing of product names in this Section 09 90 00, the Contractor shall provide affidavits, signed and sealed by an officer of the CSM's corporation, attesting to full compliance of each coating system component with current and promulgated federal, state, and local air pollution control regulations and requirements. No coatings shall be applied to a surface until the specified affidavits have been submitted and have been reviewed and accepted. Failure to comply with

this requirement shall be cause for rejection and removal of such materials from the site.

2. The following list specifies the material requirements for coating systems. Coating systems are categorized by generic name followed by an identifying abbreviation. If an abbreviation has a suffix number, it is for identifying subgroups within the coating system. Coating Systems E-5 and E-6 shall be NSF 61 certified.

Material Requirements for Coating Systems: All of U.S. Except California

Coating System	CSM	First Coat(s)	Finish Coat(s)
Epoxy Coatings			
E-1	PPG PMC	Amerlock 2/400 Series	Amerlock 2/400 Series
	Carboline	Carboguard 890	Carboguard 890
	International Paint/ICI *	Devran 224 HS	Devran 224
	Sherwin Williams	Macropoxy 646	Macropoxy 646
	Tnemec	Series V69	Series V69
E-1-G	PPG PMC	Amerlock 2/400 Series	Amerlock 2/400 Series
	Carboline	Carboguard 894	Carboguard 894
	International Paint/ICI *	Devran 223/224HS	Devran 224HS
	Sherwin Williams	Macropoxy 646 Epoxy B67-600	Macropoxy 646 Epoxy B67-600
	Tnemec	Series V27 or V69	Series V69
E-2	PPG PMC	Amerlock 2/400 Series	Amerlock 2/400 Series
	Carboline	Carboguard 890	Carboguard 890
	International Paint/ICI	Bar-Rust 236	Bar-Rust 236
	Sherwin Williams	Sea Guard 6000 Epoxy N11-400	Sea Guard 6000 Epoxy N11-400
	Tnemec	Series V27 or V69	Series V69
E-3	PPG PMC	Amerlock 2/400 Series	Amerlock 2/400 Series
	Carboline	Carboguard 890	Carboguard 890
	International Paint/ICI	Bar-Rust 236	Bar-Rust 236
	Sherwin Williams	Sea Guard 6000 Epoxy N11-400	Sea Guard 6000 Epoxy N11-400
	Tnemec	Series V69	Series V69
E-4	PPG PMC	Amerlock 2/400 Series	Amerlock 2/400 Series
	Carboline	Carboguard 890	Carboguard 890
	International Paint/ICI	Bar-Rust 236	Bar-Rust 236
	Sherwin Williams	Macropoxy 646	Macropoxy 646
	Tnemec	Series V69	Series V69
E-5	PPG PMC	Amercoat 395FD	Amercoat 395FD
	Carboline	Carboguard 691	Carboguard 691
	International Paint/ICI	Bar-Rust 233H	Bar-Rust 233H
	Sherwin Williams	Macropoxy 646	Macropoxy 646

Material Requirements for Coating Systems: All of U.S. Except California

Coating System	CSM	First Coat(s)		Finish Coat(s)
E6	Tnemec	Series V69		Series V69
	PPG PMC	Amercoat 395FD		Amercoat 395FD
	Carboline	Carboguard 691		Carboguard 691
	International Paint/ICI	Tru-Glaze 4408 - WB		Tru-Glaze 4408 - WB
	Sherwin Williams	Macropoxy 646		Macropoxy 646
E7	Tnemec	Series V69		Series V69
	PPG PMC	Amercoat 385		Amercoat 385
	Carboline	Sanitile 120		Carboguard 890
	International Paint/ICI	Bar-Rust 236		Bar-Rust 236
	Sherwin Williams	Macropoxy 646		Macropoxy 646
E8	Tnemec	Series V69		Series V69
	PPG PMC	Amercoat 385		Amercoat 385
	Carboline	Carboguard 1340		Carboguard 1340
	International Paint/ICI	Prep and Prime (Gripper)		Tru-Glaze 4408 - WB
	Sherwin Williams	Macropoxy 646		Macropoxy 646
E-9	Tnemec	Series 201		Series 201
	PPG PMC	Amercoat 395 FD		Amercoat 395 FD
	Carboline	Carboguard 890		Carboguard 890
	International Paint/ICI	Bar-Rust 231		Bar-Rust 231
	Sherwin Williams	Sea Guard 6000 Epoxy N11-400		Sea Guard 6000 Epoxy N11-400
E-9-C	Tnemec	Series 104		Series 104
	PPG PMC	Amercoat 395 FD		Amercoat 395 FD
	Carboline	Carboguard 890		Carboguard 890
	International Paint/ICI	Bar-Rust 231		Bar-Rust 231
	Sherwin Williams	Sea Guard 6000 Epoxy N11-400		Sea Guard 6000 Epoxy N11-400
E-10	Tnemec	Series 104		Series 104
	PPG PMC	Amerlock 2/400 Series		Amerlock 2/400 Series
	Carboline	Carboguard 890		Carboguard 890
	International Paint/ICI	Bar-Rust 236		Bar-Rust 236
	Sherwin Williams	Macropoxy 646		Macropoxy 646
Specialty Epoxy Linings	Tnemec	Series V69		Series V69
	EA-1	Carboline	Plasite 4500S	Plasite 4500S
		Sauereisen	Sewergard 210S	Sewergard 210S
		Tnemec	Series 435	Series 435
Coating System	CSM	Base Coat	Filler/Surfacer	Glaze Coat

Material Requirements for Coating Systems: All of U.S. Except California

Material Requirements for Coating Systems: All of U.S. Except California						
Coating System	CSM	First Coat(s)			Finish Coat(s)	
EA-2	Carboline Carboguard	Plasite 4500S	Carboguard 510		Plasite 4500S	
	Sauereisen	Sewergard 210S	Series 209 HB		Sewergard 210S	
	Tnemec	Series 435	Series 218		Series 435	
EA-3	Carboline	N/A	Carboguard 510		Plasite 5371	
	Sauereisen	N/A	Series 209 HB		Sewergard 210T	
	Tnemec	N/A	Series 218		Series 434	
Coating System	CSM	Primer	Base Coat		Glaze Coat	
EA-4	Carboline	N/A	Plasite 5371		Plasite 4500S	
	Sauereisen	N/A	Sewergard 210T		Sewergard 210G	
	Tnemec	N/A	Series 434		Series 435	
Coating System	CSM	Primer	Filler/ Surfacer	Base Coat w/Scrim Cloth	Saturation Coat w/Silica Sand	Finish Coats
EA-5	Tnemec	Series 201	Series 218	Series 239	Series 239	Series 282
	Carboline	Semstone 110/110EP	Carboguard 510	Semstone 145	Semstone 145	Semstone 145
Elastomeric Coatings						
EC-1	Carboline	Carboguard 671			Polibrid 705 (2 coats)	
	Sherwin Williams	Corobond 100			Envirolastic 170 (2 coats)	
	Tnemec	Series 1			Series 406 (2 coats)	
EC-2	Carboline	Carboguard 671			Polibrid 705 (2 coats)	
	Sherwin Williams	Corobond 100			Envirolastic 520PW (2 coats)	
	Tnemec	Series V69			Series 264	
Epoxy Flooring Systems						
Coating System	CSM	Primer	Intermediate Coat		Finish Coat	
EF-1	Stonhard	Stonhard Standard Primer	Stonshield Undercoat and Broadcoat		Stonshield Sealer	
	Tnemec	Series 238	Series 238 with Broadcoat		Series 284 Clear	
EF-2	Stonhard	Stonhard Standard Primer	Stonclad GS		Stonkote GS-4	
	Tnemec	Series 238	Series 238		Series 280	
Epoxy Polyurethane						
		Primer Coat(s)	Intermediate Coat(s)			
EU-1	PPG PMC	Amercoat	Amercoat 385		Amercoat 450H	
	Carboline	Carbozinc 859	Carboguard 890		Carbothane 134 VOC	
	International Paint/ICI	Cathacoat 313	Devran 233 or 224HS		Devthane 379	
	Sherwin Williams	Zinc Clad IV	Macropoxy 646		Hi Solids Polyurethane	
	Tnemec	Series 90-97	Series V69		Series 1075	
EU-1-FRP	PPG PMC	Amerlock 2/400 Series			Amershield VOC	
	Carboline	Carbocrylic 120			Carbothane 134 VOC	

Material Requirements for Coating Systems: All of U.S. Except California

Coating System	CSM	First Coat(s)	Finish Coat(s)
	International Paint/ICI	Devran 223/224	Devthane 378H
	Sherwin Williams	Macropoxy 646	High Solids Polyurethane
	Tnemec	Series V27	Series 1075
Grease			
G	Texaco	N/A	Rust Inhibitive Grease
	Chevron	N/A	E.P. Roller Grease
High Heat			
HH-1	High Temperature Coatings, Inc.	Hi Temp 1027	1000 VS (any color)
HH-2	High Temperature Coatings, Inc.	Hi Temp 1027	1000 VS (black or aluminum)
Latex Acrylic			
L-1	PPG PMC	Amercoat 148	Amercoat 220
	Carboline	Carbocrylic 120	Carbocrylic 3359
	International Paint/ICI	UH Gripper 3210	Dulux Pro 1406
	Sherwin Williams	Loxon Acrylic Primer	Sher Cryl HPA
	Tnemec	Series 1028 or 1029	Series 1028 or 1029
L-2	PPG PMC	Amercoat 220	Amercoat 220
	Carboline	Carbocrylic 120	Carbocrylic 3359
	International Paint/ICI	Prep and Prime Gripper	Ultrahide 250-1406
	Sherwin Williams	Sher Cryl HPA	Sher Cryl HPA
	Tnemec	Series 1028 or 1029	Series 1028 or 1029
L-3	PPG PMC	Amercoat 148	Amercoat 220
	Carboline	Carbocrylic 3359 DTM	Carbocrylic 3359 DTM
	International Paint/ICI	Devflex 4020 PF	Dulux Pro 1406
	Sherwin Williams	Procryl Primer	Sher Cryl HPA
	Tnemec	Series 1028 or 1029	Series 1028 or 1029
L-4	PPG PMC	Amercoat 148	Amercoat 220
	Carboline	Sanitile 120	Sanitile 155
	International Paint/ICI	Prepared Prime Gripper	Ultrahide 250-1406
	Sherwin Williams	Prep Rite ProBlock	Sher Cryl HPA
	Tnemec	Series 1028 or 1029	Series 1028 or 1029
Miscellaneous			
M-1	Carboline	Carbowrap Priming Paste	Tape A, B, or C (temp. dependent)
	Denso	Denso Paste	Densyl Tape
	Trenton	Waxtape Primer	#1 Wax Tape
M-2	Carboline	Carbomastic 15	Carbomastic 15

Material Requirements for Coating Systems: All of U.S. Except California

Coating System	CSM	First Coat(s)	Finish Coat(s)
	International Paint/ICI	Bar-Rust 231 (231K 9100)	Bar-Rust 231 (231K 9100)
	Sherwin Williams	Epoxy Mastic Aluminum II	Epoxy Mastic Aluminum II
	Tnemec	Series 135 (1243)	Series 135 (1243)
Penetrating Stain			
	CSM	Primer	Finish
S-1	Carboline	Carbocrete Sealer WB	Carbocrete Sealer WB
	International Paint/ICI	Groundworks	Groundworks
	Sherwin Williams	H&C Acrylic Concrete Stain	H&C Acrylic Concrete Stain
	Tnemec	Series 617	Series 617
S-2	Tnemec	N/A	Series 636 Dur A Pell 20
	Curecrete Chemical Company	N/A	Ashford Formula
S-3	Tnemec	N/A	Series V626 Dur A Pell GS
S-4	Tnemec	N/A	Series V626 Dur A Pell GS
	Professional Products of Kansas	N/A	PWS-15 Super

*See CSM's Product Data Sheets for acceptable thinners for VOC compliance or do not thin.

2.02 PRODUCT DATA

A. General:

1. Prior to application of coatings, submit letter(s) from the CTR(s) identifying the application personnel who have satisfactorily completed training as specified in paragraph 1.05 or a letter from the CSM stating that personnel who shall perform the work are approved by the CSM without need for further or additional training.
2. Submit reports specified in paragraph 1.02 Quality Control Requirements and 1.05 Coating System Inspection when the work is underway.
3. Submit the Coating System Inspection Checklists, using Form 09 90 00-A, included in Section 01 99 90, for the coating work.
4. CTR final report in accordance with paragraph 1.05 Final Report.

2.03 SPARE SUPPLIES

A. The Contractor shall provide one unbroken gallon container of each color and type of paint and each type of solvent and thinner required by the specification. These spare paint supplies shall be stored as required in paragraph 1.03 until delivery is requested by the Construction Manager.

PART 3 EXECUTION

3.01 COATINGS

A. General:

1. Coating products shall not be used until the Construction Manager has accepted the affidavits specified in paragraphs 1.04 and 2.01, the Construction Manager has

inspected the materials, and the CTR has trained the Contractor and CSA in the surface preparation, mixing and application of each coating system.

2. Erect and maintain protective enclosures as stipulated per SSPC-Guide 6 Guide for Containing Debris Generated During Paint Removal Operations.

B. Shop and Field Coats:

1. Shop Applied Prime Coat: Except as otherwise specified, prime coats may be shop-applied or field-applied. Shop-applied primer shall be compatible with the specified coating system and shall be applied at the minimum dry film thickness recommended by the CSM. Data sheets identifying the shop primer used shall be provided to the on-site coating application personnel. Adhesion tests shall be performed on the shop primer as specified in paragraph 3.01 Adhesion Confirmation. Damaged, deteriorated and poorly applied shop coatings that do not meet the requirements of this Section 09 90 00 shall be removed and the surfaces recoated. If the shop primer coat meets the requirements of this Section 09 90 00, the field coating may consist of touching up the shop prime coat and then applying the finish coats to achieve the specified film thickness and continuity.
2. Field Coats: Field coats shall consist of one or more prime coats and one or more finish coats to build up the coating to the specified dry film thickness. Unless otherwise specified, finish coats shall not be applied until other work in the area is complete and until previous coats have been inspected.
3. Adhesion Confirmation: The Contractor shall perform an adhesion test after proper cure in accordance with ASTM D3359 to demonstrate that (1) the shop applied prime coat adheres to the substrate, and (2) the specified field coatings adhere to the shop coat. Test results showing an adhesion rating of 5A on immersed surfaces and 4A or better on other surfaces shall be considered acceptable for coatings 5 mils or more in thickness (Method A). Test results showing an adhesion rating of 5B on immersed surfaces and 4B or better on other surfaces shall be considered acceptable for coating thicknesses less than 5 mils.

C. Application Location Requirements:

1. Equipment, Nonimmersed: Items of equipment, or parts of equipment that are not immersed in service, shall be shop primed and then finish coated in the field after installation with the specified or acceptable color. If the shop primer requires topcoating within a specified period, the equipment shall be finish coated in the shop and then touch-up painted after installation. If equipment removal and reinstallation is required for the project, touch-up coating work shall be performed in the field following installation.
2. Equipment, Immersed: Items of equipment, or parts and surfaces of equipment that are immersed when in service, with the exception of pumps and valves, shall have surface preparation and coating work performed in the field. Coating systems applied to immersed equipment shall be pinhole free.
3. Steel Water Tanks: The interior surfaces of steel water tanks or reservoirs shall have surface preparation and coating work performed in the field.

3.02 PREPARATION

A. General:

1. Surface preparations for each type of surface shall be in accordance with the specific requirements of each coating specification sheet (COATSPEC) and the following. In the event of a conflict, the COATSPEC sheets shall take precedence.
2. Surfaces to be coated shall be clean and dry. Before applying coating or surface treatments, oil, grease, dirt, rust, loose mill scale, old weathered coatings, and other foreign substances shall be removed. Oil and grease shall be removed before mechanical cleaning is started. Where mechanical cleaning is accomplished by blast cleaning, the abrasive used shall be washed, graded and free from contaminants that might interfere with the adhesion of the coatings. The air used for blast cleaning shall be sufficiently free of oil and moisture so as not to cause detrimental contamination of the surfaces to be coated.
3. Where deemed necessary by the Owner's representative, a NACE International certified coatings inspector, provided by the Owner, will inspect and approve surfaces to be coated before application of a coating. Surface defects identified by the inspector shall be corrected by the Contractor at no additional cost to the Owner.
4. Cleaning and painting shall be scheduled so that dust and spray from the cleaning process shall not fall on wet, newly coated surfaces. Hardware, hardware accessories, nameplates, data tags, machined surfaces, surrounding utilities, utilities to be installed / reinstalled, sprinkler heads, electrical fixtures, and similar uncoated items which are in contact with coated surfaces shall be removed or masked prior to surface preparation and painting operations. Following completion of coating, removed items shall be reinstalled. Equipment adjacent to walls shall be disconnected and moved to permit cleaning and painting of equipment and walls and, following painting, shall be replaced and reconnected.

B. Blast Cleaning:

1. When abrasive blast cleaning is required to achieve the specified surface preparation the following requirements for blast cleaning materials and equipment shall be met:
 - a. Used or spent blast abrasive shall not be reused on this project.
 - b. The compressed air used for blast cleaning shall be filtered and shall contain no condensed water and no oil. Moisture traps shall be cleaned at least once every four hours or more frequently as required to prevent moisture from entering the supply air to the abrasive blasting equipment. Any oil or water that is spilled or sprayed onto steel surfaces to be prepared shall be removed prior to painting at the Contractor's expense.
 - c. Oil separators shall be installed just downstream of compressor discharge valves and at the discharge of the blast pot discharges. These shall be checked on the same frequency as the moisture traps as defined above.
 - d. Regulators, gauges, filters, and separators shall be in use on compressor air lines to blasting nozzles times during this work.
 - e. An air dryer or desiccant filter drying unit shall be installed which dries the compressed air prior to blast pot connections. This dryer shall be used and maintained for the duration of surface preparation work.
 - f. The abrasive blast nozzles used shall be of the venturi or other high velocity type supplied with a minimum of 100 psig air pressure and sufficient volume to obtain the blast cleaning production rates and cleanliness/specified.

- g. The Contractor shall provide ventilation for airborne particulate evacuation (meeting pertinent safety standards) to optimize visibility for both blast cleaning and inspection of the substrate during surface preparation work.
- h. If, between final surface preparation work and coating system application, contamination of prepared and cleaned metallic substrates occurs, or if the prepared substrates' appearance darkens or changes color, recleaning by water blasting, reblasting and abrasive blast cleaning shall be required until the specified degree of cleanliness is reclaimed.
- i. The Contractor is responsible for dust control and for protection of mechanical, electrical, and other equipment adjacent to and surrounding the work area.

C. Solvent Cleaning:

- 1. Any solvent wash, solvent wipe, or cleaner used, including but not limited to those used for surface preparation in accordance with SSPC SP-1 Solvent Cleaning and shall be of the emulsifying type which emits no more than 340 g/l VOCs for AIM regions, 250 g/l for CARB regions and 100 g/l for SCAQMD regions, contains no phosphates, is biodegradable, removes no zinc, and is compatible with the specified primer.
- 2. Clean white cloths and clean fluids shall be used in solvent cleaning.

D. Metallic Surfaces:

- 1. Metallic surfaces shall be prepared in accordance with applicable portions of surface preparation specifications of the Society for Protective Coatings (SSPC) specified for each coating system. See Coat Spec for each coating system in this **Section 09 90 00**. The profile depth of the surface to be coated shall be in accordance with the COATSPEC requirements in this Section measured by Method C of ASTM D4417. Blast particle size shall be selected by the Contractor to produce the specified surface profile. The solvent in solvent cleaning operations shall be as recommended by the CSM.
- 2. Preparation of metallic surfaces shall be based upon comparison with SSPC-VIS1-89 (ASTM D2200), and as described in the Coat Spec for each coating system. If dry abrasive blast cleaning is selected and to facilitate inspection, the Contractor shall, on the first day of cleaning operations, abrasive blast metal panels to the standards specified. Plates shall measure a minimum of 8-1/2 inches by 11 inches. Panels meeting the requirements of the specifications shall be initialed by the Contractor and the Construction Manager and coated with a clear non-yellowing finish. One of these panels shall be prepared for each type of abrasive blasting and shall be used as the comparison standard throughout the project.
- 3. Blast cleaning requirements for steel, ductile iron and stainless steel substrates are as follows:
 - a. Steel piping shall be prepared in accordance with SSPC SP-6 (Commercial Blast Cleaning) and primed before installation. Ductile iron piping surfaces including fittings shall be prepared in accordance with NAPF 500-03, NAPF 500-03-04, and NAPF 500-03-05.
 - b. Stainless steel surfaces shall be abrasive blast cleaned to leave a clean uniform appearance with a minimum surface profile of 1.5 to 2.5 mils that is uniform.
 - c. Remove traces of grit, dust, dirt, rust scale, friable material, loose corrosion products or embedded abrasive from substrate by vacuum cleaning prior to coating application.

- d. Care must be taken to prevent contamination of the surface after blasting from worker's fingerprints, deleterious substances on workers' clothing, or from atmospheric conditions.
- e. Ambient environmental conditions in the enclosure must be constantly monitored and maintained to ensure the degree of cleanliness is held and no "rust back" occurs prior to coating material application. Contractor is responsible to remove all "rust back" that appears prior to coating material application.
- f. Cleaning of existing metal surfaces, prior to surface preparation shall be as follows.
 - 1) Cleaning for decontamination shall utilize a steam generator ("Jenny") capable of producing steam/hot water temperature of 150 degrees F minimum to 200 degrees F maximum. Hot water pressure washing at 150 degrees F can also be utilized using clean, fresh, potable water only. The steam/hot water shall be applied using a lance with a nozzle providing a fan shaped spray pattern. The recommended discharge temperature is 150 degrees F for safety reasons.
 - 2) Steam/hot water shall be applied in a minimum of two passes over surfaces cleaned. Horizontal members on substrates shall be cleaned from end to end continuously and from top to bottom as this horizontal progression continues. Vertical pipes or substrates shall be cleaned around the circumference from top to bottom (crown to invert) to ensure complete solubility and rinsing of contaminants from top to bottom. As this cleaning proceeds, the surfaces of the steel shall be scrubbed using stiff bristle brushes.
 - 3) Once completed, this cleaning shall be followed by repeated thorough rinsing. Rinsing can be accomplished using pressure water washing using unheated potable water. Once decontamination cleaning has been performed over a representative (small) area, the cleaned substrate shall be tested for soluble salt concentrations to ensure that the pattern and extent of cleaning shall be adequate. Testing shall be performed as defined in paragraph 3.07.

E. Concrete Surfaces:

- 1. Inspection of concrete surfaces prior to surface preparation and surface preparation of concrete surfaces shall be performed in accordance with SSPC-SP13 (also called NACE 6).
- 2. Prepare substrate cracks, areas requiring resurfacing and perform detail treatment including but not limited to, terminating edges, per CSM recommendations. This shall precede surface preparation for degree of cleanliness and profile.
- 3. The surface profile for prepared concrete surfaces to be coated shall be evaluated by comparing the profile of the prepared concrete with the profile of graded abrasive paper, as described in ANSI B74.18 or by comparing the profile with the ICRI 03732 (surface profile replicas). Surface profile requirements shall be in accordance with the Coat Spec requirements and the CSM's recommendations.
- 4. Surface cleanliness of prepared concrete substrates shall be inspected after cleaning, preparation, and/or drying, but prior to making repairs or applying a coat in the coating system. If concrete surfaces are repaired, they shall be reinspected for surface cleanliness prior to application of the coating system.
- 5. Surface preparation of concrete substrates shall be accomplished using methods such as dry abrasive blast cleaning, high, or ultra high-pressure water blast cleaning

in accordance with SSPC-SP-13. The selected cleaning method shall produce the requirements set forth below.

- a. A clean substrate that is free of calcium sulfate, loose coarse or fine aggregate, laitance, loose hydrated cement paste, and otherwise deleterious substances shall be achieved. Blast cleaning and other means necessary shall be used to open up air voids or bugholes to expose their complete perimeter. Leaving shelled over, hidden air voids beneath the exposed concrete surface is not acceptable. Concrete substrate must be dry prior to the application of filler/surface or coating system materials.
 - b. Acceptable surface preparation must produce a concrete surface with a minimum pH of 8.0 to be confirmed by surface pH testing. If after surface preparation, the surface pH remains below 8.0, perform additional water blasting, cleaning, or abrasive blast cleaning until additional pH testing indicates an acceptable pH level.
 - c. Following inspection by the Contractor of the concrete surface preparation, thoroughly vacuum clean concrete surfaces to be coated to remove loose dirt, and spent abrasive (if dry blast cleaning is used) leaving a dust free, sound concrete substrate. Debris produced by blast cleaning shall be removed from the structures to be coated and disposed of legally off site by the Contractor.
6. Should abrasive blast cleaning or high or ultrahigh pressure water blasting not remove degraded concrete, chipping or other abrading tools shall be used to remove the deteriorated concrete until a sound, clean substrate is achieved which is free of calcium sulfate, loose coarse or fine aggregate, laitance, loose hydrated cement paste, and otherwise deleterious substances. Concrete substrates must be dry prior to the application of filler/surfacers or coating system materials.
 7. Surface cleanliness of prepared concrete substrates shall be inspected after cleaning, preparation, and/or drying, but prior to application of coating materials. If concrete surfaces are repaired, they shall be reinspected for surface cleanliness and required surface profile prior to application of the coating system.
 8. Moisture content of concrete to be coated shall be tested in accordance with ASTM D4263, Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method and ASTM F 1869, Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride. The ASTM D4263 plastic sheet test shall be conducted at least once for every 500 sq. ft. of surface area to be coated. The presence of any moisture on plastic sheet following test period constitutes a non-acceptable test. For concrete surfaces to be coated which are on the negative or back side of concrete walls or structures exposed to soils (back filled) or immersed and waterproofed in accordance with Section 07 10 00, perform calcium chloride tests in accordance with ASTM F-1869 once for each 500 sq. ft. of surface area to be coated. Comply with CSM's written recommendations regarding acceptance/non-acceptance of moisture vapor emissions.

F. Fiberglass Reinforced Plastic (FRP) Surfaces:

1. Prepare FRP surfaces by sanding to establish uniform surface roughness and to remove gloss from the resin in the FRP. Next, vacuum clean to remove loose FRP dust, dirt, and other materials. Next, solvent clean using clean white rags and allow solvent to evaporate completely before application of coating materials.

G. Existing Facilities:

1. Existing equipment and metalwork shall be coated in accordance with the appropriate coating system specified for new work in paragraph 3.05.
2. Modified work shall require the full coating system. Other work shall require cleaning and surface preparation as recommended by the CSM followed by two finish coats of the appropriate system.
3. Contractor shall demonstrate that the existing coating is compatible with field coating by performing the adhesion test specified in paragraph 3.01 Adhesion Confirmation. Where unacceptable test results are obtained, the Contractor shall follow manufacturer's written instructions as to the necessity of a tie coat to provide a satisfactory bond between the existing coating and the specified field coating. The difference in cost between the specified coatings and that which is compatible with existing coatings, or work required to remove existing coatings, will be paid for as extra work unless identified in the Scope of Work for the project already.

3.03 APPLICATION

A. Workmanship:

1. Coated surfaces shall be free from runs, drips, sags, ridges, waves, laps, and brush marks. Coats shall be applied to produce an even film of uniform thickness completely coating corners and crevices.
2. The Contractor's equipment shall be designed for application of the materials specified. Compressors shall have suitable traps and filters to remove water and oils from the air. A paper blotter test shall be performed by the Contractor when requested by the Construction Manager to determine if the air is sufficiently free of oil and moisture so as not to produce deteriorating effects on the coating system. The amount of oil and moisture in spray air shall be less than the amount recommended by the CSM. Spray equipment shall be equipped with mechanical agitators, pressure gages, and pressure regulators, and spray nozzles of the proper sizes.
3. Each coat of coating material shall be applied evenly and sharply cut to line. Care shall be exercised to avoid overspraying or spattering paint on surfaces not to be coated. Glass, hardware, floors, roofs, and other adjacent areas and installations shall be protected by taping, drop cloths, or other suitable measures.
4. Coating applications method shall be conventional or airless spray, brush or roller, or trowel as recommended by CSM.
5. Allow each coat to cure or dry thoroughly, according to CSM's printed instructions, prior to recoating.
6. Vary color for each successive coat for coating systems when possible.
7. When coating complex steel shapes, prior to overall coating system application, stripe coat welds, edges of structural steel shapes, metal cut-outs, pits in steel surfaces, or rough surfaces with the primer coat. This involves applying a separate coat using brushes or rollers to ensure proper coverage. Stripe coat via spray application is not permitted.

B. Coating Properties, Mixing and Thinning:

1. Coatings, when applied, shall provide a satisfactory film and smooth even surface. Glossy undercoats shall be lightly sanded to provide a surface suitable for the proper application and adhesion of subsequent coats. Coating materials shall be thoroughly stirred, strained, and kept at a uniform consistency during application. Coatings

consisting of two or more components shall be mixed in accordance with the CSM's instructions. Where necessary to suit the conditions of the surface, temperature, weather and method of application, the coating may be thinned as recommended by the CSM immediately prior to use. The volatile organic content (VOC) of the coating as applied shall comply with prevailing air pollution control regulations. Unless otherwise specified, coatings shall not be reduced more than necessary to obtain the proper application characteristics. Thinner shall be as recommended by the CSM.

C. Atmospheric Conditions:

1. Coatings shall be applied only to surfaces that are dry, and only under conditions of evaporation rather than condensation. Coatings systems shall not be applied during rainy, misty weather, or to surfaces upon which there is frost or moisture condensation. During damp weather, when the temperature of the surface to be coated is within 10 degrees F of the dew point, forced dehumidification equipment may be used to maintain a temperature of minimum 40 degrees F and 10 degrees F above the dew point for the surfaces to be coated, the coated surface, and the atmosphere in contact with the surface. These conditions shall be maintained for a period of at least 8 hours or as recommended by the CSM. Where conditions causing condensation are severe, dehumidification equipment, fans, and/or heaters shall be used inside enclosed areas to maintain the required atmospheric and surface temperature requirements for proper coating application and cure.

D. Concrete Substrate Temperatures and Detail Treatment:

1. When the surface temperatures of the concrete substrates to be coated are rising or when these substrates are in direct sunlight, outgassing of air from the concrete may result in bubbling, pinhole formations, and/or blistering in the coating system. The application of the filler/surface and the coating system will only be allowed during periods of falling temperature. This will require that application of the filler/surface and coating system shall only occur during the cooler evening hours. Contractor shall include any cost for working outside of normal hours in the bid.
2. Should bubbles, pinholes, or discontinuities form in the applied coating system material, they shall be repaired as recommended by the CSM. Should pinholes develop in the filler/surfacer material or in the first coat of the coating material, the pinholes shall be repaired in accordance with the CSM's recommendations prior to application of the next coat of material. Whenever pinholes occur, the air void behind or beneath the pinhole shall be opened up completely and then completely filled with the specified filler/surfacer material. Next, the coated area around the pinhole repair shall be abraded and the coating reapplied over that area.
3. Perform application detail work per CSM's current written recommendations and/or drawings.

E. Protection of Coated Surfaces:

1. Items that have been coated shall not be handled, worked on, or otherwise disturbed, until the coating is completely dry and hard. After delivery at the site, and upon permanent erection or installation, shop-coated metalwork shall be recoated or retouched with specified coating when it is necessary to maintain the integrity of the film.

F. Method of Coating Application:

1. Where two or more coats are required, alternate coats shall contain sufficient compatible color additive to act as indicator of coverage, or the alternate coats shall be of contrasting colors. Color additives shall not contain lead, or lead compounds, which may be destroyed or affected by hydrogen sulfide or other corrosive gas, and/or chromium.
2. Mechanical equipment, on which the equipment manufacturer's coating is acceptable, shall be touch-up primed and coated with two coats of the specified coating system to match the color scheduled. Electrical and instrumentation equipment specified in Divisions 26 and 40 shall be coated as specified in paragraph 3.03 Electrical and Instrumentation Equipment and Materials.
3. Coatings shall not be applied to a surface until it has been prepared as specified. The primer or first coat shall be applied by brush to ferrous surfaces that are not blast-cleaned. Coats for blast-cleaned ferrous surfaces and subsequent coats for nonblast-cleaned ferrous surfaces may be either brush or spray applied. After the prime coat is dry, pinholes and holidays shall be marked, repaired in accordance with CSM's recommendations and retested before succeeding coats are applied. Unless otherwise specified, coats for concrete and masonry shall be brushed, rolled, or troweled.

G. Film Thickness and Continuity:

1. WFT of the first coat of the coating system and subsequent coats shall be verified by the Contractor, following application of each coat.
2. The surface area covered per gallon of coating for various types of surfaces shall not exceed those recommended by the CSM. The first coat, referred to as the prime coat, on metal surfaces refers to the first full paint coat and not to solvent wash, grease emulsifiers or other pretreatment applications. Coatings shall be applied to the thickness specified, and in accordance with these specifications. Unless otherwise specified, the average total thickness (dry) of a completed protective coating system on exposed metal surfaces shall be not less than 1.25 mils per coat. The minimum thickness at any point shall not deviate more than 25 percent from the required average. Unless otherwise specified, no less than two coats shall be applied.
3. In testing for continuity of coating about welds, projections (such as bolts and nuts), and crevices, the Construction Manager shall determine the minimum conductivity for smooth areas of like coating where the dry-mil thickness has been accepted. This conductivity shall be the minimum required for these rough or irregular areas. Pinholes and holidays shall be recoated to the required coverage.
4. The ability to obtain specified film thickness is generally compromised when brush or roller application methods are used and, therefore, more coats may need to be applied to achieve the specified dry film thickness.
5. For concrete substrates, the Contractor shall apply a complete skim coat of the specified filler/surfacer material over the entire substrate prior to application of the coating system. This material shall be applied such that all open air voids and bugholes in the concrete substrate are completely filled prior to coating application.

H. Special Requirements:

1. Before erection, the Contractor shall apply all but the final finish coat to interior surfaces of roof plates, roof rafters and supports, pipe hangers, piping in contact with hangers, and contact surfaces that are inaccessible after assembly. The final coat

shall be applied after erection. Structural friction connections and high tensile bolts and nuts shall be coated after erection. Areas damaged during erection shall be hand-cleaned or power-tool cleaned and recoated with primer coat prior to the application of subsequent coats. Touch-up of surfaces shall be performed after installation. Surfaces to be coated shall be clean and dry at the time of application. Except for those to be filled with grout, the underside of equipment bases and supports that have not been galvanized shall be coated with at least two coats of primer specified for system E-2 prior to setting the equipment in place. Provide coating system terminations at leading edges and transitions to other substrates in accordance with the CSM's recommendations or detail drawings.

I. Electrical and Instrumentation Equipment and Materials:

1. Electrical and instrumentation equipment and materials shall be coated by the equipment manufacturer as specified below.
 - a. Finish: Electrical equipment shall be treated with zinc phosphate, bonderized or otherwise given a rust-preventive treatment. Equipment shall be primed, coated with enamel, and baked. Minimum dry film thickness shall be 3 mils.
 - 1) Unless otherwise specified, instrumentation panels shall be coated with system E-1 for indoor mounting and system EU-1 for outdoor mounting.
 - 2) Before final acceptance, the Contractor shall touch up scratches on equipment with identical color coating. Finish shall be smooth, free of runs, and match existing finish. Prior to touching up scratches, Contractor shall fill them with an appropriate filler material approved by the CSM.
 - b. Color: Exterior color of electrical equipment shall be FS 26463 (ANSI/NSF 61) light gray. Interior shall be painted FS 27880 white. Nonmetallic electrical enclosures and equipment shall be the equipment manufacturer's standard grey color.
 - 1) Exterior color of instrumentation panels and cabinets mounted indoors shall be FS 26463 light gray; unless otherwise specified, exterior color for cabinets mounted outdoors shall be FS 27722, white. Cabinet interiors shall be FS 27880, white.

J. Soluble Salt Contamination of Metallic Substrates:

1. Contractor shall test in accordance with SSPC-TU-4 metallic substrates to be coated that have been exposed to seawater or coastal air or to industrial fallout of particulate or other sources of soluble chlorides (such as wastewater exposure). If testing indicates detrimental levels of soluble salts, those in excess of 25 ppm, the Contractor shall clean and prepare these surfaces to remove the soluble salts.

3.04 CLEANUP

A. General:

1. Upon completion of coating, the Contractor shall remove surplus materials, protective coverings, and accumulated rubbish, and thoroughly clean surfaces and repair overspray or other coating-related damage.

3.05 COATING SYSTEM SPECIFICATION SHEETS (COATSPEC)

A. General:

1. Coating systems for different types of surfaces and general service conditions for which these systems are normally applied are specified on the following COATSPEC sheets. Surfaces shall be coated in accordance with the COATSPEC to the system thickness specified. Coating systems shall be as specified in paragraph 3.06. In case of conflict between the schedule and the COATSPECS, the requirements of the schedule shall prevail.
2. Coating Specification Sheets included in Table A are included this paragraph 3.05.

Table A Coating Specification Sheets

Coating System ID	Coating Material	Surface	Service Condition
E-1	Epoxy	Metal	Interior; exterior, covered, not exposed to direct sunlight, non-corrosive exposure.
E-1-G	Epoxy	Galvanized Steel	Interior; exterior, covered non-corrosive exposure. Do not use in immersion service.
E-2	Epoxy	Metal	Immersed, nonpotable; non-immersed, moderately corrosive environment, color required.
E-3	Epoxy	Concrete or Masonry	Immersed, nonpotable; non-immersed, corrosive environment, color required.
E-4	Epoxy	Concrete, masonry, plaster, gypsum board	Interior
E-5 (NSF 61 certified)	Epoxy	Metal	Interior potable water tanks and reservoirs and other metal components in contact with water being treated and stored for potable use.
E-6 (NSF 61 certified)	Epoxy	Concrete	Interior potable water tanks and reservoirs and other metal components in contact with water being treated or stored.
E-7	Epoxy	Plastic	Interior; exterior covered, not exposed to direct sunlight.
E-8	Clear epoxy	Wood	Interior
E-9	Epoxy	Metal	Immersed, nonpotable; non-immersed, corrosive environment, color required. (Not for Biogenic Sulfide Corrosion areas.)
E-9-C	Epoxy	Concrete or masonry	Immersed, nonpotable; non-immersed, moderately corrosive environment, color required. (Not for Biogenic Sulfide Corrosion areas.)
E-10	Polyamidoamine epoxy	Metal or concrete	Below grade (buried).
EF-1	Amine Epoxy Broadcast Floor Coating	Concrete Floors	Light duty, wheeled traffic, frequent foot traffic, mildly corrosive.
EF-2	Amine Epoxy Troweled Floor Coating	Concrete Floors	Heavy-duty, wheeled traffic, frequent foot traffic, wet and moderately corrosive.
EA-1	Blended Amine Cured Epoxy	Metal	Immersed, nonpotable; non-immersed, corrosive environment, color not required especially for headspace environments that are corrosive due to biogenic sulfide corrosion.

Table A Coating Specification Sheets

Coating System ID	Coating Material	Surface	Service Condition
EA-2	Blended Amine Cured Epoxy	Concrete or masonry	Immersed, nonpotable; non-immersed, corrosive environment, color not required, new construction especially for headspace environments that are corrosive due to biogenic sulfide corrosion.
EA-3	Blended Amine Cured Epoxy	Concrete or Masonry	Immersed, nonpotable; non-immersed, corrosive environment, color not required, new or existing construction, especially for headspace environments that are corrosive due to biogenic sulfide corrosion.
EA-4	Blended Amine Cured Epoxy – For Very Corrosive Conditions	Concrete or Masonry Potable	Non-immersed or immersed, very corrosive environment. Very high H ₂ S conditions.
EA-5	Novolac Epoxy Lining	Concrete	Secondary containment for spills of HFS acid or ferric chloride.
G	Grease	Metal	Ferrous Metal: Ferrous metal surfaces shall be prepared in accordance with SSPC SP-1 (Solvent Cleaning.)
HH-1	Proprietary Primer Plus Silicone Topcoat	Metal	Temperature to 750 degrees F.
HH-2	Proprietary Primer Plus Silicone Topcoat (black or aluminum only)	Metal	Temperature to 1200 degrees F.
L-1	Latex	Concrete, masonry, plaster, gypsum board	Interior and Exterior including existing exterior coated concrete.
L-2	Latex	PVC and CPVC pipe	Exterior, direct sunlight exposure.
L-3	Latex-Direct to Metal	Ferrous Metal	Interior or Exterior
L-4	Latex	Wood	Interior
M-1	Petrolatum based mastic or wax based wrapping tapes	Metal	Below grade (buried) or where little to no surface preparation can be performed on piping or structural steel.
M-2	Epoxy mastic or equal	Ferrous Metal	Interior, corrosive environment, confined enclosures, where minimal surface preparation is possible.
EU-1	Zinc-epoxy-polyurethane system	Ferrous Metal	Exterior, exposed to direct sunlight, moderately corrosive non-immersed.
EU-1-FRP	Specialty Primer plus Polyurethane Finish Coat	Exterior of FRP pipe and tanks, etc.	Exterior, exposed to direct sunlight, non-immersed.
EC-1	Hybrid Polyurethane	Concrete or dense masonry where existing crack or joint movement is suspected of propagating through rigid cured epoxy coatings	Service Condition: Interior or exterior, exposed to direct sunlight or not, corrosive (immersion pH 4.0 or lower and/or headspace pH 4.0 or lower and/or gaseous H ₂ S concentrations between 10 and 150 ppm typically.)
EC-2 (NSF-61)	Modified Polyurethane	Concrete or dense masonry where existing crack or joint movement is suspected due to thermal conditions and would propagate through rigid epoxy coating systems and/or where NSF-61 certification is required	Interior or exterior, submerged or non-submerged indirect sunlight – moderately corrosive.
S-1	Penetrating acrylic stain, color required	Concrete	Non-immersed, exposure to moisture and sunlight.

Table A Coating Specification Sheets

Coating System ID	Coating Material	Surface	Service Condition
S-2	Silane/Siloxane or Blended Sealer	Concrete Floors	Wet, non-immersed, non-corrosive. Interior or exterior for waterproofing.
S-3	RTV Silicone Rubber Based Sealer	Concrete or Masonry Walls	Exterior or Interior – Weathering Exposure, Non-Corrosive.
S-4	Acrylic Co-polymer Blend	Concrete Floors	Wet, non-immersed, non-corrosive, interior for oil and water repellent.

Coating System Specification Sheets (COATSPEC)

A. Coating System Identification: E-1

1. Coating Material:	Epoxy
2. Surface:	Metal
3. Service Condition:	Interior; exterior, covered, not exposed to direct sunlight, non-corrosive exposure.
4. Surface Preparation:	
a. General:	Shop primed surfaces which are to be incorporated in the work shall be prepared in the field by cleaning surfaces in accordance with SSPC SP-2 (Hand Tool Cleaning). Damaged shop coated areas shall be cleaned in accordance with SSPC SP-5 (White Metal Blast Cleaning) to achieve a uniform surface profile of 2.0 to 2.5 mils and spot primed with the primer specified. Shop epoxy primed surfaces shall require light abrasive and vacuum cleaning blasting prior to receiving finish coats.
b. Ferrous Metal:	Bare ferrous metal surfaces shall be prepared in accordance with SSPC SP-6 (Commercial Blast Cleaning) to achieve a uniform, surface profile of 2.0 to 2.5 mils. Ferrous metal with rust bleeding shall be cleaned in accordance with SSPC SP-1 (Solvent Cleaning). Areas of rust penetration shall be spot blasted to SSPC SP-10 (Near White Blast) (to achieve the 2.0- to 2.5-mil surface profile) and spot primed with the specified primer. For ductile iron surfaces, refer to the requirements in paragraph 3.02 Metallic Surfaces.
c. Nonferrous and Galvanized Metal:	Nonferrous and galvanized metal shall be prepared in accordance with SSPC SP-7 (Brush-off Blast Cleaning) to achieve uniform, minimum surface profile 1.0 to 1.5 mils.
5. Application:	Field
a. General:	Prime coat may be thinned and applied as recommended by the CSM, provided the coating as applied complies with prevailing air pollution control regulations.
b. Ferrous Metal:	Prime coats shall be an epoxy primer compatible with the specified finish coats and applied in accordance with the written instructions of the CSM.
c. Nonferrous and Galvanized Metal:	Nonferrous and galvanized metal shall be cleaned prior to the application of the prime coat in accordance with SSPC SP-1 (Solvent Cleaning).
6. System Thickness:	10 mils dry film.
7. Coatings:	
a. Primer:	One coat at CSM's recommended dry film thickness.
b. Finish:	One or more coats at CSM's recommended dry film thickness per coat to achieve the specified system thickness.

B. Coating System Identification: E-1-G

1. Coating Material:	Epoxy
2. Surface:	Galvanized Steel
3. Service Condition:	Interior; exterior, covered, non-corrosive exposure. Do not use in immersion service.
4. Surface Preparation:	
a. General:	Damaged galvanized steel areas with exposed ferrous metal and/or rusted shall be cleaned in accordance with SSPC SP-5 (White Metal Blast Cleaning) or Power Tool Cleaned to Bare Metal in accordance with SSPC-SP-11 to achieve a uniform 1.0- to 1.5-milprofile and spot primed with the primer specified.
b. Galvanized Metal:	Nonferrous and galvanized metal shall be prepared in accordance with SSPC SP-7 (Brush-off Blast Cleaning) impart a 1- to 2-milprofile to the galvanized steel surfaces. Where this cannot be performed, prepare by abrading in accordance with SSPC-SP-3, Power Tool Cleaning to impart a 1.0- to 1.5-mil profile uniformly to the galvanized steel surfaces.
5. Application:	Field
a. General:	Prime coat may be thinned and applied as recommended by the CSM, provided the coating as applied complies with prevailing air pollution control regulations.

Coating System Specification Sheets (COATSPEC)

b. Galvanized Metal:	Nonferrous and galvanized metal shall be cleaned prior to the application of the prime coat in accordance with SSPC SP-1 (Solvent Cleaning).
6. System Thickness:	5 to 8 mils dry film.
7. Coatings:	
a. Primer:	One coat at CSM's recommended dry film thickness.
b. Finish:	One or more coats at CSM's recommended dry film thickness per coat to the specified system thickness. If the coated galvanized steel is to be exposed to ultraviolet light, apply one polyurethane top coat from coating system EU-1 over the second coat of the two epoxy coats specified.

C. Coating System Identification: E-2

1. Coating Material:	Epoxy
2. Surface:	Metal
3. Service Condition:	Immersed, nonpotable; non-immersed, moderately corrosive environment, color required.
4. Surface Preparation:	
a. Ferrous Metal:	Ferrous metal surfaces shall be prepared in accordance with SSPC SP-5 (White Metal Blast Cleaning) to achieve a uniform surface profile of 2.0 to 2.5 mils. Damaged shop coating shall be cleaned in accordance with SSPC SP-5 (White Metal Blast Cleaning) and vacuum cleaning and spot primed with the primer specified. Shop epoxy primed surfaces shall require light abrasive blasting or abrading prior to receiving finish coats if the maximum recoat time for the primer has been exceeded. This cleaning must produce a uniform 1.0- to 1.5-mil profile in the intact shop primer. For ductile iron surfaces, refer to the requirements in paragraph 3.02 Metallic Surfaces .
b. Nonferrous and Galvanized Metal:	Nonferrous and galvanized metal shall be prepared in accordance with SSPC SP-7 (Brush-off Blast Cleaning) to achieve a uniform surface profile of 1.0 to 1.5 mils. Galvanized steel with this E-2 coating system shall not be used in immersion service in wastewater.
5. Application:	Field
a. General:	Prime coat may be thinned and applied as recommended by the CSM, provided the coating as applied complies with prevailing air pollution control regulations.
b. Ferrous Metal:	Prime coat shall be an epoxy primer compatible with the specified finish coats.
c. Nonferrous and Galvanized Metal:	Nonferrous and galvanized metal, non-immersed, shall be coated prior to the application of the prime coat with a grease emulsifying agent in accordance with the CSM's written instructions. Nonferrous metal to be immersed shall not be painted. Galvanized metal shall not be immersed even if it is painted.
6. System Thickness:	16 mils dry film.
7. Coatings:	
a. Primer:	One coat at CSM's recommended dry film thickness.
b. Finish:	Two or more coats at CSM's recommended dry film thickness per coat to the specified system thickness.

D. Coating System Identification: E-3

1. Coating Material:	Epoxy
2. Surface:	Concrete or masonry
3. Service Condition:	Immersed, nonpotable; non-immersed, corrosive environment, color required.
4. Surface Preparation:	
a. Concrete:	Concrete surfaces shall be allowed to cure for at least 28 days and allowed to dry to the moisture content recommended by the CSM before coating work proceeds. Moisture content may be tested by the Construction Manager with a Delmhorst Instrument Company moisture detector, or equal. Except as otherwise specified, loose

Coating System Specification Sheets (COATSPEC)

	concrete, form oils, surface hardeners, curing compounds, and laitance shall be removed from surfaces by abrasive blasting and chipping, and voids and cracks shall be repaired as specified in Section 03 30 00. Surface preparation can be performed by abrasive blast cleaning or water blast cleaning and must achieve a uniform concrete surface profile of CSP3 in accordance with ICRI 03732. After cleaning, air voids or bugholes in the concrete shall be filled with a surfacer or block filler compatible with the specified primer and finish coats.
b. Masonry:	<p>Masonry surfaces shall be allowed to cure for at least 28 days after being constructed and be allowed to dry to the moisture content recommended by the CSM. Holes or other joint defects shall be filled with a material compatible with the primers and finish coats or shall be filled with masonry mortar that shall cure for at least 28 days. Loose or splattered mortar shall be removed by scraping and chipping.</p> <p>Masonry surfaces shall be cleaned with clear water by washing and scrubbing to remove foreign, loose, and deleterious substances.</p> <p>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.</p>
5. Application:	Field
a. General:	<p>Apply filler/surfacer as recommended by CSM to fill bugholes and air voids or block texture, etc. leaving a uniformly filled surface that does not produce blowholes or outgassing causing pinholing of the coating system. Filler/surfacers shall dry a minimum of 48 hours prior to application of prime coat or as required by the CSM.</p> <p>Prime coat shall be thinned and applied as recommended by the CSM, provided the coating as applied complies with prevailing air pollution control regulations.</p> <p>Drying time between coats shall be as recommended by CSM.</p>
6. System Thickness:	15 mils dry film.
7. Coatings:	
a. Primer:	One coat at CSM's recommended dry film thickness.
b. Finish:	Two or more coats at CSM's recommended dry film thickness per coat to the specified system thickness.

E. Coating System Identification: E-4

1. Coating Material:	Epoxy
2. Surfaces:	Concrete, masonry, plaster, gypsum board.
3. Service Condition:	Interior
4. Surface Preparation:	
a. Concrete:	Concrete surfaces shall be allowed to age for at least 28 days and allowed to dry to the moisture content recommended by the CSM. Moisture content may be tested by the Construction Manager with a Delmhorst Instrument Company moisture detector, or equal. Loose concrete, form oils, surface hardeners, curing compounds and laitance shall be removed from surfaces, and voids and cracks shall be repaired as specified in Section 03 30 00. Surface preparation shall produce a concrete surface profile of CSP-2 in accordance with ICRI 03732. After cleaning, air voids or bugholes in the concrete shall be filled with a surfacer or block filler compatible with the specified primer and finish coats.
b. Masonry:	<p>Masonry surfaces shall be allowed to age for at least 28 days. Holes or other joint defects shall be filled with mortar and repointed. Loose or splattered 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.</p> <p>Muriatic acid shall not be used. After cleaning, exterior masonry surfaces shall be sealed or filled with a sealer or block filler compatible with the specified primer.</p>
c. Plaster:	Plaster surfaces shall be dry, clean, and free from grit, loose plaster, and surface irregularities. Cracks and holes shall be repaired with acceptable patching materials, keyed to existing surfaces, and sandpapered smooth. Surfaces shall be cleaned with clean water by washing and scrubbing to remove foreign and deleterious substances.
5. Application:	Field

Coating System Specification Sheets (COATSPEC)

a. General:	Block Filler shall be multiple component epoxy block filler or an acrylic based or waterborne epoxy based block filler and shall dry a minimum of 48 hours prior to primer application or as required by the CSM.
	Prime coat shall be thinned and applied as recommended by CSM, provided the coating as applied complies with prevailing air pollution control regulations.
	Drying time between coats shall be as recommended by CSM.
6. System Thickness:	10 mils dry film, excluding block filler and sealer.
7. Coatings:	
a. Primer:	One coat at CSM's recommended dry film thickness.
b. Finish:	One or more coats at CSM's recommended dry film thickness per coat to the specified system thickness.

F. Coating System Identification: E-5 (NSF 61 certified)

1. Coating Material:	Epoxy
2. Surface:	Metal
3. Service Condition:	Interior potable water tanks and reservoirs and other metal components in contact with water being treated and stored for potable use.
4. Surface Preparation:	
a. Ferrous Metal:	Ferrous metal surfaces shall be prepared in accordance with SSPC SP-5 (White Metal Blast Cleaning) to achieve a uniform surface profile of 2.0 to 2.5 mils. Shop primed surfaces which are to be incorporated in the work shall be prepared in the field by cleaning surfaces in accordance with SSPC SP-2 (Hand Tool Cleaning) or SSPC-SP-3 (Power Tool Cleaning). Damaged shop coating shall be cleaned in accordance with SSPC SP-5 (White Metal Blast Cleaning) and spot primed with the primer specified. Cleaning shall produce a surface profile of 2.0 to 2.5 mils. Shop epoxy primed surfaces shall require light abrasive blasting or abrading prior to receiving finish coats if the maximum recoat limit has been exceeded for the primer. This cleaning shall produce a uniform surface profile of 1.0 to 1.5 mils in the intact primer.
b. Nonferrous and Galvanized Metal:	Nonferrous and galvanized metal shall be prepared in accordance with SSPC SP-7 (Brush-off Blast Cleaning) to achieve a 1.0- to 1.5-mil profile that is uniform.
5. Application:	Field
a. General:	Prime coat shall be thinned and applied as recommended by the CSM, provided the coating as applied complies with prevailing air pollution control regulations.
b. Ferrous Metal:	Prime coat shall be an epoxy primer compatible with the specified finish coats.
c. Nonferrous and Galvanized Metal:	Nonferrous and galvanized metal above the high water elevation shall be cleaned prior to the application of the prime coat in accordance with SSPC SP-1 (Solvent Cleaning).
6. System Thickness:	10 mils dry film.
7. Coatings:	
a. Primer:	One coat at the CSM's recommended dry film thickness.
b. Finish:	One or more coats at CSM's recommended dry film thickness per coat to the specified system thickness.

G. Coating System Identification: E-6 (NSF 61 certified)

1. Coating Material:	Epoxy
2. Surface:	Concrete
3. Service Condition:	Interior potable water tanks and reservoirs and other metal components in contact with water being treated or stored.
4. Surface Preparation:	
a. Concrete:	Concrete surfaces shall be allowed to cure for at least 28 days and allowed to dry to the moisture content recommended by the CSM. Moisture content may be tested by the Construction Manager with a Delmhorst Instrument Company moisture detector,

Coating System Specification Sheets (COATSPEC)

	or equal. Except as otherwise specified, loose concrete, form oils, surface hardeners, curing compounds, and laitance shall be removed from surfaces by abrasive blasting and chipping, and voids and cracks shall be repaired as specified in Section 03 30 00. Abrasive blast cleaning or water blast cleaning methods can be used and must produce a uniform concrete surface profile of a CSP-3 in accordance with ICRI 03732. After cleaning, air voids or bugholes in the concrete shall be filled with a surfacer or block filler compatible with the specified primer and finish coats.
b. Masonry:	<p>Masonry surfaces shall be allowed to cure for at least 28 days. Holes or other joint defects shall be filled with mortar and repointed and allowed to cure for 28 days or shall be filled with materials compatible with the primer and finish coats. Loose or splattered mortar shall be removed by scraping and chipping.</p> <p>Masonry surfaces shall be cleaned with clear water by washing and scrubbing to remove foreign and deleterious substances.</p> <p>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.</p>
5. Application:	Field
a. General:	<p>Surfacer or block filler shall dry a minimum of 48 hours prior to application of prime coat or as recommended by the CSM. Prime coat shall be thinned and applied as recommended by the CSM, provided the coating as applied complies with prevailing air pollution control regulations.</p> <p>Drying time between prime coat and finish coat shall be as recommended by CSM.</p>
6. System Thickness:	15 mils dry film.
7. Coatings:	
a. Primer:	One coat at CSM's recommended dry film thickness.
b. Finish:	Two or more coats at CSM's recommended dry film thickness per coat to the specified system thickness.

H. Coating System Identification: E-7

1. Coating Material:	Epoxy
2. Surface:	Plastic
3. Service Condition:	Interior; exterior covered, not exposed to direct sunlight.
4. Surface Preparation:	Plastic shall be prepared in accordance with SSPC SP-1 (Solvent Cleaning) and light sanding to produce a uniform surface roughness(uniform surface profile of 1.0 to 1.5 mils) on the plastic.
5. Application:	Field
6. System Thickness:	5 mils dry film.
7. Coatings:	One or more coats at CSM's recommended dry film thickness per coat to the specified system thickness.

I. Coating System Identification: E-8

1. Coating Material:	Clear epoxy
2. Surface:	Wood
3. Service Condition:	Interior
4. Surface Preparation:	Wood surfaces shall be cleaned of dirt, oil or other foreign substances with mineral spirits, scrapers, sandpaper or wire brush. Finished surfaces exposed to view shall be smoothed by planing or sandpapering. Millwork shall be sandpapered and given a coat of the specified exterior primer on sides before installation. Built-in surfaces of windowsills shall be double primed. Glazing rabbets and beads in exterior sash and doors shall be double primed. Small, dry, seasoned knots shall be surfaced scraped, sandpapered, and thoroughly cleaned and shall be given a thin coat of a clear knot sealer before application of the priming coat. Large, open, unseasoned knots, and beads or streaks of pitch shall be scraped off; however, if the pitch is still soft, it shall be removed with mineral spirits or turpentine, and the resinous area shall be coated with knot sealer prior to priming. After priming, holes and imperfections shall be filled with putty or plastic wood, colored to match the finish coat, allowed to dry and

Coating System Specification Sheets (COATSPEC)

	sandpapered smooth.
5. Application:	Field
a. General:	Prime coat shall be thinned and applied as recommended by the CSM, provided the coating as applied complies with prevailing air pollution control regulations.
6. System Thickness:	4 mils
7. Coatings:	
a. Primer:	One coat at CSM's recommended dry film thickness.
b. Finish:	One or more coats at CSM's recommended dry film thickness per coat to the specified system thickness.

J. Coating System Identification: E-9

1. Coating Material:	Epoxy
2. Surface:	Metal
3. Service Condition:	Immersed, nonpotable; non-immersed, corrosive environment, color required. (Not for Biogenic Sulfide Corrosion areas.)
4. Surface Preparation:	
a. Ferrous Metal:	Ferrous metal surfaces shall be prepared in accordance with SSPC SP-5 (White Metal Blast Cleaning) to achieve a uniform surface profile of 2.5 to 3.0 mils.
	Shop primed surfaces which are to be incorporated in the work shall be prepared in the field by cleaning surfaces in accordance with SSPC SP-2 (Hand Tool Cleaning) or SSPC-SP-3 (Power Tool Cleaning). Damaged shop coating shall be cleaned in accordance with SSPC SP-5 (White Metal Blast Cleaning) to achieve a uniform surface profile of 2.5 to 3.0 mils and spot primed with the primer specified. Shop epoxy primed surfaces shall require light abrasive blasting or abrading to achieve a uniform surface profile of 1.0 to 1.5 mils in the intact shop primer prior to receiving finish coats if the maximum recoat time for the primer has been exceeded. For ductile iron surfaces, refer to the requirements in paragraph 3.02 Metallic Surfaces .
b. Nonferrous and Galvanized Metal:	Nonferrous and galvanized metal shall be prepared in accordance with SSPC SP-7 (Brush-off Blast Cleaning) to achieve a 1.5- to 2.0-mil profile that is uniform. Galvanized steel with this E-2 coating system shall not be used in immersion service in wastewater.
5. Application:	Field
a. General:	Prime coat may be thinned and applied as recommended by the CSM, provided the coating as applied complies with prevailing air pollution control regulations.
b. Ferrous Metal:	Prime coat shall be an epoxy primer compatible with the specified finish coats.
c. Nonferrous and Galvanized Metal:	Nonferrous and galvanized metal, non-immersed, shall be coated prior to the application of the prime coat with a grease emulsifying agent in accordance with the CSM's written instructions. Non-ferrous metal to be immersed shall not be painted. Galvanized metal shall not be immersed even if it is painted with this coating system.
6. System Thickness:	15 to 20 mils dry film.
7. Coatings:	
a. Primer:	One coat at CSM's recommended dry film thickness.
b. Finish:	Two or more coats at CSM's recommended dry film thickness per coat to the specified system thickness.

K. Coating System Identification: E-9-C

1. Coating Material:	Epoxy
2. Surface:	Concrete or masonry
3. Service Condition:	Immersed, nonpotable; non-immersed, moderately corrosive environment, color required. (Not for Biogenic Sulfide Corrosion areas.)
4. Surface Preparation:	
a. Concrete:	Concrete surfaces shall be allowed to cure for at least 28 days following initial concrete placement and allowed to dry to the moisture content recommended by the

Coating System Specification Sheets (COATSPEC)

	CSM before coating work proceeds. Moisture content may be tested by the Construction Manager with a Delmhorst Instrument Company moisture detector, or equal. Except as otherwise specified, loose concrete, form oils, surface hardeners, curing compounds, and laitance shall be removed from surfaces by abrasive blasting and chipping, and voids and cracks shall be repaired as specified in Section 03 30 00. Cleaning can be performed using abrasive blast cleaning or water blast cleaning methods to produce a minimum concrete surface profile of CSP-3 in accordance with ICRI 03732. After cleaning, all air voids or bugholes in the concrete shall be filled with a surfacer or block filler compatible with the specified primer and finish coats.
b. Masonry:	<p>Masonry surfaces shall be allowed to cure for at least 28 days after being constructed and be allowed to dry to the moisture content recommended by the CSM. Holes or other joint defects shall be filled with a material compatible with the primers and finish coats or shall be filled with masonry mortar that shall cure for at least 28 days. Loose or splattered mortar shall be removed by scraping and chipping.</p> <p>Masonry surfaces shall be cleaned with clear water by washing and scrubbing to remove foreign and deleterious substances.</p> <p>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.</p>
5. Application:	Field
a. General:	<p>Apply filler/surfacer as recommended by CSM to fill bugholes and air voids or block texture, etc. leaving a uniformly filled surface that does not produce blowholes or outgassing causing pinholing of the coating system.</p> <p>Filler/Surfacers shall dry a minimum of 48 hours prior to application of prime coat or as required by the CSM.</p> <p>Prime coat shall be thinned and applied as recommended by the CSM, provided the coating as applied complies with prevailing air pollution control regulations.</p> <p>Drying time between coats shall be as recommended by CSM.</p>
6. System Thickness:	16 to 20 mils dry film.
7. Coatings:	
a. Primer:	One coat at CSM's recommended dry film thickness.
b. Finish:	Two or more coats at CSM's recommended dry film thickness per coat to the specified system thickness.

L. Coating System Identification: E-10

1. Coating Material:	Polyamidoamine epoxy
2. Surface:	Metal or concrete
3. Service Condition:	Below grade (buried, exterior) in contact with soil
4. Surface Preparation:	
a. Ferrous Metal:	Ferrous metal surfaces shall be prepared in accordance with SSPC SP-5 (White Metal Blast Cleaning).
b. Nonferrous Metal:	Nonferrous and galvanized metal shall be prepared in accordance with SSPC SP-7 (Brush-off Blast Cleaning) to achieve a uniform surface profile of 2.0 to 2.5 mils.
c. Concrete:	Concrete surfaces shall be allowed to age for at least 28 days and allowed to dry to the moisture content recommended by the CSM. Moisture content may be tested by the Construction Manager with a Delmhorst Instrument Company moisture detector, or equal. Except as otherwise specified, loose concrete and laitance shall be removed from surfaces by abrasive blasting and chipping, and voids and cracks shall be repaired as specified in Section 03 30 00. Concrete surface preparation can be performed using abrasive blast cleaning or water blast cleaning methods and must achieve a concrete surface profile of CSP-3 in accordance with ICRI 03732.
5. Application:	Field
6. System Thickness:	16 mils
7. Coating:	Two or more coats at CSM's recommended dry film thickness per coat to the specified

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	system thickness.
M. Coating System Identification: EF-1	
1. Coating Material:	Epoxy Resin Based Floor Coating
2. Surface:	Concrete Floors
3. Service Condition:	For interior light duty applications light wheel traffic, mostly foot traffic, and mildly corrosive. Mainly for wear resistance, aesthetics, and cleanability. Non-slip texture can be varied depending on wetness of exposure. Test patches to be installed for deciding on level of non-slip texture required.
4. Surface Preparation:	<p>Concrete floor slabs shall be allowed to age for at least 28 days and must meet a moisture vapor transmission rate of less than 3.0 lbs. of moisture per 24 hours per 1,000 SF in accordance with ASTM F1869. It is also essential that a well-sealed and intact vapor barrier has been installed beneath all slabs on grade to receive this floor coating system. Except as otherwise specified, loose concrete, curing compounds, and laitance shall be removed by abrasive blast cleaning or preferably by shotblasting. Surface preparation shall produce a clean sound concrete substrate with a concrete surface profile of CSP-6 minimum in accordance with ICRI 03732. Surface preparation shall be in accordance with SSPC-SP-13.</p> <p>Additionally, all coating termination and transition details shall be prepared in accordance with the CSM's standard detail drawings. This includes coating termination details, coating transitions at vertical and vertical to horizontal corners, coating terminations at joints, concrete crack treatment, pipe penetration treatment, coating terminations at metal embedments in the concrete substrate, and other details. The CSM's standard detail drawings shall be submitted for all such coating applications. If standard details are not available for a given detail treatment, the CSM shall be required to produce one at no additional cost to the owner, the engineer, or any other party.</p> <p>If wet abrasive or water blasting surface preparation methods were used, the concrete substrate shall be allowed to dry under warm conditions (minimum of 75 degrees F) for at least 5 days prior to coating application. Following surface preparation work and dry-out, all surfaces to be coated shall be vacuum cleaned to remove all loose dirt, dust, or other loose materials.</p>
5. Application:	Carefully follow CSM's written instructions regarding mixing, thinning, application, recoat limitations (windows) and curing of coating materials.
6. System Thickness:	125 mils dry film.
7. Coatings:	
a. Primer:	Brush or roller apply at 6.0 – 10.0 mils DFT.
b. Broadcast Applied:	Brush or roller catalyzed resin and broadcast aggregate to rejection (should achieve 100 to 105 mils DFT).
c. Top:	Brush or roller apply at 8.0 – 10.0 mils.
	Install all termination and transition details in accordance with the CSM's detail drawings.
N. Coating System Identification: EF-2	
1. Coating Material:	Epoxy Resin Based Floor Coating
2. Surface:	Concrete Floors
3. Service Condition:	For interior – heavy-duty exposure applications. Frequent, heavy wheeled traffic and moderately corrosive exposure conditions. Mainly for wear resistance, impact resistance, protection of concrete, and aesthetics. Non-slip texture can be varied as needed. Test patches to be installed for deciding on level of non-slip texture required.
4. Surface Preparation:	Concrete floor slabs shall be allowed to age for at least 28 days and must meet a moisture vapor transmission rate of less than 3.0 lbs. of moisture per 24 hours per 1,000 SF in accordance with ASTM F1869. It is also essential that a well-sealed and intact vapor barrier has been installed beneath all slabs on grade to receive this floor coating system. Except as otherwise specified, loose concrete, curing compounds, and laitance shall be removed by abrasive blast cleaning or preferably by shotblasting.

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	Surface preparation shall produce a clean sound concrete substrate with a concrete surface profile of CSP-7 minimum in accordance with ICRI 03732. Surface preparation shall be in accordance with SSPC-SP-13.
	Additionally, all coating termination and transition details shall be prepared in accordance with the CSM's standard detail drawings. This includes coating termination details, coating transitions at vertical and vertical to horizontal corners, coating terminations at joints, concrete crack treatment, pipe penetration treatment, coating terminations at metal embedments in the concrete substrate, and other details. The CSM's standard detail drawings shall be submitted for all such coating applications. If standard details are not available for a given detail treatment, the CSM shall be required to produce one at no additional cost to the owner, the engineer, or any other party.
	If wet abrasive or water blasting surface preparation methods were used, the concrete substrate shall be allowed to dry under warm conditions (minimum of 75 degrees F) for at least 5 days prior to coating application. Following surface preparation work and dry-out, all surfaces to be coated shall be vacuum cleaned to remove all loose dirt, dust, or other loose materials.
5. Application:	Carefully follow CSM's written instructions regarding mixing, thinning, application, recoat limitations (windows) and curing of coating materials.
6. System Thickness:	250 mils dry film.
7. Coatings:	
a. Primer:	Brush or roller apply at 6.0 – 10.0 mils DFT.
b. Trowel Applied:	Trowel apply to 230 – 236 mils.
c. Top:	Brush or roller apply at 8.0 – 10.0 mils. Cumulative dry film thickness.
	Install all termination and transition details in accordance with the CSM's detail drawings.

0. Coating System Identification: EA-1

1. Coating Material:	Blended Amine Cured Epoxy
2. Surface:	Metal
3. Service Condition:	Immersed, nonpotable; non-immersed, corrosive environment, color not required especially for headspace environments that are corrosive due to biogenic sulfide corrosion.
4. Surface Preparation:	
a. Ferrous Metal:	<p>Ferrous metal surfaces shall be prepared in accordance with SSPC SP-5 (White Metal Blast Cleaning) to achieve a uniform surface profile of 3.0 to 3.5 mils. Blast Cleaning shall produce a minimum surface profile of 3.0 mils.</p> <p>Shop primed surfaces which are to be incorporated in the work shall be prepared in the field by cleaning surfaces in accordance with SSPC SP-11 (Power Tool Cleaning to Bare Metal). Damaged shop coated areas shall be cleaned in accordance with SSPC SP-5 (White Metal Blast Cleaning) and spot primed with the primer specified. Shop epoxy primed surfaces shall require light abrasive blasting and blow down cleaning prior to receiving finish coats. Cast or ductile iron surfaces to be coated shall be abrasive blast cleaned to a clean, gray uniform metal appearance free of variations in color and loose materials. Ductile iron surfaces shall be prepared in accordance with paragraph 3.02 Metallic Surfaces.</p>
b. Nonferrous and Galvanized Metal:	Nonferrous and galvanized metal shall be prepared in accordance with SSPC SP-7 (Brush-off Blast Cleaning) to achieve a uniform surface profile of 2.0 to 2.5 mils. Galvanized metal should generally not be used in these environments.
5. Application:	Field
a. General:	<p>Prime coat may be thinned and applied as recommended by the CSM, provided the coating as applied complies with prevailing air pollution control regulations.</p> <p>Drying time between coats shall be as specified by the CSM for the site conditions. If the maximum recoat time is exceeded, surface preparation shall require solvent washing, light abrasive blasting, or other procedures per CSM's instructions.</p>

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b. Ferrous Metal:	If shop priming is required or field priming is necessary, the prime coat shall be an epoxy primer compatible with the specified coating system. Generally, the EA-1 coating system is self-priming and does not require a primer unless there is a special reason to prime the steel to hold the blast cleaning from rusting back.
6. System Thickness:	30 to 40 mils dry film.
7. Coatings:	
a. Primer:	One coat at CSM's recommended dry film thickness only if required by special circumstances.
b. Finish:	One or more coats at CSM's recommended dry film thickness per coat to the specified system thickness.
c. Testing:	Holiday detection shall be performed over 100% of the coated surface area to identify any holidays or pinholes that must be repaired.
d. Pinhole and Holiday Repair Procedure:	<p>Pinholes and holidays identified by Holiday Detection shall be repaired as follows:</p> <ul style="list-style-type: none"> Using a pencil grinder, remove a ½-inch diameter area of the coating system material back to the ferrous metal substrate. The metal must be shiny Aggressively sand or abrade the intact coating system surface 2 inches around the complete periphery of the ½-inch diameter removal area to produce a uniform 6 to 8 mils profile Vacuum clean the prepared area to remove all dust and dirt to achieve a clean, sound surface. Tape the peripheral area to prevent coating application onto unprepared surfaces Brush apply one coat of the finish coating material. Following proper recoat cure time, apply additional coats of the finish coating system to achieve 60 mils DFT at the coating removal area and feather the coating onto the roughened coated surfaces to form a neat repair outline

P. Coating System Identification: EA-2

1. Coating Material:	Blended Amine Cured Epoxy
2. Surface:	Concrete or masonry
3. Service Condition:	Immersed, nonpotable; non-immersed, corrosive environment, color not required, new construction especially for headspace environments that are corrosive due to biogenic sulfide corrosion.
4. Surface Preparation:	<p>All coating termination and transition details shall be prepared in accordance with the CSM's standard detail drawings. This includes coating termination details, coating transitions at vertical and vertical to horizontal corners, coating terminations at joints, concrete crack treatment, pipe penetration treatment, coating terminations at metal embedments in the concrete substrate, and other details. The CSM's standard detail drawings shall be submitted for all such coating applications. If standard details are not available for a given detail treatment, the CSM shall be required to produce one at no additional cost to the owner, the engineer, or any other party.</p> <p>If wet abrasive or water blasting surface preparation methods were used, the concrete substrate shall be allowed to dry under warm conditions (minimum of 75 degrees F) for at least 5 days prior to coating application. Following surface preparation work and dry-out, all surfaces to be coated shall be vacuum cleaned to remove all loose dirt, dust, or other loose materials.</p>
a. Concrete:	Concrete surfaces shall be allowed to cure for at least 28 days and allowed to dry to the moisture content recommended by the CSM. Moisture content may be tested by the Construction Manager with a Delmhorst Instrument Company moisture detector, or equal. Except as otherwise specified, loose concrete, form oils, surface hardeners, curing compounds, and laitance shall be removed from surfaces by abrasive blasting and chipping, and voids and cracks shall be repaired as specified in Section 03 30 00. Surface Preparation must open up all shelled over air voids or bugholes to expose fully the void's depth, width, and length. Concrete shall be abraded to achieve a uniform concrete surface profile of CSP-5 in accordance with ICRI 03732. After surface preparation has been accepted, a complete skim coat of the specified filler surfacer shall be applied over all concrete surfaces and all bugholes (air voids) shall be completely filled using this same material. The filler/surfacer material shall be applied

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	as a complete parge coat of the substrate. If the parge coat (filler/surfacer material) is non-polymer modified, it must be brush blast cleaned following adequate cure per CSM's instructions to produce a uniform anchor pattern of CSP-4 in accordance with ICRI 03732 prior to coating application.
b. Masonry:	<p>Masonry surfaces shall be allowed to cure for at least 28 days. Holes or other joint defects shall be filled with mortar and repointed and allowed to cure for 28 days or shall be filled with a repair material compatible with the coating system that does not require hydration cure time. Loose or splattered mortar shall be removed by scrapping and chipping.</p> <p>Masonry surfaces shall be cleaned with clear water by washing and scrubbing to remove foreign and deleterious substances.</p> <p>Muriatic acid shall not be used. After cleaning, masonry surfaces shall be skim coated with a surfacer or block filler compatible with the specified coating system.</p>
5. Application:	Field
a. General:	<p>Surfacer or filler shall be applied per CSM's recommendations prior to application of coating to fill all bugholes and voids and create a complete parge coat of the prepared substrate. This parge coat shall completely fill all bugholes and voids in the substrate, and will also completely cover the substrate unless specified otherwise above such filled voids by 1/8 inch (125 mils) of thickness.</p> <p>Drying time between coats shall be as specified by the CSM for the site conditions. If the maximum recoat time is exceeded, surface preparation shall require solvent washing, light abrasive blasting, or other procedures per CSM's instructions.</p>
6. System Thickness:	60 mils dry film in addition to the parge coat.
7. Coatings:	
a. Finish:	One or more coats at CSM's recommended dry film thickness per coat to the specified system thickness.
b. Testing:	<p>Holiday detection shall be performed over 100% of the coated surface area to identify any holidays or pinholes, which could compromise coating system performance. Holiday testing to be performed after application and adequate cure of the spray applied epoxy coating material. Holiday detection shall be performed in accordance with NACE RP0188.</p>
c. Pinhole and Holiday Repair Procedure:	<p>Pinholes and holidays identified by Holiday Detection shall be repaired as follows:</p> <ul style="list-style-type: none"> Using a grinder or other suitable power tool, remove the coating system at all pinholes or holidays in an area at least 2 inches in diameter or in both dimensions around the defect back to the concrete substrate. Chip out and remove the concrete to expose the full dimensions in all three directions of the air void responsible for the defect. Aggressively abrade or sand the intact coating system surface at least 3 inches beyond the removal area in all directions to produce a uniform 6- to 8-mil profile in the intact coating system. Vacuum clean the prepared area to remove all dust, dirt, etc. leaving clean sound surfaces. Tape to mask the periphery of the prepared intact coating area to prevent coating repair application onto the prepared area. Using a putty knife or other suitable tool, fill the opened void with the approved filler/surfacer material completely and strike-off. Allow to cure per CSM's recommendations. Apply the coating system in the number of coats necessary to achieve the specified 60 mils DFT over the defect and coating removal area and feather the coating onto the abraded coated surfaces around the removal area to avoid a lip and to achieve a neat repair outline. Allow to cure properly.
Q. Coating System Identification: EA-3	
1. Coating Material:	Blended Amine Cured Epoxy
2. Surface:	Concrete or masonry
3. Service Condition:	Immersed, nonpotable; non-immersed, corrosive environment, color not required, new

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	or existing construction, especially for headspace environments that are corrosive due to biogenic sulfide corrosion.
4. Surface Preparation:	<p>All coating termination and transition details shall be prepared in accordance with the CSM's standard detail drawings. This includes coating termination details, coating transitions at vertical and vertical to horizontal corners, coating terminations at joints, concrete crack treatment, pipe penetration treatment, coating terminations at metal embedments in the concrete substrate, and other details. The CSM's standard detail drawings shall be submitted for all such coating applications. If standard details are not available for a given detail treatment, the CSM shall be required to produce one at no additional cost to the owner, the engineer, or any other party.</p> <p>If wet abrasive or water blasting surface preparation methods were used, the concrete substrate shall be allowed to dry under warm conditions (minimum of 75 degrees F) for at least 5 days prior to coating application. Following surface preparation work and dry-out, all surfaces to be coated shall be vacuum cleaned to remove all loose dirt, dust, or other loose materials.</p>
a. Concrete:	<p>Concrete surfaces shall be allowed to age for at least 28 days and allowed to dry to the moisture content recommended by the CSM. Moisture content may be tested by the Construction Manager with a Delmhorst Instrument Company moisture detector, or equal. Except as otherwise specified, loose concrete, form oils, surface hardeners, curing compounds, and laitance shall be removed from surfaces by abrasive blasting and chipping, and voids and cracks shall be repaired as specified in Section 03 30 00. Concrete shall be abraded also to achieve a uniform concrete surface profile of CSP 5 minimum. If the parge coat (filler/surfacer material) is non-polymer modified, it shall be brush blasted following adequate cure per the CSM's instructions to produce a uniform concrete surface profile of CSP-4 in accordance with ICRI 03732 prior to coating application. After cleaning, air voids or bugholes in the concrete shall be filled with a surfacer or block filler. The filler/surfacer material shall be applied as a complete parge coat of the substrate.</p> <p>For existing concrete that has been degraded, apply a skim coat of a surfacer or filler material to restore the substrate to a coatable condition. Be certain the filler surfacer material is compatible with the coating system.</p>
b. Masonry:	<p>Masonry surfaces shall be allowed to age for at least 28 days. Holes or other joint defects shall be filled with mortar and repointed. Loose or splattered mortar shall be removed by scrapping and chipping.</p> <p>Masonry surfaces shall be cleaned with clear water by washing and scrubbing to remove foreign and deleterious substances.</p> <p>Muriatic acid shall not be used. After cleaning, masonry surfaces shall be sealed or filled with sealer or block filler compatible with the specified coating system.</p>
5. Application:	Field
a. General:	<p>Surfacer or filler shall be applied and dry per CSM's recommendations prior to application of coating.</p> <p>Drying time between filler/surfacer and coating system shall be as specified by the CSM for the site conditions. If the maximum recoat time is exceeded, surface preparation shall require solvent washing, light abrasive blasting, or other procedures per CSM's instructions. The parge coat shall completely fill all bugholes and voids in the substrate and it will also completely cover the substrate unless specified otherwise above such filled voids by 1/8 inch of thickness.</p>
6. System Thickness:	125 mils dry film (or 1/8 inch) in addition to the parge coat.
7. Coatings:	
a. Primer:	Self-priming.
b. Finish:	One coat at CSM's recommended dry film thickness – trowel applied.
c. Testing:	Holiday detection shall be performed over 100% of the coated surface area to identify any holidays or pinholes that could compromise coating system performance. Holiday detection shall be performed after adequate cure of the spray applied epoxy coating material. Holiday detection shall be performed in accordance with NACE RP0188.

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d. Pinhole and Holiday Repair Procedure:	<p>Pinholes and holidays identified by Holiday Detection shall be repaired as follows:</p> <ul style="list-style-type: none"> Using a grinder or other suitable power tool, remove the coating system at all pinholes or holidays in an area at least 2 inches in diameter or in both dimensions around the defect back to the concrete substrate. Chip out and remove the concrete to expose the full dimensions in all three directions of the air void responsible for the defect. Aggressively abrade or sand the intact coating system surface at least 3-inches beyond the removal area in all directions to produce a uniform 6- to 8-mil profile in the intact coating system. Vacuum clean the prepared area to remove all dust, dirt, etc. leaving clean sound surfaces. Tape to mask the periphery of the prepared intact coating area to prevent coating repair application onto the prepared area. Using a putty knife or other suitable tool, fill the opened void with the approved filler/surfacer material completely and strike-off. Allow to cure per CSM's recommendations. Apply the coating system in the number of coats necessary to achieve the specified 60 mils DFT over the defect and coating removal area and feather the coating onto the abraded coated surfaces around the removal area to avoid a lip and to achieve a neat repair outline. Allow to cure properly.
R. Coating System Identification: EA-4	
1. Coating Material:	Blended Amine Cured Epoxy
2. Surface:	Concrete or masonry
3. Service Condition:	Immersed, nonpotable; non-immersed, very corrosive environment, color not required, new or existing construction, especially for headspace environments that are very corrosive due to biogenic sulfide corrosion.
4. Surface Preparation:	<p>All coating termination and transition details shall be prepared in accordance with the CSM's standard detail drawings. This includes coating termination details, coating transitions at vertical and vertical to horizontal corners, coating terminations at joints, concrete crack treatment, pipe penetration treatment, coating terminations at metal embedments in the concrete substrate, and other details. The CSM's standard detail drawings shall be submitted for all such coating applications. If standard details are not available for a given detail treatment, the CSM shall be required to produce one at no additional cost to the owner, the engineer, or any other party.</p> <p>If wet abrasive or water blasting surface preparation methods were used, the concrete substrate shall be allowed to dry under warm conditions (minimum of 75 degrees F) for at least 5 days prior to coating application. Following surface preparation work and dry-out, all surfaces to be coated shall be vacuum cleaned to remove all loose dirt, dust, or other loose materials.</p>
a. Concrete:	<p>Concrete surfaces shall be allowed to age for at least 28 days and allowed to dry to the moisture content recommended by the CSM. Moisture content may be tested by the Construction Manager with a Delmhorst Instrument Company moisture detector, or equal. Except as otherwise specified, loose concrete, form oils, surface hardeners, curing compounds, and laitance shall be removed from surfaces by abrasive blasting and chipping, and voids and cracks shall be repaired as specified in Section 03 30 00. Concrete shall be abraded also to achieve a uniform concrete surface profile of CSP 5 minimum. If the parge coat (filler/surfacer material) is non-polymer modified, it shall be brush blasted following adequate cure per the CSM's instructions to produce a uniform concrete surface profile of CSP-4 in accordance with ICRI 03732 prior to coating application. After cleaning, air voids or bugholes in the concrete shall be filled with a surfacer or block filler. The filler/surfacer material shall be applied as a complete parge coat of the substrate.</p> <p>For existing concrete that has been degraded, apply a skim coat of a surfacer or filler material to restore the substrate to a coatable condition. Be certain the filler surfacer material is compatible with the coating system.</p>
b. Masonry:	Masonry surfaces shall be allowed to age for at least 28 days. Holes or other joint defects shall be filled with mortar and repointed. Loose or splattered mortar shall be

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	removed by scrapping 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 sealer or block filler compatible with the specified coating system.
5. Application:	Field
a. General:	<p>Surfacer or filler shall be applied and dry per CSM's recommendations prior to application of coating.</p> <p>Drying time between filler/surfacer and coating system shall be as specified by the CSM for the site conditions. If the maximum recoat time is exceeded, surface preparation shall require solvent washing, light abrasive blasting, or other procedures per CSM's instructions. The parge coat shall completely fill all bugholes and voids in the substrate and it will also completely cover the substrate unless specified otherwise above such filled voids by 1/8 inch of thickness.</p>
6. System Thickness:	140 to 145 mils dry film in addition to the parge coat.
7. Coatings:	
a. Primer:	Self-priming.
b. Troweled Coat:	One coat at CSM's recommended dry film thickness – trowel applied. (125 mils)
c. Finish (Glaze Coat):	15 to 20 mils dry.
d. Testing:	Holiday detection shall be performed over 100% of the coated surface area to identify any holidays or pinholes that could compromise coating system performance. Holiday detection shall be performed after application and adequate cure of the spray applied epoxy coating material. Holiday detection shall be performed in accordance with NACE RP0188.
e. Pinhole and Holiday Repair Procedure:	<p>Pinholes and holidays identified by Holiday Detection shall be repaired as follows:</p> <ul style="list-style-type: none"> Using a grinder or other suitable power tool, remove the coating system at all pinholes or holidays in an area at least 2 inches in diameter or in both dimensions around the defect back to the concrete substrate Chip out and remove the concrete to expose the full dimensions in all three directions of the air void responsible for the defect. Aggressively abrade or sand the intact coating system surface at least 3-inches beyond the removal area in all directions to produce a uniform 6- to 8-mil profile in the intact coating system. Vacuum clean the prepared area to remove all dust, dirt, etc. leaving clean sound surfaces. Tape to mask the periphery of the prepared intact coating area to prevent coating repair application onto the prepared area. Using a putty knife or other suitable tool, fill the opened void with the approved filler/surfacer material completely and strike-off. Allow to cure per CSM's recommendations Apply the coating system in the number of coats necessary to achieve the specified 60 mils DFT over the defect and coating removal area and feather the coating onto the abraded coated surfaces around the removal area to avoid a lip and to achieve a neat repair outline. Allow to cure properly.
S. Coating System Identification: EA-5	
1. Coating Material:	Novolac Epoxy Lining
2. Surface:	Concrete or masonry
3. Service Condition:	Chemical area process slabs, chemical loading and unloading areas, secondary spill containment areas for ferric chloride or 25% hydrofluoro-silicic acid.
4. Surface Preparation:	All coating termination and transition details shall be prepared in accordance with the CSM's standard detail drawings. This includes coating termination details, coating transitions at vertical and vertical to horizontal corners, coating terminations at joints, concrete crack treatment, pipe penetration treatment, coating terminations at metal embedments in the concrete substrate, and other details. The CSM's standard detail

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	<p>drawings shall be submitted for all such coating applications. If standard details are not available for a given detail treatment, the CSM shall be required to produce one at no additional cost to the owner, the engineer, or any other party.</p> <p>If wet abrasive or water blasting surface preparation methods were used, the concrete substrate shall be allowed to dry under warm conditions (minimum of 75 degrees F) for at least 5 days prior to coating application. Following surface preparation work and dry-out, all surfaces to be coated shall be vacuum cleaned to remove all loose dirt, dust, or other loose materials.</p>																				
a. Concrete:	Concrete surfaces shall be allowed to cure for at least 28 days and allowed to dry to the moisture content recommended by the CSM. Moisture content may be tested by the Construction Manager with a Delmhorst Instrument Company moisture detector, or equal. Except as otherwise specified, loose concrete, form oils, surface hardeners, curing compounds, and laitance shall be removed from surfaces by abrasive blasting and chipping, and voids and cracks shall be repaired as specified in Section 03 30 00 . Surface Preparation must open up all shelled over air voids or bugholes to expose fully the void's depth, width, and length. Concrete shall be abraded to achieve a uniform concrete surface profile of CSP-5 in accordance with ICRI 03732. After surface preparation has been accepted, a complete skim coat of the specified filler surfacer shall be applied over all concrete surfaces and all bugholes (air voids) shall be completely filled using this same material. The filler/surfacer material shall be applied as a complete parge coat of the substrate. If the parge coat (filler/surfacer material) is non-polymer modified, it must be brush blast cleaned following adequate cure per CSM's instructions to produce a uniform anchor pattern of CSP-4 in accordance with ICRI 03732 prior to coating application.																				
5. Application:	Field																				
a. General:	<p>Prime coat shall be applied as recommended by the CSM.</p> <p>Surfacer or filler materials shall be trowel applied per CSM's recommendations. Work surfacer/filler into all voids to displace air and fill bugholes.</p> <p>Surfacer/filler and prime coat thicknesses are in addition to the system thickness specified below.</p>																				
6. System Thickness:	<table border="1"> <thead> <tr> <th>Location</th><th>System Thickness (mils dry film)</th></tr> </thead> <tbody> <tr> <td>FECL Receiving Station</td><td></td></tr> <tr> <td>Slab</td><td>110-145 (with silica sand)</td></tr> <tr> <td>Sump walls and floor</td><td>40</td></tr> <tr> <td>Storage Tank Secondary Containment</td><td></td></tr> <tr> <td>Floor and other horizontal surfaces</td><td>60-75</td></tr> <tr> <td>Vertical Surfaces</td><td>40</td></tr> <tr> <td>Metering Pump Secondary Containment</td><td></td></tr> <tr> <td>Floor and other horizontal surfaces</td><td>60-75 (with silica sand)</td></tr> <tr> <td>Vertical Surfaces</td><td>40</td></tr> </tbody> </table>	Location	System Thickness (mils dry film)	FECL Receiving Station		Slab	110-145 (with silica sand)	Sump walls and floor	40	Storage Tank Secondary Containment		Floor and other horizontal surfaces	60-75	Vertical Surfaces	40	Metering Pump Secondary Containment		Floor and other horizontal surfaces	60-75 (with silica sand)	Vertical Surfaces	40
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7. Coatings:																					
a. Primer:	As recommended by the CSM.																				
b. Surfacer/Filler:	<p>1/16-inch minimum thickness above plane of concrete to create a monolithic and pinhole free surface.</p> <p>Surfacer or filler shall be applied per CSM's recommendations prior to application of coating system to fill all bugholes and voids and create a coatable surface by being applied as a complete 1/8 inch thick parge coat. This is for containment walls, curbs and bases and not for floor surfaces.</p>																				
c. Base Coat Floor Surfaces:	For floor surfaces, the base coat shall be applied at thickness recommended by CSM and broadcast with aggregate to create a non-slip surface (texture to be as recommended by the CSM). Following application of the broadcast aggregate and																				

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	removal of all excess aggregates, the base coat will be applied to encapsulate the non-slip aggregate embedded.
d. Base Coat and Saturation Coat:	For trench or sump surfaces and unloading areas, the base coat shall be applied to the thickness recommended by the CSM and then scrim cloth shall be embedded in it. Next, the same material will be applied as a saturation coat to encapsulate fully the scrim cloth. This shall be applied to the thickness recommended by the CSM.
e. Base Coat for Containment Wall and Base Surfaces:	For containment wall, curb, and equipment base surfaces shall be applied to the thickness recommended by the CSM.
f. Base Coat General:	The basecoat will be an aggregate filled coating as will the saturation coat. Both shall be applied in strict accordance with the CSM's recommendations. The aggregate used in these coating systems for hydrofluorosilica aggregates resistant to the HFS or fully encapsulated with resin to prevent attack of the silica aggregate.
g. Finish:	The finish coat or coats shall be applied to the thickness recommended by the CSM. All coating system thicknesses are in addition to the parge coat.
h. Testing:	Holiday detection shall be performed over 100% of the coated surface area to identify any holidays or pinholes that must be repaired. Holiday detection to be performed after proper application and cure of the coating system. Holiday detection to be performed in accordance with NACE RPO188.
i. Pinhole and Holiday Repair Procedure:	Pinholes or holidays identified by Holiday Detection shall be repaired as follows: <ul style="list-style-type: none"> Using a grinder or other suitable power tool, remove the coating system at all pinholes or holidays in an area at least 2 inches in diameter or in both dimensions around the defect back to the concrete substrate. Chip out and remove the concrete to expose the full dimensions in all three directions of the air void responsible for the defect. Aggressively abrade or sand the intact coating system surface at least 3 inches beyond the removal area in all directions to produce a uniform 6- to 8-mil profile in the intact coating system. Vacuum clean the prepared area to remove all dust, dirt, etc. leaving clean sound surfaces. Tape to mask the periphery of the prepared intact coating area to prevent coating repair application onto the prepared area. Using a putty knife or other suitable tool, fill the opened void with the approved filler/surfacer material completely and strike-off. Allow to cure per CSM's recommendations. Apply the coating system in the number of coats necessary to achieve the specified finish coat thickness over the defect and coating removal area and feather the coating onto the abraded coated surfaces around the removal area to avoid a lip and to achieve a neat repair outline. Allow to cure properly. Curing time between coats shall be as specified by the CSM for the site conditions. If the maximum recoat time is exceeded, surface preparation shall require solvent washing, light abrasive blasting, or other procedures per CSM's instructions.

T. Coating System Identification: EC-1

1. Coating Material:	Hybrid Polyurethane
2. Surface:	Concrete or dense masonry where existing crack or joint movement is suspected of propagating through rigid cured epoxy coatings.
3. Service Condition:	Interior or exterior, exposed to direct sunlight or not, corrosive (immersion pH 4.0 or lower and/or headspace pH 4.0 or lower and/or gaseous H ₂ S concentrations between 10 and 150 ppm typically).
4. Surface Preparation:	All coating termination and transition details shall be prepared in accordance with the CSM's standard detail drawings. This includes coating termination details, coating transitions at vertical and vertical to horizontal corners, coating terminations at joints, concrete crack treatment, pipe penetration treatment, coating terminations at metal embeddings in the concrete substrate, and other details. The CSM's standard detail drawings shall be submitted for all such coating applications. If standard details are

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	<p>not available for a given detail treatment, the CSM shall be required to produce one at no additional cost to the owner, the engineer, or any other party.</p> <p>If wet abrasive or water blasting surface preparation methods were used, the concrete substrate shall be allowed to dry under warm conditions (minimum of 75 degrees F) for at least 5 days prior to coating application. Following surface preparation work and dry-out, all surfaces to be coated shall be vacuum cleaned to remove all loose dirt, dust, or other loose materials.</p>
a. Concrete:	<p>Concrete surfaces shall be allowed to cure for at least 28 days and allowed to dry to the moisture content recommended by the CSM. Moisture content may be tested by the Construction Manager with a Delmhorst Instrument Company moisture detector, or equal. Except as otherwise specified, loose concrete, form oils, surface hardeners, curing compounds, and laitance shall be removed from surfaces by abrasive blasting and chipping, and voids and cracks shall be repaired as specified in Section 03 30 00. Surface Preparation must open up all shelled over air voids or bugholes to expose fully the void's depth, width, and length. Concrete shall be abraded to achieve a uniform concrete surface profile of CSP-5 in accordance with ICRI 03732. After surface preparation has been accepted, a complete skim coat of the specified filler surfacer shall be applied over all concrete surfaces and all bugholes (air voids) shall be completely filled using this same material. The filler/surfacer material shall be applied as a complete parge coat of the substrate. If the parge coat (filler/surfacer material) is non-polymer modified, it must be brush blast cleaned following adequate cure per CSM's instructions to produce a uniform anchor pattern of CSP-4 in accordance with ICRI 03732 prior to coating application.</p>
5. Application:	Field
a. General:	<p>Surfacers or filler materials shall be applied per CSM's recommendations prior to application of prime coat to fill bugholes and voids. These materials must be compatible with the primers and finish coats.</p> <p>Prime coat shall be thinned and applied as recommended by the CSM, provided the coating as applied complies with prevailing air pollution control regulations.</p>
6. System Thickness:	35-50 mils dry film in addition to the parge coat.
7. Coatings:	
a. Primer:	One coat at 2-3 mils dry film thickness
b. Finish:	One or more coats at CSM's recommended dry film thickness per coat to the specified system thickness.
c. Testing:	Holiday detection shall be performed over 100% of the coated surface area to identify any holidays or pinholes that must be repaired.
d. Pinhole and Holiday Repair Procedure:	<p>Pinholes or holidays identified by Holiday Detection shall be repaired as follows:</p> <ul style="list-style-type: none"> Using a grinder or other suitable power tool, remove the coating system at all pinholes or holidays in an area at least 2 inches in diameter or in both dimensions around the defect back to the concrete substrate. Chip out and remove the concrete to expose the full dimensions in all three directions of the air void responsible for the defect. Aggressively abrade or sand the intact coating system surface at least 3-inches beyond the removal area in all directions to produce a uniform 6- to 8-mil profile in the intact coating system. Vacuum clean the prepared area to remove all dust, dirt, etc. leaving clean sound surfaces Tape to mask the periphery of the prepared intact coating area to prevent coating repair application onto the prepared area Using a putty knife or other suitable tool, fill the opened void with the approved filler/surfacer material completely and strike-off. Allow to cure per CSM's recommendations Apply the coating system in the number of coats necessary to achieve the specified 35-50 mils DFT over the defect and coating removal area and feather the coating onto the abraded coated surfaces around the removal area to avoid a lip and to achieve a neat repair outline. Allow to cure properly.

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U. Coating System Identification: EC-2 (NSF-61)

1. Coating Material:	Modified Polyurethane
2. Surface:	Concrete or Dense Masonry where existing crack or joint movement is suspected due to thermal conditions and would propagate through rigid epoxy coating systems and/or where NSF-61 certification is required.
3. Service Condition:	Interior or exterior, submerged or non-submerged indirect sunlight – moderately corrosive.
4. Surface Preparation:	<p>All coating termination and transition details shall be prepared in accordance with the CSM's standard detail drawings. This includes coating termination details, coating transitions at vertical and vertical to horizontal corners, coating terminations at joints, concrete crack treatment, pipe penetration treatment, coating terminations at metal embedments in the concrete substrate, and other details. The CSM's standard detail drawings shall be submitted for all such coating applications. If standard details are not available for a given detail treatment, the CSM shall be required to produce one at no additional cost to the owner, the engineer, or any other party.</p> <p>If wet abrasive or water blasting surface preparation methods were used, the concrete substrate shall be allowed to dry under warm conditions (minimum of 75 degrees F) for at least 5 days prior to coating application. Following surface preparation work and dry-out, all surfaces to be coated shall be vacuum cleaned to remove all loose dirt, dust, or other loose materials.</p>
a. Concrete:	<p>Concrete surfaces shall be allowed to cure for at least 28 days and allowed to dry to the moisture content recommended by the CSM. Moisture content may be tested by the Construction Manager with a Delmhorst Instrument Company moisture detector, or equal. Except as otherwise specified, loose concrete, form oils, surface hardeners, curing compounds, and laitance shall be removed from surfaces by abrasive blasting and chipping, and voids and cracks shall be repaired as specified in Section 03 30 00. Surface Preparation must open up all shelled over air voids or bugholes to expose fully the void's depth, width, and length. Concrete shall be abraded to achieve a uniform concrete surface profile of CSP-5 in accordance with ICRI 03732. After surface preparation has been accepted, a complete skim coat of the specified filler surfacer shall be applied over all concrete surfaces and all bugholes (air voids) shall be completely filled using this same material. The filler/surfacer material shall be applied as a complete parge coat of the substrate. If the parge coat (filler/surfacer material) is non-polymer modified, it must be brush blast cleaned following adequate cure per CSM's instructions to produce a uniform anchor pattern of CSP-4 in accordance with ICRI 03732 prior to coating application.</p>
5. Application:	Field
a. General:	<p>Surfacer or filler shall be applied per CSM's recommendations prior to application of prime coat to fill bugholes and voids. These materials must be compatible with the primers and finish coats.</p> <p>Prime coat shall be thinned and applied as recommended by the CSM, provided the coating as applied complies with prevailing air pollution control regulations.</p>
6. System Thickness:	50-75 mils dry film.
7. Coatings:	
a. Primer:	One coat at 3-5 mils dry film thickness
b. Finish:	One or more coats at CSM's recommended dry film thickness per coat to the specified system thickness.
c. Testing:	Holiday detection shall be performed over 100% of the coated surface area to identify any holidays or pinholes that must be repaired.
d. Pinhole and Holiday Repair Procedure:	<p>Pinholes or holidays identified by Holiday Detection shall be repaired as follows:</p> <ul style="list-style-type: none"> Using a grinder or other suitable power tool, remove the coating system at all pinholes or holidays in an area at least 2 inches in diameter or in both dimensions around the defect back to the concrete substrate. Chip out and remove the concrete to expose the full dimensions in all three directions of the air void responsible for the defect.

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	<ul style="list-style-type: none"> Aggressively abrade or sand the intact coating system surface at least 3-inches beyond the removal area in all directions to produce a uniform 6- to 8-mil profile in the intact coating system. Vacuum clean the prepared area to remove all dust, dirt, etc. leaving clean sound surfaces. Tape to mask the periphery of the prepared intact coating area to prevent coating repair application onto the prepared area. Using a putty knife or other suitable tool, fill the opened void with the approved filler/surfacers material completely and strike-off. Allow to cure per CSM's recommendations. Apply the coating system in the number of coats necessary to achieve the specified 35-50 mils DFT over the defect and coating removal area and feather the coating onto the abraded coated surfaces around the removal area to avoid a lip and to achieve a neat repair outline. Allow to cure properly.
V. Coating System Identification: EU-1	
1. Coating Material:	Zinc-Epoxy-Polyurethane System
2. Surface:	Ferrous Metal
3. Service Condition:	Exterior, exposed to direct sunlight, moderately corrosive, non-immersed.
4. Surface Preparation:	
a. General:	Shop primed surfaces which are to be incorporated in the work shall be prepared in the field by cleaning surfaces in accordance with SSPC SP-2 (Hand Tool Cleaning). Damaged shop coated areas shall be cleaned in accordance with SSPC SP-3 (Power Tool Cleaning) and recoated with the primer specified.
b. Ferrous Metal:	<p>Bare ferrous metal surfaces shall be prepared in accordance with SSPC SP-6 (Commercial Blast Cleaning) 2.5 – 3.0. Ductile iron surfaces to be coated shall be abrasive blast cleaned in accordance with <u>paragraph 3.02 Metallic Surfaces</u>.</p> <p>Ferrous metal with rust bleeding shall be cleaned in accordance with SSPC-SP-11 (Power Tool Cleaning to Bare Metal). Areas of rust penetration shall be spot blasted to SSPC SP-10 (Near White Blast) and spot primed with the specified primer.</p>
c. Galvanized Metal:	<p>Damaged galvanized steel areas with exposed ferrous metal and/or rusted shall be cleaned in accordance with SSPC SP-5 (White Metal Blast Cleaning) or Power Tool Cleaned to Bare Metal in accordance with SSPC-SP-11 to achieve a uniform 1.0- to 1.5-mil profile and spot primed with the primer specified.</p> <p>Nonferrous and galvanized metal shall be prepared in accordance with SSPC SP-7 (Brush-off Blast Cleaning) to impart a 1.0- to 2.0-mil profile to the galvanized steel surfaces. Where this cannot be performed, prepare by abrading in accordance with SSPC-SP-3, Power Tool Cleaning to impart a 1.0- to 1.5-mil profile uniformly to the galvanized steel surfaces.</p> <p>For EU-1 over galvanized steel, delete the zinc rich primer.</p>
5. Application:	Field
a. General:	Prime coat may be thinned and applied as recommended by the CSM, provided the coating as applied complies with prevailing air pollution control regulations.
b. Ferrous Metal:	Prime coats shall be a zinc rich epoxy or polyurethane primer compatible for use with urethane finish coats and applied in accordance with written instructions of the CSM or in the case of CARB or SCAQMD applications, prime with specified primer that is not zinc rich. In these cases, only a two-coat system is applied.
6. System Thickness:	3 to 4 mils of zinc rich primer, one intermediate or primer epoxy coat at 5 to 6 mils and one finish coat of polyurethane at 2 to 3 mils DFT.
7. Coatings:	
a. Primer:	One coat at CSM's recommended dry film thickness.
b. Intermediate:	One coat at CSM's recommended dry film thickness.
c. Finish:	One coat at CSM's recommended dry film thickness per coat to meet the specified system thickness.

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W. Coating System Identification: EU-1-FRP

1. Coating Material:	Specialty Primer plus Polyurethane Finish Coat
2. Surface:	Exterior of FRP Pipe and Tanks, etc.
3. Service Condition:	Exterior, exposed to direct sunlight, non-immersed.
4. Surface Preparation:	
a. General:	Clean to remove loose dirt, dust, or other contaminants. Prepare surfaces by sanding to produce roughness to achieve a uniform, minimum surface profile of 1.5 to 2.0 mils. Solvent clean thoroughly using solvent as recommended by the CSM. Thoroughly clean to remove loose debris by vacuum cleaning.
5. Application:	Field
a. General:	Apply primer coat and thin as recommended by the CSM provided the coating applied complies with prevailing air pollution control regulations. Apply finish coat as recommended by the CSM.
6. System Thickness:	Primer to 2 to 4 mils and finish coat is 2 to 3 mils DFT.
7. Coatings:	
a. Primer:	One coat at CSM's recommended dry film thickness.
b. Finish:	One coat at CSM's recommended dry film thickness per coat to meet the specified system thickness.

X. Coating System Identification: G

1. Coating Material:	Grease
2. Surface:	Metal
3. Surface Preparation:	
a. Ferrous Metal:	Ferrous metal surfaces shall be prepared in accordance with SSPC SP-1 (Solvent Cleaning).
4. Application:	Field Coating shall be applied with stiff brush, hand swab, or airless spray gun.
5. System Thickness:	50 square feet per gallon
6. Coating:	One coat of grease coating.

Y. Coating System Identification: HH-1

1. Coating Material:	Proprietary Primer plus Silicone Topcoat
2. Surface:	Metal
3. Service Condition:	Temperature to 750 degrees F.
4. Surface Preparation:	Metal surfaces shall be prepared in accordance with SSPC SP-10 (Near White Metal Blast Cleaning) to achieve a uniform surface profile of 2.0 to 2.5 mils.
5. Application:	Field Curing as required by CSM.
6. System Thickness:	6.5 to 8.0 mils dry film
7. Coating:	Primer at 5 to 6 mils DFT plus one topcoat at 1.5 to 2.0 mils DFT.

Z. Coating System Identification: HH-2

1. Coating Material:	Proprietary Primer plus Silicone Topcoat (available in black or aluminum only)
2. Surface:	Metal
3. Service Condition:	Temperature to 1200 degrees F.
4. Surface Preparation:	Metal surfaces shall be prepared in accordance with SSPC SP-10 (Near White Metal Blast Cleaning) to achieve a uniform surface profile of 2.0 to 2.5 mils.
5. Application:	Field Curing as required by CSM.

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6. System Thickness:	6.5 to 8.0 mils dry film
7. Coating:	Primer at 5 to 6 mils DFT plus one topcoat at 1.5 to 2.0 mils DFT.

AA. Coating System Identification: L-1

1. Coating Material:	Latex
2. Surfaces:	Concrete, masonry, plaster, gypsum board.
3. Service Condition:	Interior and exterior including existing exterior coated concrete.
4. Surface Preparation:	
a. Concrete:	Concrete surfaces shall be allowed to age for at least 28 days and allowed to dry to the moisture content recommended by the CSM. Moisture content may be tested by the Construction Manager with a Delmhorst Instrument Company moisture detector, or equal. Loose concrete and laitance shall be removed from surfaces, and voids and cracks shall be repaired as specified in Section 03 30 00.
b. Existing Coated Concrete:	Remove all loose coating down to a sound substrate or intact, well-adhered existing coating by scraping or other means. Then, abrade all surfaces to achieve a 0.5- to 1.5-mil uniform profile and vacuum clean to remove all loose dirt, paint chips, and dirt.
c. Masonry:	Masonry surfaces shall be allowed to age for at least 28 days. Holes or other joint defects shall be filled with mortar and repointed. Loose or splattered 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 filled with block filler compatible with the specified primer.
d. Plaster:	Plaster surfaces shall be dry, clean, and free from grit, loose plaster, and surface irregularities. Cracks and holes shall be repaired with acceptable patching materials, keyed to existing surfaces, and sandpapered smooth. Surfaces shall be cleaned with clear water by washing and scrubbing to remove foreign and deleterious substances. After cleaning, surfaces shall be sealed with a compatible sealer.
e. Gypsum Wallboard:	Tape joints and spackled nail heads shall be sanded smooth and dusted. Seal with PVA sealer for interior uses only.
5. Application:	Field
a. General:	Sealer or filler shall dry a minimum of 48 hours prior to primer application. Drying time between coats shall be as recommended by CSM.
6. System Thickness:	4 mils dry film.
7. Coatings:	
a. Primer:	One coat at CSM's recommended dry film thickness.
b. Finish:	Two or more coats at CSM's recommended dry film thickness per coat to the specified system thickness.

BB. Coating System Identification: L-2

1. Coating Material:	Latex
2. Surface:	PVC and CPVC pipe.
3. Service Condition:	Exterior, direct sunlight exposure.
4. Surface Preparation:	Plastic pipe shall be cleaned with solvent compatible with the specified primer and sanded to roughen surfaces to achieve a uniform surface profile of 1.0 to 1.5 mils. Vacuum clean after sanding to remove all loose dust, plastic particles, and dirt.
5. Application:	Field
6. System Thickness:	3 mils dry film.
7. Coatings:	
a. Primer:	One coat at CSM's recommended dry film thickness.
b. Finish:	One or more coats at CSM's recommended dry film thickness per coat to the specified system thickness.

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CC. Coating System Identification: L-3

1. Coating Material:	Latex – Direct to Metal
2. Surface:	Ferrous Metal
3. Service Condition:	Interior or Exterior
4. Surface Preparation:	
a. Ferrous Metals:	<p>Bare ferrous metal surfaces shall be prepared in accordance with SSPC SP-6 (Commercial Blast Cleaning) unless specified otherwise. Impart a 1.5- to 2.0-mil profile to substrate.</p> <p>Ferrous metal with rust bleeding shall be cleaned in accordance with SSPC SP-1 (Solvent Cleaning). Areas of rust penetration shall be spot blasted to SSPC SP-10 (Near White Blast) and spot primed with the specified primer.</p> <p>Shop primed surfaces which are to be incorporated in the work shall be prepared in the field by cleaning surfaces in accordance with SSPC SP-2 (Hand Tool Cleaning) or SSPC-SP-3 (Power Tool Cleaning).</p>
b. Nonferrous and Galvanized Metal:	Galvanized or nonferrous surfaces shall be prepared in accordance with SSPC SP-1 (Solvent Cleaning) after Brush Blast Cleaning in accordance with SSPC-SP-7.
5. Application:	Field
6. System Thickness:	6 to 8 mils dry film excluding sealer
7. Coatings:	
a. Primer:	One coat at CSM's recommended dry film thickness.
b. Finish:	Two or more coats at CSM's recommended dry film thickness per coat to the specified system thickness.

DD. Coating System Identification: L-4

1. Coating Material:	Latex
2. Surface:	Wood
3. Service Condition:	Interior
4. Surface Preparation:	<p>Wood surfaces shall be cleaned of dirt, oil or other foreign substances with mineral spirits, scrapers, sandpaper or wire brush. Finished surfaces exposed to view shall be smoothed by planing or sandpapering. Millwork shall be sandpapered and given a coat of the specified primer on all sides before installation. Built-in surfaces of windowsills shall be double primed. Glazing rabbets and beads in exterior sash and doors shall be double primed. Small, dry, seasoned knots shall be surfaced scraped, sandpapered, and thoroughly cleaned and shall be given a thin coat of an acceptable knot sealer before application of the priming coat. Large, open, unseasoned knots, and beads or streaks of pitch shall be scraped off; however, if the pitch is still soft, it shall be removed with mineral spirits or turpentine, and the resinous area shall be coated with knot sealer prior to priming. After priming, holes and imperfections shall be filled with putty or plastic wood, colored to match the finish coat, allowed to dry and sandpapered smooth.</p>
5. Application:	Field
6. System Thickness:	4.0 mils dry film.
7. Coatings:	
a. Primer:	One coat at CSM's recommended dry film thickness.
b. Finish:	Two or more coats at CSM's recommended dry film thickness per coat to the specified system thickness.

EE. Coating System Identification: M-1

1. Coating Material:	Petrolatum based mastic or wax based wrapping tapes.
2. Surfaces:	Metal
3. Service Condition:	Below grade (buried) or where little to no surface preparation can be performed on piping or structural steel.
4. Surface Preparation:	Remove loose scale, rust, dirt, excessive moisture, or frost from the surface in

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	accordance with SSPC SP-2 (Hand Tool Cleaning).
5. Application:	<p>All surfaces shall be hand rubbed or brushed with a priming paste recommended by the CSM. Sharp projections such as threads, irregular contours, or badly pitted areas shall receive a liberal amount of priming paste to ensure maximum protection of metal throughout.</p> <p>On irregular shaped surfaces, i.e., nuts, bolts, flanges, valves, etc., the Contractor shall use either of the following systems recommended by the CSM.</p> <p>A. Apply recommended mastic by hand in sufficient quantity to build an even contour over entire surface. The Contractor shall pay particular attention to ensure that folds and air pockets within the mastic layer are thoroughly pressed out prior to subsequent application of tape.</p> <p>OR:</p> <p>B. An extra layer of tape shall be cut and carefully molded around sharp projections, nuts, bolts, etc., before final application of tape, in order to meet specified system thickness.</p> <p>Tape shall be spirally wrapped with a 55 percent overlap and sufficient tension and pressure to provide continuous adhesion without stretching the tape. Edges of tape must be continuously smoothed and sealed by hand during wrapping. On vertical application, contractor shall begin at bottom and proceed upward creating a weatherboard overlap.</p>
6. System Thickness:	Smooth contours shall have a minimum thickness of 50 mils while nuts, bolts, and sharp projections shall be 100 mils.
7. Tape:	Number and types of tape wraps shall be in accordance with the CSM's written instructions.

FF. Coating System Identification: M-2

1. Coating Material:	Epoxy mastic or equal
2. Surface:	Ferrous Metal
3. Service Condition:	Interior, corrosive environment, confined enclosures, where minimal surface preparation is possible.
4. Surface Preparation:	
a. Ferrous Metal:	All uncoated ferrous metal surfaces shall be prepared in accordance with SSPC SP-3 (Power Tool Cleaning), or SSPC-SP-11 (Power to Cleaning to Bare Metal) prior to assembly. Surface preparation to achieve a uniform surface profile of 2.0 to 2.5 mils. Shop primed ferrous metal surfaces and fabricated assemblies shall be clean and dry prior to the application of field coats. Following assembly, the Contractor shall smooth welds and prominences using power tools prior to the application of the field applied coatings.
5. Application:	Field
a. General:	Prior to the application of field applied coatings, welds, back-to-back angles, sharp or rough edges and weld splatter shall be brushed with the specified prime coat and allowed to cure overnight.
6. System Thickness:	15 mils dry film.
7. Coatings:	
a. Prime:	One coat of the CSM's recommended dry film thickness.
b. Finish:	One or more coats of CSM's recommended dry film thickness per coat to the specified system thickness.

GG. Coating System Identification: S-1

1. Coating Material:	Penetrating acrylic stain, color required.
2. Surface:	Concrete
3. Service Condition:	Non-immersed, exposure to moisture and sunlight.
4. Surface Preparation:	Brush-off blast or industry standard acid etch or other preparation as approved by the CSM.

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5. Application:	
a. General:	Drying time between coats shall be as specified by the CSM for the site conditions.
b. Coatings:	Minimum of two coats overall (coat as many times as required to achieve desired color).
6. System Thickness:	200 square feet per gallon maximum or as recommended by the CSM.
7. Color Selection:	As approved by the Construction Manager consistent with neighborhood selection. The Contractor to price materials based on custom color.

HH. Coating System Identification: S-2

1. Coating Material:	Penetrating Water Repellent (Clear and Non-Film Building)
2. Surface:	Concrete Floors
3. Service Condition:	Exterior and Interior.
4. Surface Preparation:	Clean surfaces of all traces of dirt, dust, efflorescence, mold, salt, grease, oil, asphalt, laitance, curing compounds, paint, coatings, and other foreign materials by brush-off blast, water blasting, and/or chemical cleaners or other preparation as approved by the CSM.
a. Concrete	Concrete surfaces shall be allowed to age for at least 28 days and allowed to dry to the moisture content recommended by the CSM. Moisture content may be tested by the Construction Manager with a Delmhorst Instrument Company moisture detector, or equal. Loose concrete and laitance shall be removed from surfaces, and voids and cracks shall be repaired as specified in Section 03 30 00.
5. Application:	
a. General:	Drying time before placing into service shall be as recommended by the CSM for site conditions.
6. System Coverage:	Follow CSM's recommendations.
7. Color Selection:	Clear.

II. Coating System Identification: S-3

1. Coating Material:	Penetrating Water Repellent (Clear & Non-Film Building)
2. Surface:	Concrete and Masonry Walls
3. Service Condition:	Exterior and Interior – For Anti-Graffiti Applications
4. Surface Preparation:	Clean surfaces of all traces of dirt, dust, efflorescence, mold, salt, grease, oil, asphalt, laitance, curing compounds, paint, coatings, and other foreign materials by brush-off blast, water blasting, and/or chemical cleaners or other preparation as approved by the CSM.
a. Concrete	Concrete surfaces shall be allowed to age for at least 28 days and allowed to dry to the moisture content recommended by the CSM. Moisture content may be tested by the Construction Manager with a Delmhorst Instrument Company moisture detector, or equal. Loose concrete and laitance shall be removed from surfaces, and voids and cracks shall be repaired as specified in Section 03 30 00.
b. Masonry:	Masonry surfaces shall be allowed to age for at least 28 days. Holes or other joint defects shall be filled with mortar and repointed. Loose or splattered 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.
5. Application:	
a. General:	Drying time before placing into service shall be as recommended by the CSM for site conditions.
6. System Coverage:	Follow CSM's recommendations.
7. Color Selection:	Clear.

JJ. Coating System Identification: S-4

1. Coating Material:	Penetrating Oil and Water Repellent (Non-Film Forming)
2. Surface:	Concrete Floors

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3. Service Condition:	Exterior and Interior
4. Surface Preparation:	Clean surfaces of all traces of dirt, dust, efflorescence, mold, salt, grease, oil, asphalt, laitance, curing compounds, paint, coatings, and other foreign materials by brush-off blast, water blasting, and/or chemical cleaners or other preparation as approved by the CSM.
a. Concrete	Concrete surfaces shall be allowed to age for at least 28 days and allowed to dry to the moisture content recommended by the CSM. Moisture content may be tested by the Construction Manager with a Delmhorst Instrument Company moisture detector, or equal. Loose concrete and laitance shall be removed from surfaces, and voids and cracks shall be repaired as specified in Section 03 30 00.
5. Application:	
a. General:	Drying time before placing into service shall be as recommended by the CSM for site conditions.
b. Coatings:	One coat, flood horizontal surface so coating ponds for at least 60 seconds. Broom over all puddles thoroughly until complete penetration is achieved
6. System Thickness:	Follow CSM's recommendations.
7. Color Selection:	Clear.

3.06 COATING SYSTEMS SCHEDULE (FINISH SCHEDULE)

A. General:

1. Specific coating systems, colors, and finishes for rooms, galleries, piping, equipment, clarifiers, clarifier walkways and other items that are coated or have other architectural finishes are specified in the following coating system schedule. Unless otherwise specified in the coating system schedule, the word "interior" shall mean the inside of a building or structure, and the word "exterior" shall mean outside exposure to weather elements.

Coating Systems Schedule (Finish Schedule)

Location/Surface	Coating System Identification	Standard Color
A. General: All Surfaces not Specified by Area or Structure		
1. Structural Steel, Metal Decking, and Galvanized Acoustical Decking	Uncoated or E-2	
2. Equipment and Metal Appurtenances		
a. Equipment, non immersed, unless otherwise specified		
1) Indoors	E-1	FS 25051 Blue
2) Outdoors	EU-1	FS 20040 Brown
b. Equipment, immersed, unless otherwise specified	E-2	Beige
c. High temperature equipment operable at		
1) 200 to 750 degrees F	HH-1	FS 26306 Grey
2) above 750 degrees F to 1200 degrees F	HH-2	Aluminum or Black
d. Existing equipment		
1) Not damaged nor modified by work in this contract	Uncoated	--
2) Damaged, exposed, or modified by work in this contract		
a) Indoors	E-1 (see paragraph 3.02)	Match existing color
b) Outdoors	EU-1 without primer (see paragraph 3.02)	Match existing color
e. Diffusers and grilles on coated surfaces, unless otherwise specified		
1) Indoors	E-1	Match background color
2) Outdoors	EU-1	Match background color
f. Diffusers and grilles on uncoated surfaces, unless otherwise specified		
1) Indoors	E-1	FS 25051 Blue
2) Outdoors	EU-1	FS 20040 Brown
g. Existing diffusers and grilles		
1) Not damaged not modified by work in this contract	Uncoated	--
2) Damaged, exposed, or modified by work in this contract		
a) Indoors	E-1 (see paragraph 3.02 Masonry Surfaces)	Match existing color
b) Outdoors	EU-1 without primer (see paragraph 3.02 Masonry Surfaces)	Match existing color
h. Electrical switchgear panels, unit substations, motor control centers, power transformers, distribution centers, and relay panels; indoors and outdoors	See paragraph 3.03 Electrical and Instrumentation Equipment and Materials	ANSI 61 Grey (outside) FS 27880 White (inside)
i. Instrumentation panels, graphic indicating panels, indicating and transmitting field panels, unless otherwise specified		

Coating Systems Schedule (Finish Schedule)

Location/Surface	Coating System Identification	Standard Color
1) Indoors	See paragraph 3.03 Electrical and Instrumentation Equipment and Materials	FS 26306 Grey (outside) FS 27880 White (inside)
2) Outdoors	See paragraph 3.03 Electrical and Instrumentation Equipment and Materials	FS 27722 White (outside) FS 27880 White (inside)
j. Existing electrical and instrumentation panels		
1) Not damaged by work in this contract	Uncoated	--
2) Damaged or exposed to outside surfaces by work in this contract		
a) Indoors	E-1 (see paragraph 3.02 Masonry Surfaces)	FS 26306 Grey
b) Outdoors	EU-1 without primer (see paragraph 3.02 Masonry Surfaces)	FS 26306 Grey (Electrical) FS 27722 White (Instrumentation)
3. Conduit, Piping and Ductwork		
a. Ferrous, non-ferrous and galvanized piping, and appurtenant hangers and supports, non-immersed, unless otherwise specified.		
1) Indoors – noncorrosive	E-1	FS 25051 Blue
2) Outdoors – noncorrosive	EU-1	FS 20040 Brown
3) Indoors – in corrosive environment	EA-1	To be determined
4) Buried piping	M-1 or M-2	Not required
b. Ferrous piping, appurtenant and supports, immersed	E-2	To be determined
c. Conduit, outlet and junction boxes, lighting transformers, lighting, communication and small power panels, control stations, piping, lagged ductwork, appurtenant hangers, clamps, and supports on coated surfaces, unless otherwise specified.		
1) Indoors	E-1	Match background color
2) Outdoors	EU-1	Match background color
d. Conduit, outlets and junction boxes, lighting transformers, lighting, communication and small power panels, control stations, piping, lagged ductwork, appurtenant hangers, clamps and supports on uncoated surfaces, unless otherwise specified		
1) Indoors	E-1	FS 25051 Blue
2) Outdoors	EU-1	FS 20040 Brown
e. Existing conduit, outlet and junction boxes, lighting transformers, lighting communication and small power panels, control stations, piping, lagged ductwork, appurtenant hangers, clamps, and supports		
1) Not damaged nor modified by work in this contract	Uncoated	--
2) Damaged, exposed, or modified by work in this contract		

Coating Systems Schedule (Finish Schedule)

Location/Surface	Coating System Identification	Standard Color
a) Indoors	E-1 (see paragraph 3.02 Masonry Surfaces)	Match existing color
b) Outdoors	EU-1 without primer (see paragraph 3.02 Masonry Surfaces)	Match existing color
f. Racked conduits and cable trays	Uncoated	--
g. Insulated pipe jacketing	Uncoated	--
h. Plastic, fiberglass and flexible conduit and piping		
1) Unless otherwise specified	Uncoated	--
2) PVC and CPVC Piping	L-2	FS 25051 Blue
a) Exposed to direct sunlight	L-2	FS 25051 Blue
b) Not exposed to direct sunlight	E-7	FS 25051 Blue
i. High temperature piping operable at		
1) 200 to 750 degrees F	HH-1	FS 26306 Grey
2) Above 750 degrees F to 1,200 degrees F	HH-2	Aluminum or Black
j. Exposed ductwork, unless otherwise specified	Uncoated	--
4. Concrete, Grout, Masonry and Plaster		
a. Immersed tank and channel walls and bottoms unless otherwise specified	Uncoated	--
b. Outside concrete walls below grade common with dry area or room	In accordance with Section 07 10 00	--
c. Walls and ceilings		
1) Precast concrete or colored masonry	Uncoated	--
2) Outdoors, unless otherwise specified	Uncoated	--
3) Indoors, unless otherwise specified	E-4	FS 23617 Beige
d. Concrete equipment bases unless otherwise specified	E-4	Match equipment color
e. Floors unless otherwise specified	S-2	
f. Existing coated surfaces.	L-1	Match existing color
5. Door and Door Frames		
a. Doors unless otherwise specified		
1) Ferrous metal		
a) Indoors	E-1	FS 20040 Brown
b) Outdoors	EU-1	FS 25051 Blue
2) Aluminum	Uncoated	--
3) Other	Plastic laminate	Formica 947 Brown
4) Existing		
a) Not damaged by work in this contract	Uncoated	--
b) Damaged, exposed, or modified by work in this contract		
(1) Indoors	E-1 (see paragraph 3.02 Masonry Surfaces)	Match existing color

Coating Systems Schedule (Finish Schedule)

Location/Surface	Coating System Identification	Standard Color
(2) Outdoors	EU-1 (see paragraph 3.02 Masonry Surfaces)	Match existing color
b. Door frames unless otherwise specified		
1) Adjacent wall coated		
a) Indoors	E-1	Match wall color
b) Outdoors	EU-1	Match wall color
2) Adjacent wall uncoated		
a) Indoors	E-1	FS 20040 Brown
b) Outdoors	EU-1	FS 25051 Blue
3) Aluminum	Uncoated	--
4) Existing		
a) Not damaged by work in this contract	Uncoated	--
b) Damaged, exposed, or modified by work in this contract		
(1) Indoors	E-1 (see paragraph 3.02 Masonry Surfaces)	Match existing color
(2) Outdoors	EU-1 without primer (see paragraph 3.02 Masonry Surfaces)	Match existing color
6. Handrails, Gratings, Floor Plates, Manhole Covers, and Hatches		
a. Unless otherwise specified	Uncoated	
b. Existing		
1) Not damaged by work in this contract	Uncoated	--
2) Damaged, exposed, or modified by work in this contract		
a) Indoors	E-1 (see paragraph 3.02 Masonry Surfaces)	Match existing color
b) Outdoors	EU-1 without primer (see paragraph 3.02 Masonry Surfaces)	Match existing color
7. Metal Stairs, Ladders, Platforms, and Supports Except Tread and Grating		
a. Indoors	E-1	FS 25051 Blue
b. Outdoors	EU-1	FS 20040 Brown
c. Existing		
1) Not damaged nor modified by work in this contract	Uncoated	--
2) Damaged, exposed, or modified by work in this contract		
a) Indoors	E-1 (see paragraph 3.02 Masonry Surfaces)	Match existing color
b) Outdoors	EU-1 without primer (see paragraph 3.02 Masonry Surfaces)	Match existing color
8. Aluminum Flashing, Light Standards, Supports, and Louvers		

Coating Systems Schedule (Finish Schedule)

Location/Surface	Coating System Identification	Standard Color
a. Indoors and outdoors, unless otherwise specified	Uncoated	--
9. Precast Concrete Metalwork		
a. Fasteners, anchors, supports, etc.	EU-1	Match wall
10. Other		
a. Fire hydrants	EU-1	FS 21302 Red
b. Flap gates	EA-1	Beige
c. Aluminum slide gates	Uncoated	--
d. Sluice gates		
1) Gate	--	--
2) Stem, except potable	G	--
3) Operator		
a) Indoors	E-2	FS 25051 Blue
b) Outdoors	EU-1	FS 20040 Brown
e. Tanks		
1) Steel tanks unless otherwise specified		
a) Inside of wash water or similar tanks	E-2	--
b) Inside of sludge (open top) tanks	E-9	--
c) Outside of tank		
(1) Indoors	E-1	FS 25051 Blue
(2) Outdoors	EU-1	FS 25051 Blue
2) Potable steel water storage tanks		
a) Inside of tank	E-5	See Note 1
b) Outside of tank	EU-1	FS 25051 Blue
3) Fiberglass tank	Uncoated	--
f. Pipe, ductwork, equipment and appurtenances made from fiberglass, plastic, rubber, including flexible hose, conduit, and plastic coated tubing, in areas not exposed to view (indoors) (metal hangers and supports are coated with E-1)	Uncoated	--
g. Buried, sleeve-type and flanged pipe, couplings, valves, mechanical and electrical penetrations	M-1 or M-2	Manufacturer's color
B. Primary Sedimentation Tanks and Effluent Channels		
1. Drive chain, sprockets, and shafts of longitudinal and cross collectors	G	--
2. Scum removers, collection equipment	EA-1	
3. Steel and cast iron below maximum water level (elevation [REDACTED])	E-2	
4. Effluent control valve		
a. Gate and stem	EA-1	--
b. Operator	EU-1	FS 20040 Brown
5. Concrete walls common with equipment gallery-noncorrosive.	E-2	Beige
6. Concrete headspaces above max water level elevation [REDACTED] and 2'-0" below max. water level - corrosive.		
C. Aerated Grit Removal Tank and Supply Channels		
1. Scum removers, collection equipment.	EA-1	--

Coating Systems Schedule (Finish Schedule)

Location/Surface	Coating System Identification	Standard Color
2. Steel and cast iron below maximum water level (elevation [REDACTED])		Beige
3. Concrete headspaces above max water level elevation [REDACTED] and 2'-0" below max. water level – corrosive	E-2	
D. Secondary and Final Sedimentation Tank including Supply and Effluent Channels		
1. Submerged equipment, including interior and exterior surfaces of sludge remover with center pier, sludge collectors, drive cage, and influent chamber baffle; scum skimmers; effluent collection brackets, weir trough and piping	E-2	Beige
2. Steel bridge and sludge remover drive and equipment above maximum water level (elevation [REDACTED]) (if not a covered structure)	EU-1	FS 20040 Brown
3. Chains and gears	G	--
E. Aeration Tanks including Supply and Effluent Channels Thickener		
1. Effluent water troughs and support brackets:		
a. Metals	EA-1	--
b. Concrete	EA-2	--
F. WAS Thickener		
1. Influent feed wells, drive cages, distribution weirs, and bottom sludge collectors	E-9	Beige
2. Concrete: upper main wall 2'-0" below max. water level elevation [REDACTED] and launder trough surfaces	EA-2 or EC-1	
3. Float collector arms, float troughs and float conveyors	EA-1	--
4. Air dissolution tank		
a. Inside	EA-1	--
b. Outside	EU-1	FS 25051 Blue
G. Wet Well		
1. Piping and appurtenant hangers and supports above max. water level elevation [REDACTED]	EA-1	--
2. Piping and appurtenance hangars and supports below max. water level elevation [REDACTED]	E-2	--
3. Walls and ceiling above max. water level elevation [REDACTED]	E-9-C	--
4. Walls and ceiling below max. water level elevation [REDACTED]	E-2	--
H. Digesters		
1. Inside and outside gas eductor tubes and tube supports	EA-1	--
2. Underside floating covers, inside gas domes, safety chambers, and seal pipes	EA-1	--
3. Within the floating cover including trusses, structural steel, roofing	M-2	Manufacturer's standard color
I. Sludge Gas Storage Sphere		
1. Inside	EA-1	--
2. Outside	EU-1	FS 25051 Blue
J. Influent Structure		
1. Bar screen housing		

Coating Systems Schedule (Finish Schedule)

Location/Surface	Coating System Identification	Standard Color
a. Inside	EA-1	--
b. Outside	EU-1	FS 25051 Blue
2. Bar screen sluiceway	EA-1	--
K. Administration Building		
1. Outdoors		
a. Equipment on roof	EU-1	FS 25051 Blue
b. Walls	Uncoated	--
2. Room 5401 Lobby		
a. Floor	Epoxy terrazzo	National Mosaic Assoc. Std S109
b. Base	Epoxy terrazzo	NMAS S109
c. Plaster walls	L-1	FS 23617 Beige
d. Steel deck ceiling	L-3	FS 23617 Beige
e. Steel roof trusses	L-3	FS 23617 Beige
f. Doors	L-3	FS 20040 Brown
g. Door frames	L-3	FS 23617 Beige
3. Room 5402 Clerical Area		
a. Floor	Epoxy terrazzo	NMAS S109
b. Base	Epoxy terrazzo	NMAS S109
c. Plaster walls	L-1	FS 23617 Beige
d. Steel deck ceiling	L-3	FS 23617 Beige
e. Steel roof trusses	L-3	FS 23617 Beige
f. Doors	L-3	FS 20040 Brown
g. Door frames	L-3	FS 23617 Beige
h. Filing cabinets	Shop coated	Steelcase Tan
4. Room 5403 Conference Room		
a. Floor	Vinyl composite tile	To be determined
b. Base	Plastic laminate	Formic 879 Beige
c. Plaster walls	L-1	FS 23617 Beige
d. Acoustical tile ceiling	Uncoated	Match wall color
e. Doors	L-3	FS 20040 Brown
f. Door frames	L-3	FS 23617 Beige
g. Shelving and gables	Plastic laminate	Formica 879 Beige
h. Tackboards	--	Claridge Products 1104 Burnt Umber
i. Chalkboard	--	Claridge Products 14 Charcoal Brown
5. Room 5404 Stairwell		
a. Floor	Vinyl composite tile	Amtico Ava-548

Coating Systems Schedule (Finish Schedule)

Location/Surface	Coating System Identification	Standard Color
b. Base	Plastic laminate	Formica 879 Beige
c. Treads and risers	Vinyl composite Tile	Amtico Ava-548
d. Plaster walls and ceiling	L-1	FS 23617 Beige
e. Doors	L-3	FS 20040 Brown
f. Door frames	L-3	FS 23617 Beige
6. Room 5405 Women's Wash Room		
a. Floor	Epoxy terrazzo	NMAS S109
b. Base	Epoxy terrazzo	NMAS S109
c. Wainscoat	Ceramic tile	Dallas Ceramic C-125
d. Plaster walls and ceiling	L-1	FS 23617 Beige
e. Doors	L-3	FS 20040 Brown
f. Door frames	L-3	FS 23617 Beige
g. Toilet partition	Shop coated	Sanymetal 24 Blue
h. Vanity	Plastic laminate	Formica 879 Beige
7. Room 5406 Men's Wash Room		
a. Floor	Epoxy terrazzo	NMAS S109
b. Base	Epoxy terrazzo	NMAS S109
c. Wainscoat	Ceramic tile	Dallas Ceramic DC-125
d. Plaster walls and ceiling	E-4	FS 23617 Beige
e. Doors	L-3	FS 20040 Brown
f. Door frames	L-3	FS 23617 Beige
g. Toilet partition	Shop coated	Sanymetal 24 Blue
8. Room 5407 Plant Superintendent		
a. Floor	Vinyl composite Tile	Amtico Ava-548
b. Base	Plastic laminate	Formica 879 Beige
c. Plaster walls	L-1	FS 23617 Beige
d. Acoustical tile ceiling	--	Match wall color
e. Doors	L-3	FS 20040 Brown
f. Door frames	L-3	FS 23617 Beige
g. Counters		
1) Top	Plastic laminate	Formica 879 Beige
2) Door faces	Plastic laminate	Formica 947 Brown

Coating Systems Schedule (Finish Schedule)

Location/Surface	Coating System Identification	Standard Color
3) Dead panels	Plastic laminate	Formica 947 Brown
4) Inside and shelving	L-4	FS 23617 Beige
h. Upper cabinet		
1) Door faces	Plastic laminate	Formica 947 Brown
2) Inside and shelving	L-4	FS 23617 Beige
9. Room 5408 Shower Room		
a. Floor	Epoxy terrazzo	NMAS S109
b. Base	Epoxy terrazzo	NMAS S109
c. Wainscoat	Ceramic tile	Dallas Ceramic DC 125
d. Plaster walls and ceiling	E-4	FS 23617 Beige
e. Bench		
1) Top	E-8	--
2) Steel frame	E-1	FS 20040 Brown
f. Lockers	Shop coated	To match Sanymetal 24 Blue
10. Room 5409 Laboratory		
a. Floor	Epoxy terrazzo	NMAS S109
b. Base	Epoxy terrazzo	NMAS S109
c. Plaster walls	L-1	FS 23617 Beige
d. Acoustical tile ceiling	--	Match wall color
e. Doors	L-3	FS 20040 Brown
f. Door frames	L-3	FS 23617 Beige
g. Counters		
1) Tops	Plastic laminate	Formica 879 Beige
2) Door and drawer faces	Plastic laminate	Formica 947 Brown
3) Dead panels	Plastic laminate	Formica 947 Brown
4) Inside	L-4	FS 23617 Beige
5) Shelving	Plastic laminate	Formica 879 Beige
6) Bookshelves	Plastic laminate	Formica 879 Beige
7) Bookshelf gables	Plastic laminate	Formica 879 Beige
h. Upper cabinets		
1) Gable faces	Plastic laminate	Formica 879 Beige
2) Inside	L-4	FS 23617 Beige
3) Shelving	Plastic laminate	Formica 879 Beige

Coating Systems Schedule (Finish Schedule)

Location/Surface	Coating System Identification	Standard Color
i. Exhaust hood trim	Plastic laminate	Formica 947 Brown
j. Dumbwaiter door	Plastic laminate	Formica 947 Brown

Note: Owner will select color from coating manufacturer's list of EPA approved colors for potable water.

3.07 INSPECTION AND TESTING BY OWNER

A. General:

1. Inspection by the Owner or others does not limit the Contractor's or CSA's responsibilities for quality workmanship or quality control as specified or as required by the CSM's instructions. Inspection by the Owner is in addition to any inspection required to be performed by the Contractor.
2. The Owner may perform, or contract with an inspection agency to perform, quality control inspection and testing of the coating work covered by this **Section 09 90 00**. These inspections may include the following:
 - a. Inspect materials upon receipt to ensure that are supplied by the CSM.
 - b. Inspect to verify that specified storage conditions for the coating system materials, solvents and abrasives are provided.
 - c. Inspect and record findings for the degree of cleanliness of substrates.
 - d. Inspect and record the pH of concrete and metal substrates.
 - e. Inspect and record substrate profile (anchor pattern)
 - f. Measure and record ambient air and substrate temperature.
 - g. Measure and record relative humidity.
 - h. Check for the presence of substrate moisture in the concrete.
 - i. Inspect to verify that correct mixing of coating system materials is performed in accordance with CSM's instructions.
 - j. Inspect, confirm, and record that the "pot life" of coating system materials is not exceeded during installation. Inspect to verify that recoat limitations for coating materials are not exceeded.
 - k. Perform adhesion testing.
 - l. Measure and record the thickness of the coating system.
 - m. Inspect to verify proper curing of the coating system in accordance with the CSM's instructions.
 - n. Perform holiday or continuity testing for coatings that will be immersed or coatings that will be exposed to aggressively corrosive conditions.

3.08 FINAL INSPECTION

A. General

1. Contractor shall conduct a final inspection to determine whether coating system work meets the requirements of the specifications.

2. The Construction Manager will subsequently conduct a final inspection with the Contractor to determine the work is in conformance with requirements of the contract documents.
3. Any rework required shall be marked. Such areas shall be recleaned and repaired as specified at no additional cost to the Owner.

END OF SECTION

VOLUME 3: SPECIFICATIONS DIVISIONS 24 TO 46

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SECTION 26 05 00.01

COMMON WORK RESULT FOR ELECTRICAL FOR SMALL PROJECTS

PART 1 – GENERAL

1.01 DESCRIPTION

- A. Scope: This section specifies general requirements for electrical work. Project Detailed requirements specified in other sections are subject to the general requirements of this section.
1. Furnish labor, equipment, tools, materials, supplies, and perform operations necessary to install a complete and operable electrical system. Furnish incidental material and perform work shown on the Drawings and in the Specifications.
 2. Perform electrical work and provide material and equipment in compliance with applicable National, State, and Local codes, regulations, laws, and ordinances.
 3. Obtain electrical permits, arrange for required inspections, correct deficiencies resulting from inspections, and pay permit fees and inspections charges. Pay fines and the cost of extra work incurred by action or inaction of the Contractor, at no additional cost to the Owner.
 4. Furnish properly executed certificates of final electrical inspection and approval from the Code Authority Having Jurisdiction (AHJ) at the conclusion of the work, before final acceptance.
 5. Adhere to the Area Classification shown for the product required and the installation required. Provide products in Hazardous Classified Areas in accordance with NEC Article 500 for the Class and Division specified or identified and products in corrosion areas in accordance with this specification.
 6. Maintain a complete set of Contract Drawings in "Record" condition, available for review by the Owner or Engineer. Mark, initial, and date changes, modifications, or corrections, as they occur. Refer to the Record Drawing specification section requirements.
 7. Field verify the exact locations of equipment or equipment terminations. Use accepted equipment submittals as the basis of the conduit openings and slab penetrations.
- B. Drawing Definitions and Requirements:
1. Elementary or Schematic Diagram: Shows, by means of graphic symbols, the electrical connections and functions of a specific circuit arrangement that facilitates tracing the circuit and its functions without regard to the actual physical size, shape, or location of the component devices or parts.
 2. One-Line Diagram: Shows by means of single lines and graphical symbols the course of an electrical circuit or system of circuits and the components, devices or parts used therein. Physical relationships are usually disregarded.
 3. Block Diagram: Diagram of a system, instrument, computer, or program in which selected portions are represented by annotated boxes and interconnecting lines.
 4. Wiring Diagram or Connection System: Includes all of the devices in a system and shows their physical relationship to each other including terminals and interconnecting wiring in an assembly. A panel layout diagram shows the physical location of devices and the wiring connections.

5. Interconnection Diagram:
 - a. Shows external connections between terminals of equipment in panels or electrical assemblies and outside points, such as motors, auxiliary devices, control devices, and instruments. Provide references to connection diagrams that interface to the interconnection diagrams of the continuous line type.
 - b. Show bundled wires as a single line with the direction of entry/exit of the individual wires clearly shown. Show each wire identification as actually installed. Wireless diagrams and wire lists are not acceptable.
 - c. Provide wire identification for each end of the same wire for devices and equipment, indicate terminal blocks identification actually installed with individual terminal identification.
 - d. Show jumpers, shielding and grounding termination details not shown on the equipment connection diagrams on the interconnection diagrams. Wires or jumpers shown on the equipment connection diagrams shall not be shown again on the interconnection diagram. Signal and DC circuit polarities and wire pairs shall be shown. Show spare wires and cables.
6. Arrangement, Layout, or Outline Drawings: Shows the physical space and mounting requirements of a piece of equipment and may indicate ventilation requirements, space provided for connections, or the location connections are to be made.
7. Drawing Cross-Referencing:
 - a. Internally cross-reference submittal drawings related to the same subject shall be referenced to other submittal drawings. Failure to cross-reference Contract Documents with the submittal shall be cause for rejection of the entire submittal with no further consideration.

1.02 QUALITY ASSURANCE

A. References:

1. This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.
2. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ANSI A58.1 / ASCE 7	Minimum Design Load in Buildings and Other Structures, 1982
ANSI C80.1	Rigid Steel Conduit - Zinc Coated, 1994
ASTM B3	Standard Specification for Soft or Annealed Copper Wire, 2001

Reference	Title
ASTM B8	Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft, 1999
ASTM B33	Standard Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes, 2000
ICEA S-68-516 / NEMA WC 70, 71, & 74	Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
ICEA S-95-658	Standard for Non-Shielded Power Cables Rated 2000 Volts or Less, 2000
IEEE 81	Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System, 1983
IEEE 383	Type Test of Class IE Electric Cables, Field Splices, and Connections for Nuclear Power Generating Stations, 1974 (1992)
JIC EMP-1	Electrical Standard for Mass Production Engineering, 1967
NEMA TC2	Electrical Polyvinyl Chloride (PVC) Conduit, 2003
NEMA 250	Enclosures for Electrical Equipment (1000 Volt Maximum)
NEMA WC-70	Non-Shielded Power Cable 2000V or Less (ICEA S-95-658), 1999 (2001)
NEMA WD-1	General Requirements for Wiring Devices, 1999
NFPA 70	National Electrical Code (NEC)
UBC	Uniform Building Code
UL 6	Electrical Rigid Metal Conduit – Steel, 12th Edition, 2000 (2003)
UL 44	Thermoset-Insulated Wires and Cables, 15th Edition, 1999 (2002)
UL 67	Panelboards, 11th Edition, 1993 (2003)
UL 83	Thermoplastic-Insulated Wires and Cables, 13th Edition, 2003 (2004)
UL 263	Fire Tests of Building Construction and Materials, 13th Edition, 2003
UL 360	Liquid-Tight Flexible Steel Conduit, 5th Edition, 2003
UL 489	Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures, 10th Edition, 2002 (2003), Adopted: NEMA AB 1-1999
UL 1277	Electrical Power and Control Tray Cables with Optional Optical-Fiber Members, 4th Edition, 2001 (2003)

B. Listed and Labeled Products:

1. Provide electrical equipment and materials listed or labeled by an independent testing laboratory for the purpose for which they are to be used and provide associated testing laboratory label.
2. The independent testing laboratory shall be acceptable to the inspection authority having jurisdiction. Test Laboratory examples: Underwriters Laboratories (UL), Electrical Testing Laboratories (ETL), and Canadian Standards Association (CSA).
3. Include costs and expenses incurred for special inspections in the contract price for electrical products required to undergo a special inspection either at the manufacturer's place of assembly or at the installed location by the local inspection authority when a product is not available with a testing laboratory listing or labeling.

C. Factory Tests:

1. Perform factory tests at the place of fabrication and on completion of manufacture or assembly where specified in the individual product specification section.
 - a. Include the costs of factory tests in the contract price.
 - b. Include the costs of Engineer witness of factory tests in the contract price.

1.03 SUBMITTALS

- A. The following information shall be provided for all electrical equipment and materials in accordance with Section 01 33 00:
 - 1. Catalog cuts of equipment, devices, and materials requested by the individual specification sections.
 - a. Catalog information with technical specifications and application information including ratings, range, weight, accuracy, and other pertinent product information.
 - b. Edit catalog cuts to show only the items, model numbers, and information that apply.
 - c. Assemble catalog cuts in an electronic PDF with a cover sheet, indexed by item, and cross-referenced to the appropriate specification paragraph.
 - 2. Arrangement, layout, and outline drawings with dimensions and weight, as appropriate.
 - 3. Control schematics and interconnection wiring diagrams depicting internal and external wire and cable terminations. Drawing cross-reference to specification and Contract Document drawings.
- B. PRODUCT DATA
 - 1. The following information shall be provided in accordance with Section 01 33 00:
 - a. Operating and maintenance information as specified in Section 01 78 23.
 - b. One 11" x 17" set of drawings in a protective covering and shipped with the equipment in the internal equipment pocket at the time of equipment delivery to the project site.
 - c. Record documents as specified in Section 01 78 39.
 - d. Certificates of final electrical inspection and approval from the Code Authority Having Jurisdiction (AHJ) as specified in paragraph 26 05 00.01-1.01 A 4.
- C. RECORD DOCUMENTS
 - 1. Provide Record Drawings and documents maintained and annotated during construction. Submit drawings in accordance with Section 01 78 39 and the following.
 - 2. Include addendum items, requests for information, change orders, and field changes posted or drawn on the Record Drawings. Include the following drawings with the Record Drawings:
 - a. Interconnection Diagrams specified herein.
 - b. Original Submittal Drawings specified herein.
 - 3. Schedule a meeting with the Engineer in the Engineer's office to review the Record Drawings at the end of the project. Make corrections to the Record Drawings prior to re-submitting the Record Drawings to the Engineer.
 - 4. Submit Record Drawings and Operations and Maintenance (O&M) Manuals as specified in Sections 01 78 23 and 01 78 39, to be included in the completed project Record Document Set for the Owner.

1.04 DRAWINGS

- A. Prepare specified drawings on 22-inch by 34-inch drafting media complete with borders and title blocks clearly identifying project name, equipment, and the scope of the drawing.
- B. Prepare drawings to reflect the final constructed state of the project installation or supplied equipment. Provide drawing quality, clarity, and size of presentation to permit insertion in operation and maintenance manuals.

1.05 PROJECT/SITE CONDITIONS

- A. General:
 - 1. Unless otherwise specified, equipment and materials shall be sized and de-rated for the ambient conditions specified in Section 01 11 80, but not less than an ambient temperature of 40 degrees C at an elevation ranging from sea level to 3000 feet without exceeding the manufacturer's stated tolerances.
- B. Seismic:
 - 1. Electrical equipment and supports shall be braced in accordance with all applicable building codes.
- C. Construction Materials:
 - 1. Refer to the individual specification section for each component for material composition and installation practices.
 - 2. Construction materials required for each area classification are listed in the following table that specifies the type of raceway required for each location and application by RACESPEC sheet. Unscheduled conduit shall be galvanized rigid steel conduit: RACESPEC type RMC-Steel.

Location	Application/Condition	RACESPEC
Indoor non-corrosive	Exposed	RMC-Steel
Outdoor	Exposed	PVC coated RMC-Steel
Concealed	Embedded in concrete structure or beneath slab-on-grade	RNC40
Nonhazardous	Final connection to equipment	LFMC

Notes:

- 1. Install conduit connections to control stations, enclosures, and device boxes through threaded hubs.
- 2. Install flexible conduit for final connections to devices, equipment and motors not exceeding 18 inches. Limit length to 36 inches where flexibility is required.
- 3. Mount enclosures, device boxes, control stations, and raceway systems with 1/4-inch (minimum) air space between the electrical system and supporting structure.

1.06 STORAGE OF MATERIALS AND EQUIPMENT

- A. Store equipment and materials in the factory-sealed container and protect with additional covering and materials to avoid physical damage or weather damage.

1.07 ELECTRICAL NUMBERING SYSTEMS

A. Raceway Numbers:

1. Tag raceways with brass tags at the access locations including manholes, pull boxes, junction boxes, and at the terminations with stainless steel tags.
2. Tag raceways with aluminum tags where subject to hydrogen sulfide atmosphere typically found at wastewater treatment facilities.

B. Wire and Cable Circuit Numbers:

1. Identify wire and cable circuit numbers at both ends. Refer to the circuit labeling method specified and shown in the drawings to label circuits.
2. Identify lighting and receptacle branch circuits with the power source and circuit load, at source and destination locations. Identify the load, location, and circuit in typed panel schedules with corrections shown.
3. Include copies of schematic diagrams, wiring connection diagrams, and interconnection diagrams inside of the equipment enclosure, protected in a plastic container in the equipment print holder.

PART 2 – PRODUCTS

2.01 EQUIPMENT AND MATERIALS

A. General:

1. Provide new equipment and materials free from defects. Provide material and equipment of the same or a similar type of the same manufacturer throughout the work. Use standard production materials wherever possible.

B. Galvanizing:

1. Galvanize products, supports, etc. as specified in the Hot-Dip Zinc Coating section.

2.02 RACEWAYS, BOXES, AND SUPPORTS

A. Raceways and Boxes:

1. Pullboxes, handholes, and device boxes are generally called boxes herein. Size boxes, manholes, and handholes in accordance with the National Electrical Code. Provide separate raceways for lighting, receptacles, power, control, instrumentation, and signaling systems.

B. Boxes and Wireways:

1. Provide indoor boxes, larger than FD boxes, constructed of stainless steel.
2. Provide boxes constructed of Grade 316 stainless steel rated NEMA-4X for outdoor locations.
3. Size and provide wireways at locations above and below boxes, panels and groups of devices. Comply with the NEC sizing for conductor fill requirements. Wireway NEMA type shall match the location and area classification and equipment NEMA enclosure ratings.

C. Terminal Cabinets:

1. Provide cabinets located indoors in dry spaces- with NEMA-12 rating. Provide cabinets located outdoors, in process areas and in corrosive areas with NEMA-4X rating of stainless steel. Provide cabinets with hinged doors and 2 or 3-point stainless steel quick release latches with locking features via handle or latching clasps with provisions for padlocks.
2. Provide adjustable terminal strip mounting accessories and with channel mounted terminal blocks rated 30 amperes, 600 volt AC. Provide No. 8 minimum strap-screw type terminal strip, suitable for ring tongue, locking spade terminals. Provide Phoenix Contact products with capture feature and terminal identification method per terminal, as specified.

D. Manholes, Handholes and Pullboxes:

1. Pullboxes generally called boxes herein, contain wires, cables, and conductors. Provide box dimensions where shown. Provide boxes per NEC sizing rules where the dimensions are not sized or shown.

E. Raceway and Box Supports:

1. Provide stainless steel framing channel with end caps to support groups of conduit. Provide individual conduit supports that have one-hole stainless steel malleable iron pipe straps used with stainless steel clamp backs and nesting backs.
2. Provide stainless steel supports, channel, fittings, all-thread, and fasteners in outdoor locations, in corrosive areas, and as shown. Provide factory end-caps for supports and channels.
3. Independently support boxes by stainless steel brackets, expansion bolts, toggle bolts, or machine or wood screws as appropriate. Wooden or plastic plugs inserted in masonry or concrete shall not be used as a base to secure boxes, nor shall welding or brazing be used for attachment.

F. Underground Marking Tape:

1. Provide low-density, polyethylene plastic, underground marking tape and install above and centered for early warning protection for digging near electrical ductbanks.
2. Provide Brady "Identoline"; Services and Materials "Buried Underground Tape"; Somerset (Thomas & Betts) "Protect-A-Line"; or equal. Provide tape with nominal dimension of 6 inches wide, 4-mil thickness.
3. Provide underground marking tape 6-inch wide metallic-lined tape with red polyethylene film on top and with clear polyethylene film on the bottom of the tape for installation above and centered on direct buried cables and conduits without ductbank encasement.
4. Provide black over red marking tape clearly printed with: "CAUTION ELECTRIC LINE BURIED BELOW", or provide OSHA approved marking tape.

G. Nameplates:

1. Provide nameplates for all boxes and enclosures with nameplate wording as shown on the drawings. Provide the tag number or box number with device functional description on device nameplate. Nameplate wording may be changed without additional cost where changes are made during the submittal process or prior to commencement of engraving.

2. Provide machine engraved laminated white phenolic nameplates with black lettering for panel-mounted equipment with the instrument tag number/description in 3/32-inch minimum size lettering and attach to the panel or enclosure with a minimum of two self-tapping 316 stainless steel screws. Provide nameplates for power sources indicating the power loads and nameplates for power loads that indicate the power sources, in accordance with these specifications and the NEC.

H. Raceway Markers:

1. Provide raceway markers: 0.036-inch minimum thickness, solid brass tags or aluminum tags with raceway number or the circuit number, stamped in 3/16-inch minimum height characters and attach tags to the raceway with 316 stainless steel wire. Install raceway markers inside of pull boxes, handholes, manholes, and where entering electrical equipment enclosures.
2. Provide raceway markers indicating the power source and circuit number for lighting and receptacle raceways to the associated panelboard. Interior lighting and receptacle raceways do not require raceway markers for conduit between components.

I. Identification Tags:

1. Provide the following:
 - a. Equipment: Typical size 1-inch x 3-inch wide, white with black engraved equipment number and equipment description.
 - b. Raceway/Conduit: Tags with raceway or conduit number or circuit shown.
 - c. Instrument: 1.5-inch wide, aluminum tag with instrument number and description.
 - d. Conductor: Power, control, or instrument cable with the circuit identified as shown; power source or power/control panel identified; power load, equipment, instrument, or device identified; purpose of the conductors identified.
 - e. Fastener: nylon-coated 48-mil stainless steel wire. Manufacturer: Brady catalog number 23310 or equal with double ferrule type brass wire clamps. Manufacturer: Brady number 23312.

J. General Raceway Requirements:

1. Provide additional pullboxes for conduit runs with greater than 360 degrees in any run between pull boxes. Limit maximum conduit runs without additional pullboxes to 400 feet, less 100 feet for every 90 degrees for the conduit run change in direction.
2. Determine conduit routing that conforms to the installation requirements set forth herein and in accordance with the NEC requirements for size and number of pullboxes. The RACESPEC sheets with specified requirements begin on the next page.

2.03 RACEWAY SPECIFICATION SHEETS (RACESPEC) - RMC-STEEL

A. Raceway Identification:

1. RMC-Steel

B. Description:

1. Rigid Steel Conduit

- C. Compliance:
 - 1. ANSI C80.1, UL 6
- D. Finish:
 - 1. Hot-dip galvanized after fabrication, inside and outside. Smooth finished surfaces.
- E. Manufacturers:
 - 1. Allied Tube and Conduit Corp., Wheatland Tube Co., or equal.
- F. Minimum size:
 - 1. Unless otherwise shown: 3/4-inch for exposed; 1-inch for concealed or embedded; 2-inch for ductbank encased.
- G. Fittings:
 - 1. Hubs:
 - a. Insulated throat with bonding locknut, hot-dip galvanized. The hubs shall utilize a neoprene "O" ring and shall provide a watertight connection. O-Z Gedney, CHM-XXT, or equal.
 - 2. Unions:
 - a. Electro-galvanized ferrous alloy type Appleton UNF or UNY, Crouse-Hinds UNF or UNY, or equal. Threadless fittings are not acceptable.
- H. Boxes:
 - 1. Indoor:
 - a. Type FD cast ferrous for all device boxes and for junction boxes less than 6 inches square. NEMA-12 welded steel 6 inches square and larger. Door shall have hinges with clamp locks. Boxes in process areas shall be NEMA-4 watertight. Boxes in corrosion areas shall be NEMA-4X.
 - b. Conduit bodies: ferrous alloy type with screw taps for fastening covers. Gaskets shall be made of neoprene.
 - 2. Outdoor:
 - a. Type FD cast ferrous for all device boxes and for junction boxes less than 6 inches square. NEMA-4X stainless steel nonmetallic for 6 inches square and larger.
- I. Elbows:
 - 1. (3/4" thru 2.5")
 - a. Factory fabricated or field bent.
 - 2. (3" thru 6")
 - a. Factory fabricated.
- J. Conduit Bodies:
 - 1. (3/4" thru 4")
 - a. Malleable iron, hot-dip galvanized, unless otherwise noted. Neoprene gaskets for all access plates. Tapered threads for all conduit entrances.
 - 2. (5" and 6")
 - a. Electro-galvanized iron or cast iron box.

K. Expansion Fittings:

1. Expansion fittings in embedded runs shall be watertight and shall be provided with an internal bonding jumper. The expansion material shall be neoprene and shall allow for 3/4-inch movement in any direction.

L. Manufacturers:

1. Appleton, Crouse-Hinds, Hubbell, O. Z. Gedney, or equal.

M. Installation:

1. Rigid steel conduit shall be made up tight and without thread compound. Joints shall be made with standard couplings or threaded unions. Steel conduit shall be supported away from the structures using hot-dip galvanized malleable iron straps with nesting backs.
2. Conduit entering boxes shall be terminated with a threaded hub as specified or standard fittings with grounding bushing.
3. Exposed male threads on rigid steel conduit shall be coated with zinc-rich paint.

2.04 RACEWAY SPECIFICATION SHEETS (RACESPEC) - LFMC

A. Raceway Identification:

1. LFMC

B. Description:

1. Liquid-Tight Flexible Metal Conduit

C. Application:

1. Final connection to equipment subject to vibration or adjustment.

D. Compliance:

1. UL 360

E. Construction:

1. Spirally wound galvanized steel strip with successive convolutions securely interlocked and jacketed with liquid-tight plastic cover.

F. Minimum size:

1. 3/4 inch

G. Fittings:

1. Cadmium-plated malleable iron body and gland nut with cast-in lug, brass grounding ferrule threaded to engage conduit spiral and O-ring seals around the conduit and box connection and insulated throat. Forty-five and 90-degree fittings shall be used where applicable.

H. Installation:

1. Do not exceed 36-inch length.

2.05 RACEWAY SPECIFICATION SHEETS (RACESPEC) - RNC40

- A. Raceway Identification:
 - 1. RNC40
- B. Description:
 - 1. Rigid Nonmetallic Conduit, heavy wall thickness for direct bury, concrete encasement or surface mounting where not subject to physical damage. DZYR per NEC Article 352.
- C. Compliance:
 - 1. NEMA TC2, UL 651
- D. Construction:
 - 1. Schedule 40, high-impact, polyvinyl-chloride (PVC)
- E. Minimum size:
 - 1. 3/4 inch exposed; 2-inch embedded or encased
- F. Fittings:
 - 1. PVC solvent weld type
- G. Boxes:
 - 1. Outdoor and corrosive:
 - a. NEMA Class 4X, nonmetallic
- H. Installation:
 - 1. PVC conduit entering fiberglass boxes or cabinets shall be secured by threaded bushings on the interior of the box and shall be terminated with a threaded male terminal adapter having a neoprene O-ring. Joints shall be made with standard PVC couplings.
 - 2. PVC conduit shall have bell ends where terminated at manholes, handholes, or building walls. Bell ends shall terminate flush at the walls and floors and not extend or protrude.

2.06 RACEWAY SPECIFICATION SHEETS (RACESPEC) - PVC COATED RMC-STEEL

- A. Raceway Identification:
 - 1. PVC Coated RMC-Steel
- B. Description:
 - 1. Rigid Steel Conduit, Corrosion-Resistant, Polyvinyl Chloride (PVC) Coated
- C. Compliance:
 - 1. ANSI C80.1, UL 6
- D. Finish:
 - 1. Hot-dip galvanized rigid steel conduit, to which a minimum 40-mil thick PVC coating has been bonded to the outside of the conduit. A 2-mil coat of urethane coating shall

be bonded to the inside. Coating shall be free of pinholes. Bond strength shall exceed the tensile strength of the PVC coat. Elbows and fittings shall be factory made and coated.

- E. Fittings: (includes unions, conduit bodies and expansion fittings)
1. Refer to RACESPEC RMC-Steel for additional requirements. Similarly coated to the same thickness as the conduit and provided with type 316 stainless steel hardware. Conduit and fittings shall be manufactured by the same company.
 - a. Hubs:
 - 1) Hubs for connection of conduit to junction, device, or terminal boxes shall be threaded with the same PVC coating as the conduit and provide a watertight connection.
 - b. Boxes:
 - 1) Refer to RACESPEC RMC-Steel. FD boxes shall be PVC coated.
 - c. Elbows:
 - 1) Refer to RACESPEC RMC-Steel.
- F. Manufacturers:
1. PVC coated conduit shall be by Robroy Industries, PLASTI-BOND RED; Occidental Coating Company (OCAL), or equal.
- G. Installation:
1. Plastic coated conduit shall be made up tight, threaded, and installed using tools approved by the conduit manufacturer.
 2. Conduit threads shall be covered by a plastic overlap which shall be coated and sealed per manufacturer's recommendations. Painted fittings are not acceptable.
 3. Pipe wrenches and channel locks shall not be used for tightening plastic coated conduits. Damaged areas shall be patched, using manufacturer's recommended material.

2.07 CONDUCTORS, WIRE, AND CABLE

- A. Provide products specified.
- B. Unscheduled Conductor Sizing:
1. Size conductors, wire, and cables in accordance with the National Electrical Code where not specified on the Drawings and install in the minimum size raceway as specified in the RaceSpecs herein.
- C. Control Wire Color Coding:
1. Provide control wires with the following colors for the shown voltage:

120 Vac Power, line and load	Black
120 Vac Control	Red
24 Vac	Orange
12 Vac	Brown
Foreign Voltage (AC) (Interlock)	Yellow
AC Neutrals	White

Ground	Green
24 VDC (+ & -)	Violet
12 VDC (+ & -)	Blue
Foreign Voltage (DC)	Violet/White or Blue/White

D. Power Conductors:

1. Provide power conductors with following colors for the shown voltage:

Wire	480Y/277V, 3Ø	208Y/120V, 3Ø	240/120V, 3Ø
Phase A	Brown	Black	Black
Phase B	Orange	Red	Orange per NEC 408.3(E) and 215.8
Phase C	Yellow	Blue	Blue
Ground	Green	Green	Green
Neutral	White or Gray per NEC 210.4(D)	White	White

2. Provide black insulation conductors larger than #10 AWG with colored 3/4-inch vinyl plastic tape to identify the phase color at each cable termination. Tape wrap with 25 percent overlay to provide minimum of 3 inches of coverage.

E. Scheduled and Unscheduled Wire and Cable:

1. Provide the insulation and jacket material specified in the CABLESPEC sheets for scheduled and unscheduled (not shown) conductors. Provide stranded copper conductors for all wire and cable.

F. Electrical Enclosure Conductor Ratings:

1. Provide conductors with 600-volt insulation ratings in panels and other electrical enclosures. Conductors with less than 600-volt insulation ratings are prohibited, unless specifically identified.
2. Bundle and lace conductors in panels and electrical equipment at intervals not greater than 6 inches, spread into trees and connected to their respective terminals. Provide lacing using plastic cable ties that are tensioned and cut off using a tool specifically designed for the purpose such as a Panduit GS2B. Other methods of cutting cable ties are prohibited.
3. Bundle conductors crossing hinges into groups not exceeding 10 to 15 conductors and protected using nylon spiral flexible covers to protect conductors and provide oversized plastic panel wiring duct within panels.
4. Provide slack in junction boxes, pull boxes, handholes and manholes sufficient to allow cables or conductors to be routed along the walls with the amount of slack equal to largest dimension of the enclosure.
5. Provide dedicated electrical wireways and insulated cable holders mounted and secured on stainless steel unistrut in manholes and handholes.

G. Instrument Signal Cable:

1. Provide terminal blocks at instrument cable junctions within dedicated terminal boxes provided by the installer. Provide twisted shielded cable with individual shield for each pair. Provide twisted shielded cable multi-pair with overall shield and jacket.

Provide triads wherever 3-wire circuits are required. Circuits shall not be made using conductors from different pairs or triads.

2. Install instrument, signal, and data communication circuits without splices between instruments, terminal boxes, or panels. Shields as a signal path, except for circuits operating at radio frequencies and utilizing coaxial cables are not acceptable. Common ground return conductors for two or more circuits are not acceptable.
3. Bond shields to the signal ground bus at the control panel. Isolate shields from ground and other shields at other locations by cutting short or taping. Provide terminal strips for signal leads and shield drain wires.
4. Terminate spare circuits and the shield drain wire on terminal blocks at both ends of the cable run. Shields or drain wires for spare circuit cables shall be bonded at control panel only with the other end insulated by tape cover.
5. Provide an instrument stand with terminal box mounted approximately 3 feet above grade to center or as shown. Provide terminal boxes for instrument cable with the cable and conductor labels specified.
6. Install and terminate conductors for paging, security, data communication, voice communication, and telephone systems in compliance with the manufacturer and the system utility recommendations.

H. Splicing and Terminating Materials:

1. Use an UL listed tool for the applied compression type of connectors with the correct size and type. Provide tin-plated high conductivity copper connectors. Mechanical clamp, dimple, screw-type connectors are prohibited.
2. Provide polymeric insulating material over motor terminations with high dielectric strength mastic or material to seal the ends against ingress of moisture and contamination.
3. Cover splices with electrical products designed for the application and insulate with a heat-shrinkable sleeve or boot.

I. Circuit Numbering Marking System:

1. Identify each power, control, and signal conductor at each terminal connection. Machine print the letters and numbers with black on white alphanumeric characters representing the circuit numbering system.
2. Identify conductors, including spares. Provide cable markers and wire markers for distribution and utilization equipment circuits identifying the power source and circuit source from which it is served.
3. Provide the identification system of vinyl power cable strap-on cable markers, vinyl multi-conductor control cable strap-on cable markers, and vinyl or polyolefin wire slip-on sleeves and encircle the conductor.
4. Provide conductor marker used in outdoor, damp, or wet locations on heat-shrinkable polyolefin shrinkable marking sleeves covered with clear heat-shrink sleeve or clear tape cover.
5. Print conductor markers using the Brady Marker "XC PLUS", the Brady LS2000 printer with the Brady sleeve wire marking system, or Engineer accepted equal.

J. Terminal Blocks:

1. Provide terminal blocks with the following features:
 - a. Voltage rated: 600 volts.

- b. Current rated: match largest conductor connected to the assembly.
- c. Integral marking strips.
- d. Terminal block assemblies: provide with mounting channels, barriers, and end clamps.
- e. Power and grounding terminal blocks: solderless box lug type.
- f. Control and signal terminal blocks. Manufacturer: Allen-Bradley 1492-HM1GY, NEMA type, 30-ampere.
- g. DIN-rail mount for direct wiring into terminal blocks.
- h. Pre-printed snap-in markers.

2.08 CABLE SPECIFICATION SHEETS (CABLESPEC)

A. CABLESPEC Sheets

1. The following CABLESPEC sheets are included in this section:

Type	Volt	Product	Purpose
SIC	600	P-OS: 1-PR#16SH OR 1-TR#16SH (TC)	Instrument
XHHW-2	600	XLP Insulated Industrial Grade Conductor	Power cable

2.09 CABLE SPECIFICATION SHEETS (CABLESPEC) – SIC

A. Cable System Identification:

1. SIC

B. Description:

1. Single twisted, shielded pair or triad, 16 AWG, instrumentation and signal cable, UL listed

C. Voltage:

1. 600 volts

D. Conductor Material:

1. Bare annealed copper; stranded in accordance with ASTM B8

E. Insulation:

1. 15 mil, 90 degree C, polyvinylchloride (PVC) with 4 mil nylon conduit or jacket

F. Lay:

1. Twisted on a 2-inch lay

G. Shield:

1. 100 percent, 1.35 mil aluminum-Mylar tape with a 7-strand tinned copper drain wire

H. Jacket:

1. 45 mil polyvinylchloride (PVC)

- I. Flame Resistance:
 - 1. UL 1277
- J. Manufacturer(s):
 - 1. Okonite, Okoseal-N type P-OS; or Cooper Industries-Belden equal
- K. Execution:
 - 1. Installation:
 - a. Install in accordance with Section 26 05 00.01
 - 2. Testing:
 - a. Megger Test: use Form in Section 01 99 90

2.10 CABLE SPECIFICATION SHEETS (CABLESPEC) – XHHW-2

- A. Cable System Identification:
 - 1. XHHW-2
- B. Description:
 - 1. Industrial grade single conductor
 - 2. Sizes: 14 AWG through 750 kcmil as shown
- C. Voltage:
 - 1. 600 volts
- D. Conductor Material:
 - 1. Bare annealed copper; stranded per ASTM B8
- E. Insulation:
 - 1. NEC Type XHHW-2, 90 degrees C dry or wet, Cross-Linked Polyethylene (XLP) per ICEA S-66-524 and UL-44, Color in sizes 14, 12 and 10 AWG: Black, Green, Yellow, White, Orange, Brown, Red, Blue
- F. Jacket:
 - 1. None
- G. Flame Resistance:
 - 1. UL 83
- H. Manufacturer(s):
 - 1. Okonite, X-Olene; Cablec, Durasheath XLP; or equal.
- I. Uses Permitted:
 - 1. Power, control, lighting and outlet circuits.
- J. Execution:
 - 1. Installation:
 - a. Install in accordance with Section 26 05 00.01.

2. Testing:
 - a. Test in accordance with paragraph 26 05 00.01-3.02 and Section 26 05 00.01.

2.11 WIRING DEVICES

- A. Unless specified otherwise, provide UL approved wiring ivory devices for the current and voltage ratings specified and comply with NEMA WD-1 with provisions for back wiring and side wiring with captive held binding screws.
- B. Switches:
 1. Indoor Switches: Quiet AC type, heavy duty, specification grade in accordance with rated capacities as required. Match the switch color and the receptacles color. Manufacturer: Cooper, Hubbell, or equal.
 2. Switches for Outdoor and Corrosive Areas: Provide 20-ampere, push-type switches; Cooper Tap-Action, Hubbell PressSwitch, or equal.
- C. Device Plates: Provide device plates with switches and receptacles that match the area classification location.
 1. Indoor, NEMA-12 Areas: In areas designated NEMA-12, or other areas specified provide hinged covers with neoprene gaskets. Manufacturer: Hubbell, Cooper, or equal.
 2. Outdoors: Provide corrosion-resistant/marine-duty stainless steel type covers. Manufacturer: Hubbell, or equal.
 3. In-Use Covers: In areas designated NEMA-4X, Corrosive, or other areas specified, and in outdoor areas, provide in-use type weatherproof lift covers that maintain weatherproof rating with plug installed for equipment that is cord connected with plug and receptacle. Covers shall be cast aluminum. Manufacturer: Outdoor, NEMA 4X areas: In-use covers shall be Hubbell WP7, WP8, WP26, or equal. Corrosive areas; Manufacturer: TayMac Corporation 20510, Carlon E9UXXXX, Hubbell WP826XXX, or equal.
 4. Wet Area Switch Covers: In outdoor, areas, wet areas, areas designated NEMA-4X, Corrosive, or other areas specified, provide weatherproof, corrosion-resistant covers for switches to maintain weatherproof rating during operation of switch. Covers shall have flexible bubble of silicone or neoprene rubber for switch operation. Manufacturer: Cooper, Hubbell, or equal.
- D. Pilot Devices:
 1. Provide heavy-duty push buttons, selector switches and indicating lights: 30mm, oil-tight, NEMA 4X. Indicating lights shall be light emitting diode (LED) type lamps. Unless otherwise shown, provide push-to-test type indicating lights. Provide diode isolating type pilot indicating lights specified for remote-test. Provide red indicating lamps for "RUN" indication and green indicating lamps for "STOP".
 2. Provide 120VAC control units: heavy-duty type Allen-Bradley 800H, or equal. For 24VDC: Allen-Bradley 800T, Square-D Class 9001 Type J, or equal.

2.12 GROUNDING SYSTEM

- A. Provide electrical system grounding electrode conductors, equipment grounding conductors for equipment grounding and raceways, grounding electrodes, grounding

electrode conductors, connections, and bonding in compliance with the National Electrical Code-Article 250 and the National Electrical Safety Code.

- B. Provide annealed bare copper, concentric stranded grounding conductors. Provide the minimum sizes per NEC Article 250 for grounding conductors or service entrance conductors, if not sized on the drawings.
- C. Bond grounding conductors entering enclosures together to metallic enclosure and to metallic raceways terminating at the enclosure. Clean the conductor and enclosure metal surface at the point of connection prior to making equipment grounding connections or bond connections.
- D. Compression Connectors:
 - 1. Compression connections: cast copper.
 - 2. Manufacturer: Thomas & Betts Company, or equal.
- E. Raceway Ground:
 - 1. Install metallic conduits to provide a continuous ground path. Use insulated grounding bushings and bonded to the ground grid system in compliance with Article 250 of the National Electrical Code.
 - 2. Provide an equipment-grounding conductor with green insulation in all metallic and non-metallic conduit, raceway, wireway, gutter, or ductbanks.
 - 3. Provide an equipment grounding conductor with green insulation for size up to #6 AWG and provide green color insulation tape band for conductor size #4 AWG and larger.

2.13 POWER, CONTROL, AND METERING EQUIPMENT

- A. Circuit Breakers:
 - 1. Provide circuit breakers: molded-case type provided for the current ratings and pole configurations as shown or as specified on the panelboard schedule and with a minimum interrupting current rating as shown on drawings or schedules.
 - 2. Provide circuit breakers listed in accordance with UL 489 for the service specified and load terminals with solderless connectors. Provide bolt-on type circuit breakers. Provide circuit breakers with machine-printed, circuit number labels indicating the load served.
- B. Safety Disconnect Switches:
 - 1. Provide safety disconnect switches:
 - a. Motor horsepower rated, heavy-duty, non-fusible
 - b. Safety type rated 600 volts AC
 - c. Ratings and fuse size as shown
 - d. Rating and fuse size as required by the utilization equipment manufacturer
 - e. Disconnect "open status" switch rated 1-ampere
 - f. Switch operator with a positive, quick-make, quick-break mechanism
 - g. NEMA-12 indoor-conditioned space, or as shown
 - h. NEMA-4X stainless steel below grade, process areas, outdoors, corrosive areas, or as shown

- i. Tinplated copper products. Silver-plated products are prohibited.
- j. Manufacturer: Square-D, GE, Allen-Bradley and Cutler Hammer or approved equal.

PART 3 – EXECUTION

3.01 GENERAL

A. Construction:

1. Perform the work specified by Contract Documents in accordance with these specifications.
2. Coordinate the location of electrical material or equipment with the work and adjust conduit location to accommodate equipment in accordance with the accepted submittal drawings from the manufacturer.

B. Housekeeping:

1. Protect electrical equipment from dust, water and damage. Cover the exterior to keep dry. Electrical distribution equipment such as motor control centers, switchgear, switchboards, panelboards, and other power source buses shall be clean and free of dust and dirt.
2. Protect electrical equipment temporarily exposed to weather, debris, liquids, or damage during construction as specified in Shipment, Protection, and Storage section. Touch up scratches on equipment as specified in Coating Systems section before final acceptance.
3. Wipe clean and vacuum equipment on the inside prior to acceptance testing and energization and again prior to detailed inspection and acceptance of the work.

C. Installation:

1. Perform the installation work specified in accordance with these specifications.
 - a. Splices are not allowed except by permission. Submit proposed splice locations to the Engineer and Construction Manager for review prior to installation. Splices and terminations are subject to inspection prior to and after insulating and may require re-termination after inspection. Underground splices will not be allowed.
 - b. Lighting and receptacle circuits may be in the same conduit in accordance with derating requirements of the NEC. Lighting and receptacle circuits in conduits with power or control conductors is prohibited.
 - c. Adhere to the NEC raceway fill limitations. Provide separate conduits for signal and instrument conductors and cables.
 - d. Install power conductors derived from uninterruptible power supply systems in separate raceways.
 - e. Provide terminations at 460-volt motors by bolt-connecting the lugged connectors and insulating. Alternately, provide Tyco Electronics GelCap Motor Connection Kit by Raychem.
 - f. Install **pre-approved** in-line splices and tees with tubular compression connectors and insulate. Splices and tees in underground handholes or pull boxes shall be insulated using Scotch-cast epoxy resin splicing kits.

- g. Provide self-insulating tubular butt-splice type of compression connectors for terminations at solenoid valves, 120-volt motors, and other devices furnished with pigtail leads.
- h. Adjust motor circuit protectors in accordance with manufacturer's instructions and NEC requirements.
- i. Adjust motor overload device in accordance with manufacturer's instructions and NEC requirements.

D. Conductors, Wire, and Cable Installation:

- 1. Identify conductors at each connection terminal and at splice points with the identification marking system specified.
- 2. Install wire and cable into raceways, conduit, cable trays, or wireways without damaging or putting undue stress on the insulation or jacket. Provide manufacture's recommended and UL Listed pulling compounds lubricants for pulling wire and cable. Grease is prohibited.
- 3. Raceway construction shall be complete, cleaned, and protected from the weather before cable is installed. Provide wire or cable support where wire or cable exits a raceway. Provide reusable stainless steel Kellums grips or equal product where cable support is required and where loads are removable.
- 4. Scratch-brush the contact areas and tinplate the connection where flat bus bar connections are made with tinplated or unplated flat bus bar. Provide non-oxide material approved for the function. Torque bolts to the bus manufacturer's recommendations.
- 5. Adhere to raceway fill limitations defined by NEC and the following: Lighting and receptacle circuits may be in the same conduit in accordance with de-rating requirements of the NEC. Lighting and receptacle circuits shall not be in conduits with power or control conductors. Signal conductors shall be in separate conduits.
- 6. Install pre-approved in-line splices and tees made with tubular compression connectors and insulated as specified for terminations and for motor terminations. Splices and tees in underground handholes or pull boxes shall be insulated using Scotch-cast epoxy resin or equal splicing kits.
- 7. Conductors in all handholes and manholes shall have adequate slack to be tied up around the perimeter of the vault and will be suspended by insulators around the vault's perimeter as needed to support the cable.

E. Raceway Installation:

- 1. Provide additional pullboxes for conduit runs with greater than 360 degrees in any run between pull boxes. Limit maximum conduit runs without additional pullboxes to 400 feet, less 100 feet for every 90 degrees for the conduit run change in direction.
- 2. Determine conduit routing that conforms to the installation requirements set forth herein and in accordance with the NEC requirements for size and number of pullboxes.
 - a. Install exposed conduit either parallel or perpendicular to structural members and surfaces.
 - b. Route two or more exposed conduits in the same general routing parallel with symmetrical bends.
 - c. Install exposed conduit on supports spaced not more than 10 feet apart.

- d. Install conduits out from the wall using framing channel where three or more conduits are located in parallel run.
- e. Install conduits between the reinforcing steel in walls or slabs that have reinforcing in both faces. Verify installation method for conduits larger than 2-inch with Construction Manager prior to installation.
- f. Install conduit in slabs that have only a single layer of reinforcing steel, under the reinforcement.
- g. Install conduits with large radii under the slab in a one-sack concrete slurry.
- h. Route conduit clear of structural openings and shown future openings.
- i. Provide conduit roofs or wall penetrations with flashing sealed watertight and fire-stop, as required to maintain the structural rating.
- j. Grout conduit into any openings cut into concrete and masonry structures.
- k. Cap conduits during construction to prevent entrance of dirt, trash, and water.
- l. Terminate exposed conduit stubs for future use with pipe-caps and provide couplings and pipe-plugs where flush with the slab.
- m. Determine concealed conduit stub-up locations from the manufacturer's shop drawings.
- n. Terminate conduit in equipment with conduit couplings with pipe-plugs flush with structural surfaces for empty conduit.
- o. Install conduit horizontally with at least 7-feet headroom clearance.
- p. Terminate conduit with fittings that ensure that the NEMA rating of the enclosure and provide conduit hubs, as required heretofore.
- q. Connect underground metallic or nonmetallic conduit that turns out of concrete, masonry, or earth to a 90-degree elbow of PVC-coated rigid steel conduit before emergence. Taped or painted RMC-Steel or RNC is prohibited.
- r. Provide conduit crossing structural joints with structural movement with O-Z "Type DX" or Crouse-Hinds "Type XJG-SA," aluminum, bonded, weather-tight expansion fitting of the same size and type as the conduit.
- s. Seal conduits in corrosive areas using removable mastic material.

F. Underground Raceway Installation:

- 1. Adhere to the Power Utility underground service entrance requirement for excavation, raceways installation and termination, pads and reinforcement, backfilling, and location criteria. Provide excavation, backfilling, and concrete work as specified and shown.
- 2. Provide underground conduit installations that conform to the following requirements:
 - a. Direct bury underground conduits that are not shown to be installed in an electrical ductbank.
 - b. PVC coated RMC-steel elbows for underground to above ground transitions.
 - c. Underground conduit bend radius: not less than 2 feet minimum at vertical risers nor less than 3 feet elsewhere for up to 2-inch diameter conduit.
 - d. Determine conduit manufacturer's bending radius requirement for 3-inch and larger diameter conduit and use factory "long radius" ells.
 - e. Underground ductbanks and direct-buried conduits: 2-feet minimum earth cover, except where shown otherwise.

- f. Concrete encased conduit:
 - 1) Minimum concrete thickness of 2 inches between conduits 2.5-inch and smaller
 - 2) 3 inches between 3-inch conduit and larger or per NEC requirements.
 - 3) 1-inch between conduit and reinforcing.
 - 4) 3 inches over reinforcing.
 - 5) Embed #4/0 bare ground in the concrete encasement and installed with direct buried raceways.
 - 6) Standard detail or typical details shown supersede these general requirements.
 - 7) Provide 3-pounds of red-oxide dye-color per sack of cement for in the concrete encasement for electrical ductbanks.
 - 8) Provide 467-ASTM coarse aggregate size with 3-cement sacks per cubic yard concrete.
 - 9) Provide concrete with 28-day, 2000-psi compressive strength unless specified at higher value in the cast-in-place concrete specification.

G. Electrical Equipment Labeling – Arc Flash

- 1. Electrical equipment shall have field marked signs and labeling to warn qualified persons of the potential electric arc flash hazards per NEC Article 110.16 Flash Protection. These labels will be provided by the Contractor.

3.02 TESTING

- A. Provide electrical equipment acceptance tests in accordance with the latest version of NETA Acceptance Testing Specification for electrical distribution and utilization equipment to demonstrate that all electrical equipment is functioning as designed.
- B. Test lighting system for proper function. Test wiring devices for correct connections. Test outlet grounding and polarity using a plug-in test device. Test motor control stations and control devices for proper function.
- C. Test power, control, instrument, and signal conductors to verify free from grounds. Megger test all conductors with the test voltage appropriate to the conductor insulation voltage. Use a 600 or 1,000-volt megohmmeter for resistance measurements for 600VAC rated insulation and all motors. Test between conductors and from conductor to ground. Insulation with resistance of less than 10-megohms is not acceptable. Record the insulation resistance measurements in a format similar to or on the Form 26 05 00.01-A in Section 01 99 90.
- D. Pre-test conductors prior to installation, as appropriate. Replace damaged conductors. Test all conductors after installation.
- E. Measure motors insulation resistance before they are connected.

3.03 FUNCTIONAL CHECKOUT

- A. Prior to energization of equipment, perform a functional checkout of the control circuit. Prior to functional testing, adjust and make protective devices operative. Energizing each

control circuit and operating each control, status, alarm, protective device, and each interlock to verify that the specified action occurs. Submit a description of his proposed functional test procedures prior to the performance of functional checkout.

- B. Verify motors are connected to rotate in the correct direction by momentarily energizing the motor. Prior to motor rotation test, confirm that the motor, the driven equipment, nor personnel will be damaged by reverse operation.

END OF SECTION

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SECTION 26 05 05
SELECTIVE DEMOLITION FOR ELECTRICAL

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Selective Demolition for Electrical
- B. CONTRACTOR Shall Coordinate all Demolition Work With:
 - 1. The OWNER and their electrical safety plan and/or procedures.
 - 2. The OWNER and their Plant Manager and Operations.
 - 3. Systems Integrator for removal of instruments, control equipment and systems as shown or specified.
 - 4. Work of other CONTRACTORS, trades and with the Construction Administrator.
- C. Conditions:
 - 1. Perform preliminary investigations as required to ascertain extent of work and planning/coordination requirements. Conditions which would be apparent by such investigation will not be allowed as cause for claims for extra costs.
 - 2. See plans for extent of work and associated demolition in addition to this section.

1.02 RELATED SECTIONS

- A. This section contains specific references to the following related sections. Additional related sections may apply that are not specifically listed below.
 - 1. General Clauses and Special Clauses
 - 2. Division 1 - General Requirements
 - 3. Division 2 - Existing Systems
 - 4. Division 3
 - a. Section 03 01 00 - Concrete Repair
 - b. Section 03 60 00 - Grouting
 - 5. Division 26 - Electrical

1.03 REFERENCES

- A. This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
NEIS NECA 1	Standard for Good Workmanship
NFPA 70	National Electrical Code
NFPA 70E	Standard for Electrical Safety in the Workplace

1.04 DEFINITIONS

- A. Terminology used in this Section conforms to the following definitions:
1. Demolish: Detach items from existing construction and legally dispose of items off site, unless indicated as removed and salvaged, or removed and reinstalled.
 2. Remove: Planned deconstruction and disassembly of electrical items from existing construction including removal of conduit, junction boxes, cabling and wiring from electrical component to panel taking care not to damage adjacent assemblies designated to remain; legally dispose of items off site, unless indicated as removed and salvaged, or removed and reinstalled.
 3. Remove and Salvage: Detach items from existing construction and deliver them to OWNER ready for reuse.
 4. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.
 5. Abandon-In-Place: Render item permanently nonoperational in its existing location, detach from any existing construction and cease to maintain.
 6. Existing to Remain: Existing items of construction that are not removed and that are not otherwise indicated as being removed and salvaged, or removed and reinstalled.
 7. Hazardous Substances: Dangerous substances, dangerous goods, hazardous commodities and hazardous products may include asbestos, mercury and lead, PCBs, poisons, corrosive agents, flammable substances, radioactive substances, or other material that can endanger human health or wellbeing or environment if handled improperly as defined by Federal Hazardous Products Act (RSC 1985) including latest amendments.

1.05 ADMINISTRATIVE CONTROLS

- A. Coordination:
1. See Section 01 12 16 Work Sequence.
 2. Coordinate work of this Section to avoid interference with work by other Sections.
 3. Coordinate with OWNER in advance for scheduling removal of items.
- B. Pre-demolition Meetings:
1. Schedule Pre-demolition meeting with OWNER and ENGINEER.
 2. Safety plan(s) and de-energization as required.
 3. Review areas where existing construction is to remain and requires protection.
 4. OWNER shall be given the opportunity to retain any of the equipment in the areas being demolished. Confirmation of any salvage items will take place at this meeting.

1.06 SUBMITTALS

- A. Action Submittals:
1. Procedures: Section 01 33 00.
 2. Landfill Records: Indicate receipt and acceptance of selective demolition waste and hazardous wastes by a landfill facility licensed to accept hazardous wastes.
 3. Schedule of Demolition Activities: Schedule the following activities in conjunction with the requirements of Section 01 12 16:

- a. Detailed sequence of demolition and removal work, with starting and ending dates for each activity. Ensure OWNER's on-site operations are uninterrupted.
 - b. Coordination plan by plant process or area.
 - c. Provisions for temporary systems.
 - d. List of equipment effected.
 - e. Contingency plans or systems.
 - f. Lockout/tagout procedures and permissions.
4. Pre-demolition Photographs or Video: Submit before work begins.

1.07 QUALITY ASSURANCE

- A. Perform work in this section in accordance with:
 - 1. Code of Federal Regulation Part 1926 - Safety and Health Regulations for Construction.
 - 2. Site-specific health and safety guidelines.

1.08 SITE CONDITIONS

- A. Condition of materials identified as being salvaged or demolished are based on their observed condition at time of site examination.
- B. Discovery of Hazardous Substances:
 - 1. It is not expected that Hazardous Substances will be encountered in the work. Immediately notify OWNER if materials suspected of containing hazardous substances are encountered.

1.09 SALVAGE AND DEBRIS MATERIAL

- A. Demolished items become CONTRACTOR's property and will be removed from Project site; except for items indicated as being reused, salvaged, or otherwise indicated to remain the OWNER's property.
- B. Carefully remove materials and items designated for salvage and store in a manner to prevent damage or devaluation of.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Materials used to cover blank openings in NEMA 4X panels, boxes and equipment enclosures:
 - 1. Polished edge, sheet stainless steel equivalent to gauge of enclosure.
 - 2. Provide neoprene gasket or silicone-based caulk to maintain NEMA rating.
- B. Materials used to cover blank openings in NEMA 7 boxes and equipment enclosures:
 - 1. Material must match box or enclosure.
 - 2. Must be threaded or have labyrinth type seals to maintain NEMA 7 construction integrity.

- C. Materials used to cover blank openings in NEMA 1, 3R, 4 and 12 panels, boxes and equipment enclosures:
 - 1. Provide plugs or fittings that will maintain the NEMA construction integrity.
 - 2. Tape shall not be allowed to cover blank openings.
 - 3. Primed and painted to match enclosure.
 - a. Provide neoprene gasket or silicone-based caulk to maintain NEMA rating.
- D. Conduit Caps and Plugs:
 - 1. Same material as conduit.
 - 2. Glued or threaded as required.
 - 3. Tag conduit as SPARE and the destination equipment tag.
- E. Insulating Materials:
 - 1. Refer to Section 26 05 19 Low Voltage Electrical Power Conductors and Cables for wire and cable.

PART 3 EXECUTION

3.01 GENERAL

- A. Provide partitions, barricades, warning lights, signage and other means necessary to ensure the safety of persons inside and outside of the area of work in accordance with NFPA 70E.
- B. Pre-Bid Verification of Existing Conditions:
 - 1. Visit site, thoroughly examine and become familiar with conditions that may affect the work of this Section before submitting the Bid.
- C. Ensure the integrity of all enclosures containing energized conductors or equipment is maintained during demolition. Provide barriers or covers over all openings during all phases of work.
- D. Protect property to prevent damage during demolition.
- E. Promptly cleanup and remove from site all material to be disposed.
- F. Dispose of all materials in accordance with federal, state and local laws.

3.02 PREPARATION

- A. Protect systems and components indicated to remain in place during selective demolition operations and as follows:
 - 1. Prevent movement and install bracing to prevent settlement or damage of adjacent services and parts of existing buildings scheduled to remain.
 - 2. Notify OWNER and cease operations where safety of buildings being demolished, adjacent structures or services appears to be endangered and await additional instructions before resuming demolition work specified in this Section.
 - 3. Prevent debris from blocking drainage inlets.
 - 4. Protect mechanical systems that will remain in operation.

5. Demolition drawings are based on limited visual field observation and existing record documents:
 - a. CONTRACTOR shall field verify all existing systems as required for demolition.
 - b. Verify field measurements and circuiting arrangements are as indicated.
 - c. Verify that abandoned wiring and equipment serve only abandoned facilities or systems.
 - d. Report discrepancies to Engineer before disturbing existing installation.
6. Maintain existing electrical system(s) in service until new system is complete and ready for service.
 - a. Provide temporary wiring and connections to maintain existing systems in service during demolition.
 - b. Coordinate utility service outages with Utility Company to minimize length and number of outages.
7. Beginning of demolition means installer accepts existing conditions.

3.03 DEMOLITION

A. General:

1. All existing electrical equipment, systems, devices and fixtures to be removed shall be removed with such care as may be required to prevent unnecessary damage, to keep existing systems in operation and to maintain the integrity of the grounding systems.
2. Poles and overhead wiring within the limits of demolition shall be abandoned as shown. Poles shall be completely removed from the site.
3. Unless otherwise shown on the Drawings, specified or directed, the CONTRACTOR shall dispose of all surplus excavated materials and materials and equipment from demolition, legally off the site.

B. Equipment Containing Toxic Substances:

1. Perform work for removal and disposal of equipment and materials containing toxic substances regulated under the Federal Toxic Substances Control Act (TSCA) in accordance with applicable federal, state, and local regulations. Applicable equipment and materials include, but are not limited to:
 - a. Polychlorinated biphenyls (PCB)-containing electrical equipment, including transformers, capacitors, and switches.
 - b. PCB- and Di-ethylhexyl phthalate (DEHP)-containing lighting ballasts.
 - c. Mercury-containing lamps and tubes, including fluorescent lamps, high intensity discharge (HID), arc lamps, ultra-violet, high pressure sodium, mercury vapor, ignitron tubes, neon, and incandescent.

C. Wire and Cable:

1. Remove power and control conductors from conduits and/or trays indicated or as required. Removal shall include conductors in duct banks and direct buried conductors as shown or specified.
2. Conductors tapped from circuits that will remain in service:
 - a. Disconnect conductors from terminals or splices at nearest pull box or equipment enclosure outside of the indicated removal area.

- b. Re-insulate gutter taps or terminals from which conductors have been removed to the original insulation level.
- 3. Conductors of circuits dedicated to equipment which is to be removed:
 - a. Remove power conductors back to panelboard or motor control center and relabel circuit breaker(s) "spare" on schedule.
 - b. Remove control conductors back to nearest control panel outside demolition area. Mark up panel shop drawings by striking through components and wiring removed, sign and date revisions.
- 4. Remove equipment grounding conductor(s) with phase conductors, unless indicated otherwise.

D. Conduit:

- 1. Remove conduit from area indicated back to the nearest pull box, motor control center, or equipment enclosure outside of the indicated area or as noted on the drawings.
- 2. Remove associated straps and supports.
- 3. Provide blank cover over knockouts from which conduit has been removed in indoor enclosures.
- 4. Install square head plug with thread sealing compound in cast enclosure hubs from which conduit has been removed.
- 5. Restore integrity of all floors, roofs or walls penetrated by conduit to be removed.
- 6. Restore fire rating of all partitions penetrated by conduit to be removed.
- 7. Where conduits pass through (perpendicular to surface) walls, roofs, or floors, remove entirely and plug holes in accordance with Section 01 73 29 Cutting and Patching.
- 8. Where conduits are embedded in (parallel to surface) walls, floors or roofs, cut off below surface of concrete, plug conduits and patch concrete.
- 9. For all enclosures abandoned in-place, provide labeling indicating raceway source, "SPARE PULLBOX BACK TO abc-xyz".
- 10. All conductors designated for reuse or reconnection shall be identified as to circuit designation and phase sequence to permit maintaining existing phase relationships upon reconnection.

E. Equipment:

- 1. Disconnect and remove or relocate all equipment indicated.
- 2. Protect equipment to be reused from dust, dirt, impact or other damage during demolition.
- 3. Close all conduit penetration, bus penetrations, or other openings in remaining equipment caused by the removal of equipment indicated.
- 4. Remove equipment anchor bolts by grinding flush with floor surface or top of concrete pad if pad is to remain.
- 5. Where equipment removed leaves openings in walls or floor restore wall or floor to match adjacent construction.
- 6. Where removal of concrete equipment mounting pads is indicated, remove concrete and reinforcing flush to floor and seal exposed concrete surface.

7. Spare space in electrical equipment shall be covered with manufacturer's plates and/or fillers as needed to close and safeguard space/equipment from any/all energized. Spare space shall be labeled as "SPARE" on equipment enclosures and/or schedules.

3.04 SALVAGE OF MATERIALS

- A. Salvage items designated for OWNER's salvage, as a unit.
 1. Clean, list and tag for storage.
 2. Protect from damage and deliver to locations designated.
 3. Salvage each item along with all ancillary equipment required for operation.
- B. Remove items designated for reuse and reuse as a unit.
 1. Clean, tag and deliver to locations designated.
 2. Clean and lubricate moving parts.
 3. Cover openings and surfaces to protect from dirt, debris and damage during construction.
- C. OWNER has the right to first refusal on all salvage items. CONTRACTOR shall remove and dispose of items refused by OWNER. Construction Administrator shall act as an agent of the OWNER in this regard.
- D. Arrange for legal disposal and remove demolished materials to accredited landfill site or alternative disposal site (recycle center) except where explicitly noted otherwise for materials being salvaged for reuse in new construction.

3.05 CLEANING AND REPAIR

- A. Clean and repair existing materials and equipment that remain or that are to be reused.
- B. Panelboards: Clean exposed surfaces and check tightness of electrical connections.
- C. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.

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SECTION 31 09 00
GEOTECHNICAL INSTRUMENTATION AND MONITORING

PART 1 GENERAL

1.01 DESCRIPTION

- A. This Section specifies the requirements for providing, installing, and monitoring of ground movements around excavations and shoring work, as well as movements of existing improvements, utilities, and roadways, before, during and after excavation and shoring operations.
- B. Work shall be performed by a State of Utah Professional Licensed Surveyor, by such methods, instruments, tools, and other materials necessary to perform the Work to the required accuracies.

1.02 REQUIREMENTS

- A. Minimum instrumentation and monitoring requirements are presented herein. Conduct additional instrumentation and monitoring as necessary to comply with the Approved Dewatering Plan and to control the work and ensure the safety of the work.
- B. The CONTRACTOR shall obtain applicable encroachment permits and traffic control permits to perform the work.
- C. Remove or abandon in place all instrumentation in accordance with applicable laws, regulations and guidelines and restore the ground at the completion of the project. As a minimum, instrumentation shall be demolished within five feet of the ground surface.

1.03 DEFINITIONS

- A. SETTLEMENT MONITORING POINTS (SMP) – Each Settlement Monitoring Point shall be attached to the structure being monitored.
- B. CRACK MONITORS. Avongard Tell-tale or approved equal.

1.04 REFERENCES

- A. This Section includes references to the standards as specified in the Contract Documents. They are a part of this Section as specified and modified. In case of conflict between the requirements of this Section and those of the listed documents, the requirements affording the greatest protection to the OWNER shall apply, as determined by the CONSTRUCTION MANAGER.

1.05 SUBMITTALS

- A. Submittals in accordance with the General Conditions and Section 01 33 00.
- B. Permits. List permits, third party approvals, and approval contract submittals required to perform the work.
- C. Submit product data on manufactured survey markers for SMP, and crack monitors.

- D. Description of methods and materials for installing and protecting the instruments.
- E. For all instrumentation installed in borings, submit proposed schedule for installing instruments, detailed step by step procedures for installation, including post installation acceptance test, together with a sample installation record sheet. The installation procedures shall include:
 - 1. Specifications for proposed grout mixtures, including commercial names, proportions of admixtures and water, mixing sequence, mixing methods and duration, pumping methods and tremie pipe type, size and quantity.
 - 2. Drill casing or auger type and size.
 - 3. Method for overcoming buoyancy of instrumentation components during grouting.
 - 4. Method of sealing joints in pipes and casing to prevent ingress of grout.
- F. Prior to commencement of activities submit the following:
 - 1. Submit a copy of the monitoring report form for approval. The results shall be presented in a graphical format showing successive readings and total cumulative vertical movement (i.e., settlement or heave), total cumulative horizontal movement.
 - 2. Submit initial readings.
 - 3. Submit a schedule and outline of procedures and timing for the performance of monitoring.
 - 4. Submit final readings.
- G. During activity, submit a daily monitoring report to the CONSTRUCTION MANAGER on the approved form. Submit SMP, and crack monitoring reports to the CONSTRUCTION MANAGER within 12 hours after the readings are taken. If readings exceed action levels, immediately notify CONSTRUCTION MANAGER and submit monitoring data within 2 hours after readings are taken.
- H. Submit actions to be taken if SMP, and crack monitoring readings exceeds Action Trigger Levels. Submit mitigation plan in the event that SMP, crack monitor Maximum Allowable Reading is exceeded.
- I. Submit close-out report on the approved form.

1.06 QUALITY ASSURANCE

- A. A Professional Land Surveyor registered in the State of Utah shall supervise and direct all survey activities related to monitoring and the establishment of horizontal and vertical control.
- B. Survey for location and elevation shall be performed by individuals with a minimum of 3 years surveying experience performing the type of survey required.
- C. Surveys are to be performed to a minimum horizontal accuracy of 0.02 feet (1/4 inch) and minimum vertical accuracy of 0.01 feet (1/8 inch).

PART 2 EQUIPMENT, PRODUCTS, AND MATERIALS

2.01 PRODUCTS

- A. NOT USED

2.02 MONITORING REPORTS

- A. Monitoring shall be provided on an approved report form. The report form will clearly indicate the following information:
 - 1. SMP, crack monitoring identification number and marker type, and calibration date.
 - 2. Station and offset along the pipe alignment.
 - 3. Initial elevation and horizontal coordinates.
 - 4. Elevation and horizontal coordinates from subsequent readings.
 - 5. Direction of movement.
 - 6. Date and time of readings.
 - 7. Names of the individuals who performed the monitoring.
 - 8. Bench mark and horizontal control point data including identification, location, elevation and horizontal coordinates.
- B. The approved report for shall be used for initial, all daily and close-out submittals.

2.03 INSTRUMENT SCHEDULE

- A. Provide SMP as shown on G-08-1002.

PART 3 EXECUTION

3.01 QUALITY CONTROL

- A. Instrument Installation. Install all instruments within 3 ft of the horizontal location shown on the Contract Drawings or as approved or directed by the ENGINEER.
- B. Should actual field conditions prevent installation of instruments at the location and elevations shown on the Contract Drawings or specified herein, obtain prior acceptance from the ENGINEER for new instrument location and elevation.

3.02 SAFETY REQUIREMENTS

- A. Methods of installing the instrumentation shall be such as to ensure the safety of the work, project participants, the public, third parties, and adjacent property, whether public or private.

3.03 INSTALLATION

- A. SMP shall be located as shown on the Contract Drawings and the Instrumentation Schedule.
- B. Install six (6) crack monitors, at the approximate locations of the SMP and as directed by the ENGINEER, permanently affixed to structure.

3.04 INSTALLATION AND INITIAL READINGS

- A. A minimum of fourteen (14) days prior to activity, install all SMP, crack monitors unless otherwise approved by the Engineer. Survey the SMP for the horizontal and vertical location. Submit the results to the CONSTRUCTION MANAGER.
- B. A minimum of seven (7) days prior to activity, survey the location of each SMP and record each crack monitor observation. Submit the results to the CONSTRUCTION MANAGER.
- C. A minimum of one (1) days prior to activity, survey the location of each SMP and record each crack monitor observation. Submit the readings to the CONSTRUCTION MANAGER.

3.05 MONITORING

- A. Monitor all SMP, crack monitor to the accuracy and the frequency specified. Frequency:
 - 1. As a minimum, the CONTRACTOR shall follow the following schedule:

Table 1: Frequency

Instrument Type	During Dewatering	During Removal / Installation of new clarifier materials	During Pipe Rehabilitation work	During Construction	Post Construction – 3 months after end of construction and dewatering
SMP	Once (1) per day	Once (1) per day	Once (1) per day	Once (1) per day	Weekly
Crack Monitor	Once (1) per day	Once (1) per day	Once (1) per day	Once (1) per week after dewatering	NA

- 2. The CONTRACTOR shall perform additional monitoring as necessary to control construction and to ensure the safety of the work.
- B. Notify CONSTRUCTION MANAGER within 2 hours of taking readings if action limits are exceeded. The action and maximum limits for ground distortions are provided in Table 2.
- C. As directed by the CONSTRUCTION MANAGER or when maximum allowable movement limits are exceeded per Table 2, immediately take additional readings to verify SMP, crack monitors stability. Notify CONSTRUCTION MANAGER and submit readings.
- D. Corrective Action Trigger Levels:

Table 2: Maximum Allowable Readings

Movement	Action Trigger Level	Maximum Allowable Movement
SMP (vertical)	0.031 ft (0.375 in)	0.063 ft (0.75 in)
SMP (horizontal)	0.031 ft (0.375 in)	0.063 ft (0.75 in)
Crack Monitor	0.0052 ft (0.0625 in)	0.0078 ft (0.09375 in)

- E. At any time during the Work, additional monitoring shall be performed if measurements fail to meet required accuracies, measurements detect significant, anomalous, or sudden changes in elevation or horizontal location and/or when action limits and maximum allowable movements are exceeded. Such additional monitoring will be performed at no additional cost to the OWNER.

- F. Evaluate existing damage to properties in the area of influence of the construction project that might be affected by the construction activities.

3.06 PROTECTION, MAINTENANCE AND REPLACEMENT

- A. Maintain access to SMP, crack monitors throughout the duration of monitoring and performance of the Work.
- B. Replace damaged or missing SMP, crack monitors immediately and notify the CONSTRUCTION MANAGER.

3.07 CLOSE-OUT READINGS

- A. Upon completion of the Work, including backfill, grouting, and surface restoration, perform a minimum of two sets of monitoring readings of all SMP, crack monitors. Final Readings shall be performed seven (7) days and three (3) months after completion of the Work Submit the readings to the CONSTRUCTION MANAGER.

END OF SECTION

SECTION 31 10 00

SITE CLEARING

PART 1 GENERAL

1.01 DESCRIPTION

- A. Scope: This section specifies site preparation which consists of clearing, grubbing and demolition.
- B. Existing Conditions: The Contractor shall determine the actual condition of the site as it affects this portion of work.
- C. Protection: Site preparation shall not damage structures, landscaping or vegetation adjacent to the site. The Contractor shall repair, or replace any damaged property.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.01 CLEARING AND GRUBBING

- A. Unless otherwise specified, the Contractor shall remove obstructions such as brush, trees, logs, stumps, roots, heavy sod, vegetation, rock, stones larger than 6 inches in any dimension, broken or old concrete and pavement, debris, and structures where the completion of the work require their removal.
- B. Material that is removed and is not to be incorporated in the work shall be disposed of off the site.

3.02 DEMOLITION AND REMOVAL

- A. Structures: Demolition and removal activities in east clarifiers 1, 2 and 3 are to consist of the removal and disposal of all internal painted carbon steel items, scum system, FRP weirs, baffles and current density baffles, clarifier drives and walkways. Walkway lighting is to be removed and reinstalled with new painted carbon steel walkways. Chlorine piping inside these clarifiers is to remain in place and protected during demolition and reinstallation activities. The clarifier concrete walls, launders and floors are to remain in place and are to be protected during demolition and reinstallation activities.
- B. Pavement: When portions of asphalt pavements and concrete pads are to be removed and later construction is to be connected, edges shall be saw cut, on a neat line at right angles to the curb face.
- C. Salvage: The Owner has the right to salvage any items scheduled for removal. The Contractor shall notify the Construction Manager 5 days prior to any salvage or demolition work to determine the disposition of items to be removed. The Construction Manager will mark items to be salvaged. Such items shall be properly disconnected, removed from their foundations, cleaned, and stored at a location on the plant site as specified.

3.03 UTILITY INTERFERENCE

- A. Where existing utilities interfere with the prosecution of the work, the Contractor shall relocate them in accordance with the General Conditions of the Contract Documents.

END OF SECTION

SECTION 31 23 00
EXCAVATION AND FILL

PART 1 GENERAL

1.01 DESCRIPTION

A. Scope:

1. This section specifies earthwork which consists of excavation, filling, grading, and disposal of excess material.

B. Definitions:

1. Compaction: The degree of compaction is specified as percent compaction. Maximum or relative densities refer to dry soil densities obtainable at optimum moisture content.
2. Excavation Slope: Excavation slope shall be defined as an inclined surface formed by removing material from below existing grade.

1.02 QUALITY ASSURANCE

A. References:

1. This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.
2. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, whether or not the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ASTM C136	Standard Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM D1556	Test Method for Density of Soil in Place by the Sand-Cone Method
ASTM D1557	Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb (4.5-kg) Rammer and 18-in. (457-mm) Drop
ASTM D2419	Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate
ASTM D3017	Test Method for Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

B. Tests:

1. The Construction Manager will take samples and perform moisture content, gradation, compaction, and density tests during placement of backfill materials to

check compliance with these specifications. The Contractor shall remove surface material at locations designated by the Construction Manager and provide such assistance as necessary for sampling and testing. The Construction Manager may direct the Contractor to construct inspection trenches in compacted or consolidated backfill to determine that the Contractor has complied with these specifications. Payment for inspection trenches shall be as specified in the General Conditions of the Contract Documents.

2. Tests will be made by the Construction Manager in accordance with the following:

Test	Standard Procedure
Moisture content	ASTM D3017
Gradation	ASTM C136
Density in-place	ASTM D1556
Moisture-density relationships	ASTM D1557

1.03 SUBMITTALS

- A. Samples of fill materials to be used shall be submitted 2 weeks in advance of use. Samples shall consist of 0.5 cubic feet of each type of material.

PART 2 PRODUCTS

2.01 FILL MATERIALS

- A. Type A material shall be a clean gravel-sand mixture free from organic matter and shall conform to the following gradation:

U.S. standard sieve size	Percent by weight passing
3/4 inch	100
3/8 inch	70-100
No. 4	55-100
No. 10	35-95
No. 20	20-80
No. 40	10-55
No. 100	0-2

- B. Type B:

1. Type B material shall be a select granular material free from organic matter and of such size and gradation that the specified compaction can be readily attained. Material shall have a sand equivalent value determined in accordance with ASTM D2419 of not less than 20 and shall conform to the following gradation:

U.S. standard sieve size	Percent by weight passing
3 inch	100
No. 4	35-100
No. 30	20-100

2. The coefficient of uniformity shall be 3 or greater.
3. The material may be an imported quarry waste, clean natural sand or gravel. The native excavation material does not meet this requirement..

C. Type C:

1. Type C material shall be unclassified material which is free from peat, wood, roots, bark, debris, garbage, rubbish or other extraneous material. The maximum size of stone shall not exceed 6 inches. If the material excavated from the site meets these requirements, it may be classified as Type C.

D. Type D:

1. Type D material shall be granular material commonly known as pea gravel and shall conform to the following gradation:

U.S. standard sieve size	Percent by weight passing
1/4 inch	100
No. 8	0-5

E. Type E:

1. Type E material shall be crushed rock commonly known as drain rock and shall conform to the following gradation:

U.S. standard sieve size	Percent by weight passing
1-1/2 inch	100
3/4 inch	30-75
1/2 inch	15-55
1/4 inch	0-5

2. Type E material shall be composed of hard, durable, sound pieces having a specific gravity of not less than 2.65.

PART 3 EXECUTION

3.01 GENERAL

A. Control Of Water:

1. The Contractor shall keep excavations reasonably free from water during construction. The static water level shall be drawn down a minimum of 1 foot below the bottom of excavations to maintain the undisturbed state of natural soils and allow the placement of any fill to the specified density. Disposal of water shall not damage property or create a public nuisance. The Contractor shall have on hand pumping equipment and machinery in good working condition for emergencies and shall have workmen available for its operation. Dewatering systems shall operate continuously until backfill has been completed to 1 foot above the normal static groundwater level.
2. Groundwater shall be controlled to prevent softening of the bottom of excavations, or formation of "quick" conditions. Dewatering systems shall not remove natural soils. The Contractor shall control surface runoff to prevent entry or collection of water in excavations.

3. Release of groundwater to its static level shall be controlled to prevent disturbance of the natural foundation soils or compacted fill and to prevent flotation or movement of structures or pipelines.
- B. Overexcavation:
1. Where the undisturbed condition of natural soils is inadequate for support of the planned construction, the Construction Manager will direct the Contractor to overexcavate to adequate supporting soils. The excavated space shall be filled to the specified elevation with backfill. The overexcavated space under footings may be filled with concrete. The quantity and placement of such material will be paid for as extra work.
- C. Surplus Material:
1. Unless otherwise specified, surplus excavated material shall be disposed of off site in accordance with applicable ordinances and environmental requirements.
- D. Hauling:
1. When hauling is done over highways or city streets, the loads shall be trimmed and the vehicle shelf areas shall be cleaned after each loading. The loads shall be watered after trimming to eliminate dust.
- E. Finish Grading:
1. Finished surfaces shall be smooth, compacted and free from irregularities. The degree of finish shall be that normally obtainable with a blade-grader.
 2. Finished grade shall be as specified by the contours plus or minus 0.10 foot except where a local change in elevation is required to match sidewalks, curbs, manholes and catch basins, or to ensure proper drainage. Allowance for topsoil and grass cover, and subbase and pavement thickness shall be made so that the specified thickness of topsoil can be applied to attain the finished grade.
 3. When the work is an intermediate stage of completion, the lines and grades shall be as specified plus or minus 0.5 foot to provide adequate drainage.
 4. If the soil is to be cultivated or straw is to be incorporated into the surface, rocks larger than 2-1/2 inches in maximum dimension, roots and other debris on the surface of the slope shall be removed and disposed of prior to cultivation or placement of straw.
- F. Control Of Erosion:
1. The Contractor shall maintain earthwork surfaces true and smooth and protected from erosion. Where erosion occurs, the Contractor shall provide fill or shall excavate as necessary to return earthwork surfaces to the grade and finish specified.

3.02 CLASSIFICATION OF FILL

- A. Fill material shall be placed in horizontal layers and compacted with power operated tampers, rollers, idlers, or vibratory equipment. Material type, maximum layer depth, relative compaction, and general application are specified in Table A. Unless otherwise specified, fill classes shall be used where specified in Table A under general application.

Table A, Fill Classifications

Fill class	Material type	Maximum uncompressed layer depth, inches	Minimum relative compaction, percent	General application
A1	A	8	95	Bedding for pipe, initial and subsequent pipeline backfill; slabs on grade (other than specified for Class E1)
B1	B	8	95	Structure and subsequent pipeline backfill
C1	C	8	90-95	Subsequent pipeline backfill; compaction as specified
D1	D	-	95	Bedding for pipe, initial and subsequent pipeline backfill
E1 ^a	E	8	-	Fill under slabs for structures with pressure relief valves

^aCompaction of layers shall be accomplished in two passes of equipment with complete coverage across the width of the field.

3.03 EARTHWORK FOR STRUCTURES

A. Structure Excavation:

1. The bottom shall not be more than 0.15 foot above or below the lines and grades specified. If the elevation of structure excavation is not specified, the excavation shall be not more than 0.15 foot above or below the elevation specified for fill material below the structure. Slopes shall vary no more than 0.5 foot from specified grade unless the excavation is in rock where the maximum variation shall be 2 feet.
2. Should the excavation be carried below the lines and grades specified on the drawings or should the bottom of the excavation be disturbed because of the Contractor's operations and require overexcavation and backfill, the Contractor shall refill such excavated space to the proper elevation in accordance with the procedure specified for backfill. The cost of such work shall be borne by the Contractor.
3. Unless otherwise specified, excavations shall extend a sufficient distance from walls and footings to allow for placing and removal of forms, installation of services, and for inspection, except where concrete is specified to be placed directly against excavated surfaces.

B. Structure Backfill:

1. Unless otherwise specified, structure backfill shall be Class B1.
2. After completion of construction below the elevation of the final grade, and prior to backfilling, forms shall be removed and the excavation shall be cleaned of debris.
3. Structure backfill shall not be placed until the subgrade portions of the structure have been inspected by the Construction Manager. No backfill material shall be deposited against concrete structures until the concrete has developed a strength of not less than 2500 pounds per square inch in compression, or until the concrete has been in place for 28 days, whichever occurs first.
4. Backfill material shall be placed in uniform layers and shall be brought up uniformly on all sides of the structure. Unless otherwise specified, backfill around and above pipelines within the excavation line of any structure shall be the same as that specified for structures.

3.04 EARTHWORK FOR PIPELINES AND CONDUITS

A. General:

1. Earthwork for pipelines and conduits is specified in **Table A**; in the standard details; and in the following paragraphs.
- B. Pipeline Excavation:
1. The bottom of the trench shall be carried to the specified lines and grades with proper allowance for pipe thickness and for bedding as specified.
- C. Pipeline Backfill:
1. Bedding: The Contractor shall not proceed with backfill placement in excavated areas until the subgrade has been inspected by the Construction Manager. All pipe shall have a minimum thickness of bedding material below the barrel of the pipe as specified. Bedding material shall be placed in the bottom of the trench, leveled and compacted. Bell holes shall be excavated at each pipe joint to permit proper inspection and uniform bearing of pipe on bedding material.
 - a. After the pipe has been laid to alignment and grade, unless otherwise specified, additional bedding material shall be placed in layers the full width of the trench and compacted up to the specified level. Bedding shall be placed simultaneously on both sides of the pipe, keeping the level of backfill the same on each side. The material shall be carefully placed and compacted around the pipe to ensure that the pipe barrel is completely supported and that no voids or uncompacted areas are left beneath the pipe. Contractor shall use particular care in placing material on the underside of the pipe to prevent lateral movement during backfilling.
 2. Initial Backfill: After pipe has been properly bedded, Contractor shall place and compact initial backfill as specified. Initial backfill, where specified below the springline of the pipe, shall be placed and compacted in accordance with **paragraph 3.04 Bedding** for additional bedding material.
 3. Subsequent Backfill:
 - a. General: Backfill material, placement and compaction above the pipe zone shall be as specified. Backfill above the pipe zone shall not commence until pipe zone backfill has been inspected and accepted by the Construction Manager.
 - b. Improved Areas: Unless otherwise specified, select granular backfill (Class A, B or C) shall be used under all paved and unpaved roadways and paved and unpaved roadway shoulders, roadway embankments, and in all public right-of-ways and easements. The trench shall be backfilled to an elevation which will permit the placement of the specified surface or paving. Other surfaces shall be restored, including compaction, to the condition existing prior to construction including restoration of yard areas.
 - c. Unimproved Areas: Class C1 backfill shall be used for all trenches in pastureland, cultivated land, undeveloped land, and for other unimproved areas where specified. Class C1 backfill shall not be used in any public right-of-way. Trench operation which meets the requirements of Type C material may be used. The Contractor shall maximize the use of fine-grained materials (e.g., sand, silty sand, sandy silt) as Class C1 backfill.
 - 1) For Class C1 backfill, the trench above the pipe zone shall be backfilled to within 12 inches of original ground surface. The top 12 inches of soil shall be removed and stored in such a manner that it will not become mixed with unsatisfactory soils. After the trench has been backfilled, the stored topsoil shall be replaced at a uniform depth in its original area compacted to its original condition. The Contractor shall leave the backfilled trench neatly

mounded not more than 6 inches above existing grade for the full width of the Class C1 backfill area.

3.05 SUBGRADE FOR PAVEMENT

- A. The prepared subgrade shall be scarified to a depth of at least 12 inches and recompact to at least 95 percent of the maximum density.

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SECTION 32 12 20
SURFACE RESTORATION

PART 1 GENERAL

1.01 SCOPE

- A. CONTRACTOR shall provide all labor, equipment, materials, and services required to replace existing surfaces and improvements removed, damaged, or worn in connection with performing the Work, bypass operations, or maintaining or detouring traffic including, but not limited to, markers, painting and stripping; permanent pavement and surfacing; driveways, sidewalks, curbs, gutters, and valley gutters; and base and subgrade aggregate. Improvements shall be reconstructed to equal or better, in all respects, than the existing improvements removed.
- B. Surface restoration shall meet the requirements of the OWNER or the jurisdiction of the right-of-way in which the Work is completed. In the case of conflict between the listed Agency's requirements and as required herein, the requirements affording the greatest protection to the PUBLIC and/or OWNER shall apply, as determined by the CONSTRUCTION MANAGER.
- C. Paving may only occur between April 15 through October 15.

1.02 REFERENCES

- A. This Section includes references to the following standards. They are a part of this Section as specified and modified. In case of conflict between the requirements of this Section and those of the listed documents, the requirements affording the greatest protection to the OWNER shall apply, as determined by the ENGINEER.

Reference	Title
APWA	Standard Specifications for Municipal Public Works Construction, Prepared by Utah State Chapter of the American Public Works Association, latest edition as modified by Standard Practice #5, Standard Practices for Salt Lake City Public Utilities, January 5, 2010.
OSHA	OSHA Safety Regulations (29 CFR, Part 1926, Subpart P. Excavations
MUTCD	Manual on Uniform Traffic Control Devices, United States Department of Transportation, Federal Highway Administration (latest edition): herein referred to as MUTCD

1.03 SUBMITTALS

- A. Submittals in accordance with the General Conditions and Section 01 33 00.
- B. CONTRACTOR shall make submittals of all materials, methods, and required testing intended for use on the project from this section. Submitted data shall be in accordance with APWA for each item and the samples and tests required in the referenced section unless otherwise specified.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. Unless otherwise specified by permit or these Contract Documents, pavement replacement shall comply with the specifications and typical details C2105.
- B. CONTRACTOR shall provide full depth pavement replacement of hard surfacing, untreated base course, and granular borrow material matching existing pavement.
- C. All trench repairs will need to match the existing thicknesses, anticipated to be 3" asphalt, 12" road base, and 12" subgrade.
- D. Existing chip seal shall be replaced in-kind where damaged or removed for work occurring in this area.

2.02 MEASUREMENT AND PAYMENT

- A. Measurement and payment guidelines for above referenced sections and subsections shall not be incorporated into the Contract Documents.
- B. Compensation for permanent pavement replacement and all required Work appurtenant thereto shall be included in the applicable Price for the Work in accordance with the Bid Schedule. No separate payment shall be made for replacement of pavement and appurtenant Work.

PART 3 EXECUTION

3.01 GENERAL

- A. The pavement, sidewalk, curb and gutter, driveway, etc. shall be cut vertically parallel to the lines forming the trench, or at the nearest full joint, in such a manner as to not cause damage to adjoining pavement, sidewalk, curb and gutter, driveway, etc. The portion to be removed shall be broken up in a manner that will not cause damage to the pavement or concrete outside the limits of the trench.
- B. Sawcut lines and joints will not be permitted within the limits of a travel lane. Pavement replacement limits shall extend to the edge of any travel lane in which pavement must be replaced, as approved by the CONSTRUCTION MANAGER.
- C. Do not install asphalt or concrete surfacing until trench compaction is accepted by CONSTRUCTION MANAGER.

3.02 PAVEMENT REPLACEMENT LIMITS

- A. Except where specifically required elsewhere in these Specifications, CONTRACTOR shall provide a permanent pavement replacement as follows:
 - If a cut is made in an asphalt surface three (3) years old or less, the roadway will be rotomilled for a distance of five feet (5') from the edge of each cut, or to the next designated lane divider, whichever is greater. New asphalt must then be placed for the length and width of the area rotomilled.

For all older road surfaces, new asphalt will be required for the length and width of the cut. Any adjustments may be required by the OWNER based on the location of any seams when compared to the traveled paths upon the roadway.

Replace asphalt to lip of gutter if extent of surface repair is less than 5 feet from lip of gutter.

Insert flowable fill into all excavations 12" or less in width prior to application of an asphalt finished surface.

Pavement shall be replaced with the same type and thickness of asphalt to match the existing asphalt plus 1" or 4" inches, whichever is greater.

- B. If CONTRACTOR's operations cause damage to existing pavement beyond specified limits, CONTRACTOR shall, at his sole cost and expense, remove and permanently replace such damaged pavement.
- C. The limits of required pavement replacement are not shown on the Contract Drawings. Pavement replacement should be considered as part of the means and methods selected by the CONTRACTOR for their own convenience and as required by the government agency with jurisdiction of the right-of-way as a result of the CONTRACTOR's work.
- D. The CONTRACTOR shall be responsible to replace any damaged or destroyed pavement as set forth herein. Operations of CONTRACTOR which result in pavement replacement shall be considered as part of the means and methods selected by the CONTRACTOR for his own convenience at no additional cost to the OWNER.
- E. CONTRACTOR shall protect in place or replace pavement markings, traffic loops, and signage as required by the government agency with jurisdiction of the right-of-way at no additional cost to the OWNER.

3.03 TEMPORARY PAVEMENT

- A. Whenever permanent pavement repair is not constructed as the excavation backfilling operation is completed, a temporary pavement patch shall be utilized to reopen the paved travel lanes at the end of each construction day. Temporary patches shall be in accordance with the agency requirements or consists of a minimum of two (2) inches of hot or cold plant mix unless otherwise approved by the CONSTRUCTION MANAGER.
- B. The temporary pavement patch shall be maintained within 100 feet of the construction excavation at all times during the day.
- C. Temporary pavement patches may be left in place for a maximum of seven (7) working days following completion of backfilling operations (includes between manholes), unless otherwise authorized by the CONSTRUCTION MANAGER.

3.04 CHIP SEAL

- A. Chip Seal: Replace existing chip seal in-kind where damaged or removed for work.

3.05 SCHEDULING

- A. Scheduling of surface restoration shall comply with the environmental limitations requirements of the government agency with jurisdiction of the right-of-way.

END OF SECTION

SECTION 33 01 32
CLOSED-CIRCUIT TELEVISION INSPECTION OF
EXISTING AND REHABILITATED PIPELINES AND SEWERS

PART 1 GENERAL

1.01 SCOPE

- A. This section describes the requirements for internal television inspection of the existing sewer pipelines before and after rehabilitation.
- B. The CONTRACTOR shall inspect the sewer interior using closed circuit television (CCTV) and document the inspection on a digital recorder. Exported CCTV data shall be PACP latest version.
- C. The nature of the inspections shall be to verify condition of the sewers and to provide a permanent record of the existing sewer and lateral condition as it relates to liner dimensions, materials, obstructions, breakage, connections, and deterioration.
- D. Inspections shall be performed in accordance with NASSCO standards by NASSCO PACP certified operators.
- E. The Contractor shall inspect the sewer interior using a color CCTV camera and document the inspection on video with audio location and date information, video title information, and hard copy inspection logs. Perform a CCTV inspection less than 48 hours after cleaning and before rehabilitation. Perform CCTV inspection again in the same direction as the previous inspection after rehabilitation to ensure proper installation.
- F. The Contractor shall be responsible for modifications to the CCTV equipment and inspection procedures to achieve report material of acceptable quality. No work shall commence prior to acceptance of the material by the OWNER.
- G. The Contractor shall maintain a copy of all inspection documentation (thumb drives, databases, and logs) for the duration of the Work and warranty period.

1.02 RELATED SECTIONS

- A. This section contains specific references to the following related sections. Additional related sections may apply that are not specifically listed below.
 - 1. Section 01 33 00 – Submittal Procedures

1.03 REFERENCES:

- A. This Section includes references to the following standards. They are a part of this Section as specified and modified. In case of conflict between the requirements of this Section and those of the listed documents, the requirements affording the greatest protection to the OWNER shall apply, as determined by the CONSTRUCTION MANAGER..

Reference	Title
NASSCO	National Association of Sewer Service Companies (NASSCO)
PACP	Pipeline Assessment and Certification Program Latest Version.

1.04 SUBMITTALS

A. Action Submittals

1. Procedure: Section 01 33 00:
2. A copy of this specification section with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.
3. Check-marks (✓) shall denote full compliance with a paragraph as a whole. Deviations shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Include a detailed, written justification for each deviation. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
4. Submit CONTRACTOR reference projects.
5. Submit Operator PACP certificate.
6. Submit Inspection Work Sample.
7. Submit Manufacturer's product literature for inspection equipment.
8. Two (2) copies of audio-video logs in an OWNER-approved format in accordance with NASSCO PACP export standards on portable hard drive showing the existing sewer pipelines after cleaning prior to liner installation and after liner installation. OWNER review will be limited to verifying that the required information is provided and that the recording is of acceptable quality and content. If the OWNER determines that the video log is unacceptable, repeat CCTV inspection video at no additional cost to the OWNER. Submittals shall include the following:
 - a. PACP standard database export (.mdb) in a version approved by the OWNER (NASSCO Version 7 at the time of solicitation)
 - b. PACP standard inspection video export saved in MPEG format
 - c. PACP standard inspection photograph export saved in .jpeg format
 - d. Map depicting sewer lines inspected to date

1.05 QUALITY ASSURANCE

- A. CONTRACTOR's Qualifications: The CONTRACTOR shall have a minimum of three years of experience in such work necessary to successfully meet this specification and provide references for five sewer inspection projects involving remote CCTV pan and tilt inspection or digital inspection equipment.
- B. The CONTRACTOR shall have operators who are responsible for logging defects into the data collection software successfully trained and certified through NASSCO PACP. The CONTRACTOR shall provide copies of the PACP certificates for the operators.

- C. The CONTRACTOR shall use CCTV defect logging software that is PACP-certified, which assures that the software can be used to export a database of all inspection and defect details that conform to the NASSCO PACP database standard. Exported CCTV data shall be PACP latest version.
- D. The CONTRACTOR shall add OWNER specific defect codes to the database as required to ensure uniform defect identification and naming.
- E. The CONTRACTOR must have an internal quality assurance/quality control program in place and all inspection data shall be subjected to the procedures prior to submittal.
- F. The Project Manager and/or delegate will perform QA/QC audits on submitted data and inspections.

1.06 NOTIFICATION

- A. The Contractor shall notify the Project Manager a minimum of 48 hours prior to commencing inspection of pipelines and shall notify the Project Manager daily during the inspection process with the approximate location of the work that day. No payment will be made for inspections performed without proper notification.

PART 2 PRODUCTS

2.01 TELEVISION CAMERA FOR REMOTE CCTV AND MONITOR

- A. For inspection of sewer, the camera shall be equipped with a rotating head, capable of 90-degree rotation from the horizontal and 360-degree rotation about its centerline. Camera(s) shall be intrinsically safe and shall be operative in 100 percent humidity conditions. Lighting intensity shall be remote controlled and shall be adjusted to minimize reflective glare. Lighting and camera quality shall provide a clear, in-focus picture of the entire inside periphery of the sewer. Camera shall record in color. Camera and lighting equipment used shall be suitable for use in the diameter of pipe inspected, ensuring a clear view of the complete inside periphery of the sewer. The camera unit shall have sufficient quantities of line and video cable to inspect sewers with access as far apart as 2,500 feet.
- B. The television camera, electronic systems, and monitor shall provide an image that meets the following specifications:
 - 1. The gray scale shall show equal changes in brightness ranging from black to white with a minimum of five stages.
 - 2. With the monitor control correctly adjusted, the six colors - Yellow, Cyan, Green, Magenta, Red, and Blue, plus Black and White, shall be clearly resolved with the primary colors in order of decreasing luminance. The gray scale shall appear in contrasting shades of gray with no color tint.
 - 3. The picture shall show no convergence or divergence over the whole of the picture. The monitor shall be at least 13 inches diagonally across the picture tube.
 - 4. The live picture on the CCTV monitor shall be capable of registering a minimum of 500 lines horizontal resolution and be a clear, stable image with no interference.
- C. Lighting intensity shall be remote controlled and shall be adjusted to minimize reflective glare. Lighting and camera quality shall provide a clear, in-focus picture of the entire

inside periphery of the sewers and laterals for all conditions except submergence. Under ideal conditions (no fog in the sewer) the camera lighting shall allow a clear picture up to five pipe diameter lengths away for the entire periphery of the sewer. The lighting shall provide uniform light free from shadows or hot spots. The CONTRACTOR is to provide adequate lighting to fully illuminate the Host pipe which is a black HDPE material.

- D. Camera focal distance shall be remotely adjustable through a range of 6 inches to infinity.
- E. The monitor and software shall be able to capture and save screen images of typical sewer details and all defects. Screen image files shall be named using upstream manhole number and footage and submitted on CDs, DVDs, or external hard drives.

2.02 VIDEO RECORDINGS

- A. The video and audio recordings of the sewer inspections shall be made using digital video equipment. The digital recording equipment shall capture sewer inspection on CD, DVD, or external hard drive, with each sewer reach inspection recorded as an individual movie file (.mpeg, .mpg). The files shall be named according to Upstream/Downstream manhole.
- B. The audio portion of the composite video shall be sufficiently free from electrical interference and background noise to provide complete intelligibility of the oral report. Audio shall be recorded by the operating technician on the inspection video as the sewer is inspected and shall include the sewer location, identification of beginning and terminating manholes including location (address or cross streets), inspection direction, length of inspection, side sewer identification, flow information, complete descriptions of the sewer line conditions as they are encountered, description of the rehabilitation work, reason for termination, and other relevant commentary to the inspections. In addition, the audio reports shall include the distance traveled on the specific run, a description of abnormal conditions in the sewer and side sewer connections as they are encountered, explanations for pausing, backing up, or stopping the survey, and the final measured center to center distances between consecutive manholes. Audio dubbing after the inspection is prohibited.
- C. The reaches shall be inspected from upstream to downstream, wherever possible. The images recorded on the CCTV video shall be the same images that are required to be displayed on the CCTV monitor. The footage counter shall be zeroed at the beginning of each inspection and at each intermediate manhole along the inspection run. The video recorder shall be paused if the camera progress is stopped for a period longer than 30 seconds due to breakdown of the equipment or any purpose other than analyzing conditions of the sewer. The operator shall document the delay on the recording when progress resumes.
- D. The equipment used for the inspection must provide for simultaneous monitoring of the in-sewer inspection by the CONSTRUCTION MANAGER. Equipment that does not allow for out of sewer observation of the inspection will not be allowed.
- E. Inspection video shall be submitted in MPEG file format (.mpg) and saved on CDs, DVDs, or external hard drives for submittal. Each inspected sewer reach, manhole to manhole, should have an associated MPEG file. Electronic PDF (.pdf) files of each inspection log

and digital photographs (.jpg files) shall accompany the video inspections for each inspected sewer reach (manhole to manhole).

- F. Typed labels shall be attached to the face of each CD, DVD or hard drive. The typed index labels shall include the following information:
 - 1. Content (CCTV)
 - 2. Contractor name
 - 3. Type of survey (CCTV)
 - 4. Interceptor name
 - 5. Reaches included (from Manhole Number to Manhole Number)
 - 6. Date of survey
 - 7. Work order number (if applicable).
- G. The inspection video shall be delivered on a medium that is not re-recordable. CONTRACTOR shall maintain a copy of all inspection documentation (CDs/DVDs, databases, and logs) for the duration of the work and warranty period.

2.03 WORK SAMPLES

- A. CONTRACTOR shall provide an example of previous inspection work for approval. The example shall consist of one CD or DVD of previous sewer inspection work complete with inspection recording, audio commentary and inspection log(s). The submitted example shall be the work of the field supervisor or foreman to be used on this project. CONTRACTOR shall be responsible for modifications to equipment and/or inspection procedures to achieve report material of acceptable quality.

2.04 MANUFACTURER'S CATALOGS

- A. CONTRACTOR shall provide manufacturer's product literature for all video equipment including but not limited to cabling, camera, monitor, footage counter, video titling device, and recorder.

2.05 PRODUCT DATA

- A. The CONTRACTOR shall submit TV inspection reports each week covering the previous week's work.

PART 3 EXECUTION

3.01 VIDEO INSPECTION METHODS

- A. Scope
 - 1. The Contractor shall thoroughly document the condition of all sewer segments and structures, manhole corbel, barrel and cone-sections in the study areas. The sewer segments shall be carefully inspected to determine the location and extent of any deterioration, breaks, obstacles, obstructions, debris, infiltration/inflow, alignment, grade variations, separated joints, location of service connections, and any other anomalies not typical of a sanitary sewer system. All inspection shall be conducted according to NASSCO PACP standards and by a PACP certified inspector.

B. Access

1. TSSD and their representatives shall have access to observe the monitor and all other operations at all times. The system of cabling employed to transport the camera and transmit its signal shall not obstruct the camera's view.

C. Inspection Rate

1. The camera shall be pulled through the sewer in either direction, but all inspections at each location shall be in the same direction. Maximum rate of travel shall be 30 feet per minute when recording.

D. Image Perspective

1. The camera image shall be down the center axis of the pipe when the camera is in motion. Provide a 360-degree view of the pipe interior. Points of interest shall also be videoed and shall include, but not be limited to, defects, joint off-sets or separations, mineral deposits, debris, sediment, service connections, any location determined not to be clean or part of a proper liner installation, or defects in the liner (including, but not limited to, bumps, folds, tears, dimples, etc.)

E. Sewer Identification

1. The following PACP inspection header form fields are mandatory for all inspections and are to be completed using the standard PACP codes for the respective fields.
 - a. Inspection Number
 - b. Upstream Manhole Facility ID, an alphanumeric tag supplied by the TSSD
 - c. Downstream Manhole Facility ID, an alphanumeric tag supplied by the TSSD
 - d. Operator Name and Company Performing Inspection
 - e. Date and Time of Inspection
 - f. Upstream manhole rim to invert measurements for upstream and downstream sewer(s).
 - g. Downstream manhole rim to invert measurements for upstream and downstream sewer(s).
 - h. Flow Control
 - i. Pipe Diameter
 - j. Lining method (for lined sewers)
 - k. Length Surveyed
 - l. Direction of Survey
 - m. Pre-cleaning (jetter, heavy cleaning, no pre-cleaning)
 - n. Date and time of cleaning

F. Inspection Details

1. The CCTV inspection work must be completed by certified NASSCO PACP trained operator(s) using current PACP coding and observations standards, and using NASSCO certified data collection software.
2. Facility IDs. Prior to inspection the Contractor shall obtain the pipe and manhole asset tags (Facility IDs) for the sewer segments to be inspected from the Project Manager. Inspections performed using identification numbers other than Facility IDs will be rejected.

3. Video Recording. The video recording shall begin as the camera is lowered down the manhole all the way to the preset footage and continuously throughout the sewer segment until the downstream manhole is reached.
4. Flow Level. Flow levels within existing sewers to be inspected shall not exceed 25 percent of the pipe diameter. If water levels exceed 25 percent of the diameter, then conducting the work during low flow periods or other methods like drawing down the water level using the hydraulic cleaning equipment, plugging, and bypass pumping shall be implemented. The cost of re-inspecting during low flow periods, drawing down the water level using the hydraulic cleaning equipment, or plugging the sewer segment shall be incidental to the contract unit price per lineal foot for sewer inspection. If bypass pumping is deemed necessary the contractor shall first obtain approval from the Project Manager and the cost of the pumping shall be according to the unit price for bypass pumping for 8 – 15” diameter sewers and negotiated under a separate contract for larger sewers.
5. Sags and Dips. Where sags cause the water level in the pipe to increase by 20 percent of the pipe diameter but the camera lens is still above water the sag shall be coded using the MWLS PACP code. Where sags are sufficient to submerge the camera lens the sag shall be coded using the MCU PACP defect code. For these sections of the sewer the contractor shall first attempt to maneuver the camera through the sag/submerged section to determine the extent of such areas prior to dewatering the sewer section using the hydraulic cleaning equipment to allow inspection of the pipe and identification of pipe defects and features. The inspection may be paused during the dewatering and resumed when the sag has been dewatered. The cost of dewatering sags shall be incidental to the contract unit price per lineal foot for sewer inspection
6. Location measurement. Measurement for location of defects and actual length of pipe shall be by means of a calibrated meter on the camera with a digital readout on the video monitor. This readout shall be included in the video recording. Marking on cable, or the like, which would require interpolation for depth of manhole, will not be allowed.
7. Camera Maneuvering. The camera shall be slowed, stopped, or backed-up to perform detailed inspections of significant features. The camera shall be stopped at all defects, changes in material, water level, size, side connections, manholes, junctions, or other unusual areas. When stopped at the defect or feature, the operator shall pan the camera to the area and around the circumference of the pipe. The operator shall then back-up the camera sufficiently to provide a view of the full pipe at the defect/feature and code the defect/feature at the full pipe view location. The camera shall be paused long enough at areas suspected of infiltration to determine the severity of the infiltration.
8. Camera Speed. The camera shall be directed through the sewer at a uniform, slow rate. In no case will the video camera record while moving at a speed greater than 30 feet per minute. If, during the course of the project, the inspection is rejected due to camera speeds exceeding 30 feet per minute, the inspection shall be redone, at no additional cost to TSSD.
9. Reverse Inspection. Wherever possible the inspections shall be performed in the upstream to downstream direction. When sewer conditions prevent forward movement of the camera, the inspection may be paused and the cleaning equipment may be used to attempt to remove any debris which may be obstructing the movement of the inspection equipment. If additional cleaning does not allow the camera to pass, the camera shall be withdrawn, the inspection shall be closed out,

and the Contractor shall begin a new inspection from the opposite direction. The cost of this additional cleaning and of reverse set-ups shall be incidental to the contract unit price per lineal foot for sewer inspection.

10. Recording Manhole and Structure Conditions. The camera shall pan the periphery of the upstream and downstream manholes or structures from rim to invert. To achieve this, the CCTV camera operator shall pan and zoom the manhole to obtain the best possible image of the manhole, including the wall, cone and chimney sections.
11. Deformed or Collapsed Pipes. If the inspection reveals that any section of a sewer is deformed or has collapsed the Contractor shall notify the Project Manager as possible, but no later than 8 hours after discovering the defect.
12. New Manholes. If a new manhole is discovered in the field that was not on current maps, the Contractor shall consult with the Project Manager for assignment of new manhole identification numbers.
13. Spare Parts. The Contractor equipment shall be equipped with adequate back up equipment and spare parts so field repairs to equipment can be made and down time is minimized.
14. Audio. Audio reporting will be avoided.
15. Data Displays. The CCTV images shall include an initial data display that identifies the sewer reach being surveyed and a survey status display that provides continuously updated information on the location of the survey unit as the survey is being performed. These data displays shall be in alphanumeric form. The size and position of the data shall not interfere with the main subject of the monitor picture. At the beginning of each reach of sewer being inspected, the following information shall be electronically generated and displayed on the CCTV monitors:
 - a. Date of survey
 - b. Operator/Surveyor's name
 - c. Upstream Manhole Facility ID
 - d. Downstream Manhole Facility ID
 - e. Direction of survey (With or Against Flow)
 - f. Time of start of survey

During inspections, the following information shall be electronically generated, automatically updated, and displayed on the CCTV monitors:

- a. Survey unit location in the sewer line in feet and tenths of feet
- b. Sewer diameter
- c. Time

END OF SECTION

SECTION 33 01 34
CLEANING OF PIPELINES

PART 1 GENERAL

1.01 DESCRIPTION

- A. The Work covered by this Section includes furnishing all labor, material, equipment and services required for cleaning all pipelines, prior to inspection of the pipelines by closed circuit television, authorized by the Project Manager, prior to installation of pipe rehabilitation system, as shown on the Drawings and/or specified herein. The objective of preconditioning and cleaning is to prepare pipelines for rehabilitation by the selected pipe rehabilitation method and to maximize pipeline service efficiency and effectiveness. Preconditioning and cleaning involves removal of silt, which is defined as any and all solid or semi-solid materials, including fine and granular material, such as sand, grit, gravel, and rock as well as debris, grease, oil, sludge, slime, or any other loose material or encrustation lodged in the pipeline. Preconditioning and cleaning also involve removal of invading roots, corroded concrete, intruding laterals and any other extraneous debris.
- B. No chemicals shall be used to clean the pipelines without prior written authorization of the CONSTRUCTION MANAGER. In no case shall any chemical additive be used that might be considered hazardous, detrimental to organisms or equipment at the wastewater treatment plant, or detrimental to old or new pipe materials.
- C. The CONTRACTOR shall be solely responsible for assessing the existing facilities and determining the expected quantity of sediments, debris, grease, scale, encrustations, and roots to be removed by the cleaning process selected by the CONTRACTOR to comply with the requirements of this Section.
- D. Unless otherwise specified, all services of the CONTRACTOR in performing cleaning of pipes and structures included in this Section are considered as incidental to the Work, and shall not be considered as reimbursable costs (labor material, equipment, etc). The CONTRACTOR shall include the costs of cleaning performed by the CONTRACTOR in the unit costs or lump sum costs included in the Bid Schedule.

1.02 RELATED SECTIONS

- A. This section contains specific references to the following related sections. Additional related sections may apply that are not specifically listed below.
 - 1. Section 01 33 00 – Submittal Procedures
 - 2. Section 33 01 32 – Closed-Circuit Television Inspection of Existing and Rehabilitated Pipelines and Sewers

1.03 DEFINITIONS

- A. The term "clean" as used in this Section, shall mean removing all sand, dirt, roots, grease and all other solid or semi-solid materials from the pipelines, so that a closed circuit television camera can be used in the internal pipeline inspection for the purpose of discerning structural defects, misalignment and infiltration/inflow sources.
- B. NOT USED

1.04 REFERENCES:

- A. This Section includes references to the following standards. They are a part of this Section as specified and modified. In case of conflict between the requirements of this Section and those of the listed documents, the requirements affording the greatest protection to the OWNER shall apply, as determined by the CONSTRUCTION MANAGER.

Reference	Title
ASTM D4258	Standard Practice for Surface Cleaning Concrete for Coating
ASTM D4259	Standard Practice for Abrading Concrete

1.05 SUBMITTALS

- A. Action Submittals
1. Procedure: Section 01 33 00:
 2. A copy of this specification section with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.
 3. Check-marks (✓) shall denote full compliance with a paragraph as a whole. Deviations shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Include a detailed, written justification for each deviation. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
 4. A Work Plan identifying the equipment and the methods the CONTRACTOR plans to employ to remove sediment, debris, grease, scale, encrustations, and roots from the pipelines and structures. The plan shall include:
 - a. Detailed explanation of the entire cleaning process including removal and disposal of debris.
 - b. Schedule of activities.
 - c. References where the CONTRACTOR has used the identified cleaning method successfully within the past three years.
 - d. List of actions planned to mitigate impact to the public during the cleaning operation.
 5. Record copies of permits required for performance of the Work including but not limited to permits for transporting sediment and/or disposing of removed materials.
 6. Submit cleaning reports on a weekly basis in accordance with paragraph 3.07 of this section.

PART 2 PRODUCTS

2.01 EQUIPMENT

- A. Equipment shall be capable of removing dirt, grease, rocks, sand, roots, and obstructions from pipelines and manholes.
- B. High-Velocity, Hydro Cleaning Equipment:

1. High-Pressure Hose: 700 feet, minimum.
2. Hydraulically driven hose reel.
3. High Velocity Nozzle.
 - a. Two, minimum
 - b. Capable of producing scouring action from 10 degrees to 45 degrees in lines to be cleaned.
4. High-velocity Gun: Capable of producing flows ranging from fine spray to long distance solid stream.
5. Water Tank: 1,000-gallon storage, minimum.
6. Auxiliary engines and pumps.
7. Equipment Operating Controls: Locate above ground.
8. Working Pressure: Minimum 2,000 pounds per square inch at 35 gallons per minute.

C. NOT USED

PART 3 EXECUTION

3.01 GENERAL

- A. The Contractor shall certify that sufficient cleaning units can be provided, including standby units in the event of breakdown, in order to complete the Work within the contract period. Further, the Contractor shall certify that standby or back-up equipment can be delivered to the site within 24 hours in the event of equipment breakdown.
- B. The CONTRACTOR shall be thoroughly familiar with all phases of pipeline and structure cleaning to ensure the completion of this Contract without causing a health hazard or damage to the sewage system, public, and private properties.
- C. The CONTRACTOR shall locate all hydrants or other sources from which water may be obtained. The Contractor shall be responsible for the cost of purchasing water and transportation from the source to the point of use.

3.02 PIPELINE CLEANING

- A. Cleaning will be accomplished by utilizing a high pressure, hydraulic sewer pipeline cleaner. Pressure jetting equipment used shall be sufficient for the purposes of attaining the degree of cleanliness in pipelines as specified.
- B. The cleaning unit(s) shall be capable of operating routinely, up to a minimum of 600 feet from the point of access to the pipeline; minimum hose diameter shall be one-inch diameter.
- C. Successive passes using constantly moving pressure jetting techniques shall be applied to pipelines until they are cleaned to the level specified. Nozzle hold-time (stationary time), for any particular location, shall not be more than 60 seconds in order to mitigate damage to the pipe being cleaned. Ideally nozzles shall have jet angles between 30-degrees to 45-degrees. "High efficiency nozzles" (discharging "pencil jets") with jet angles higher than this figure shall not be allowed to be stationary at any time. Successive passes using constantly moving pressure jetting techniques shall be applied

to pipelines until they are cleaned to the level specified. The CONTRACTOR shall exercise care at all times in order to mitigate damage to the pipe being cleaned.

- D. Cleaning shall be done immediately prior to the internal inspection to preclude the buildup of debris from infiltration/inflow sources. Should television inspection reveal that a pipeline is not clean; the cleaning operations shall be repeated until the pipeline is clean. This additional cleaning shall be done at the expense of the CONTRACTOR, at no additional cost to the OWNER.
- E. NOT USED
- F. NOT USED
- G. Cleaning shall include the trapping and removal of all sediments and residual wastes from successive pipe segments as the cleaning progresses. Under no circumstances shall sewage or solids removed from the pipeline or manhole, be dumped onto streets, in catch basins or in storm drains.
- H. The cost of trapping, removing, and hauling of the residual wastes shall be included in the bid price.
- I. The CONTRACTOR shall provide for the pumping down and dewatering of pipelines, if required, during the cleaning operation.
- J. Blockages in the system shall be reported to the Project Manager immediately.
- K. A responsible representative of the CONTRACTOR shall be present on the site of the Work, or other location approved by the OWNER, to provide supervision of the Work. At all times, and especially when a change of Work location is underway, the CONTRACTOR's representative shall keep the Project Manager continuously aware of the location, progress, planned execution of the Work, and problems encountered.
- L. NOT USED
- M. NOT USED

3.03 NOT USED

3.04 NOT USED

3.05 PRECAUTIONS

- A. The CONTRACTOR shall take all necessary precautions to ensure that water used does not flood property or buildings served by the pipeline being cleaned.
- B. No fire hydrant shall be obstructed, in case of a fire in the area served by the hydrant.
- C. The CONTRACTOR shall take all necessary precautions to protect the pipelines from damage that might be inflicted by improper use of cleaning equipment and shall repair, at no cost to the OWNER, any damage caused by the cleaning operation.

- D. If, at any time, the Project Manager has reason to believe that the footage counter used to determine actual footage cleaned is inaccurate, the CONTRACTOR shall have the counter calibrated to the satisfaction of the Project Manager before any more work progresses.
- E. The CONTRACTOR shall provide, operate, maintain and subsequently remove on completion, adequate ventilation apparatus in the form of blowers and/or fans. The ventilation apparatus shall introduce a fresh air supply to support a safe environment for Work in pipelines, structures, and all other confined spaces, which shall be kept free from dangerous, toxic and/or explosive gases, whether generated from sewage, soil strata or other source.
- F. The CONTRACTOR shall employ the “best practicable means” to minimize and mitigate noise as well as vibration resulting from operations. Mitigation measures shall include the utilization of sound suppression devices on all equipment and machinery particularly in residential areas and in the near vicinity of hospitals and schools, especially at night.
- G. The CONTRACTOR shall inform the Project Manager before the commencement of any portion of the Work of any significant change in the methods of noise attenuation from those previously approved.
- H. All pumps, generators, combination cleaners, or other noise emitting equipment shall be suitably screened to minimize nuisance and noise pollution. This requirement shall not be taken as preventing or prohibiting the execution of Work necessary for the saving of life, protection of property, or safety of the personnel and/or facilities. The CONTRACTOR shall notify the Project Manager of such use of plant or equipment in an emergency situation as soon as practicable.

3.06 TRANSPORT AND DISPOSAL OF SEDIMENTS

- A. The CONTRACTOR shall be responsible for transporting and disposing, including all disposal fees, of any sediments and material removed from the pipelines or structures.
- B. The CONTRACTOR is responsible for obtaining all necessary permits and approval and paying fees from all regulatory agencies required to perform the Work, including transport of sediments to approved disposal sites.
 - 1. Hauling containers shall be watertight and shall be certified for transport of this material by local Health Department or responsible permitting agency.
- C. All materials dislodged during cleaning shall be removed from the Work area operation at the end of each workday. On-site stockpiling of removed material will not be permitted.
- D. NOT USED
- E. NOT USED

3.07 DATA COLLECTION

- A. The CONTRACTOR shall complete a cleaning report for each pipeline segment cleaned. A hard copy of this report shall be furnished on a weekly basis to the Project Manager. The information required on the cleaning report shall be as follows:

1. Pipeline cleaned
 2. Degree and nature of deposits prior to cleaning.
 3. Length of pipeline cleaned.
 4. Quantity of debris removed.
- B. The CONTRACTOR shall submit a typed or legibly hand written, tabular inspection sheet that includes the above requested items. CONTRACTOR shall submit samples of the inspection sheet they intend to use for approval by the Owner prior to beginning inspection activities.
- C. NOT USED

END OF SECTION

SECTION 33 05 01
PROTECTION OF EXISTING UTILITIES

PART 1 GENERAL

1.01 REQUIREMENTS

- A. This Section specifies the requirements to identify and locate (potholing) existing subsurface utilities and requirements for protection of existing utilities and improvements.
- B. Electrical, telephone, CATV, fiber optic, gas, water, and sewer locations are approximations only. Dimensions and configurations shown are compiled from various sources and are not field verified. Neither the accuracy nor the completeness of information shown is guaranteed. CONTRACTOR shall verify utility locations, dimensions, and configuration prior to start of construction.
- C. Existing condition of utilities is neither known nor implied. Maintain the present day functional purpose of all existing utilities regardless of the discovered state of repair and condition, unless shown to be abandoned or removed.

1.02 REFERENCES

- A. This Section includes references to the following standards. They are a part of this Section as specified and modified. In case of conflict between the requirements of this Section and those of the listed documents, the requirements affording the greatest protection to the OWNER shall apply as determined by the CONSTRUCTION MANGER.

Reference	Title
APWA	Standard Specifications for Municipal Public Works Construction, Prepared by Utah State Chapter of the American Public Works Association
ASCE 38-02	ASCE Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data

- B. DEFINITIONS:
 - 1. Definitions used in this specification are as defined in ASCE 38-02 and as follows:
 - 2. Utility support systems are defined as the support systems provided to secure and suspend utilities in place and in complete working order during the performance of the WORK and for extended periods as specified.
 - 3. Maintenance is defined as monitoring and maintaining the functional purposes of all utilities and support systems affecting the WORK.

1.03 SUBMITTALS

- A. Submittals in accordance with the General Conditions and Section 01 33 00.
- B. Prepare and submit a Utility Protection Plan for underground utilities affected by the Work. Plan shall include but not limited to:
 - 1. Description of utility to be protected

2. Potholing data showing the relationship of the proposed work to the existing utility, size, horizontal and vertical position, material and service.
3. Work to be completed in the proximity of the utility
4. Proposed method to protect including:
 - a. Shop drawing, the method of excavation, shoring, dimensions of trench or pit, zone of influence, offset distances from critical utilities, deflections, strain/stress on facilities, and soil-bearing loads;
 - b. Structural details and calculations of temporary support systems and proposed sequence of construction;
 - c. Materials list and specifications of the materials proposed for the support systems.
5. Proposed method to verify utility is undamaged

PART 2 PRODUCTS

2.01 REPLACEMENT IN KIND

- A. Except as indicated below or as specifically authorized by the CONSTRUCTION MANAGER, reconstruct utilities with new materials of the same size, type, and quality as that removed or damaged.

2.02 PARALLEL AND PERPENDICULAR UTILITY PROTECTION

- A. The pipeline alignments have numerous parallel and perpendicular utilities in close proximity which may or may not lie within the CONTRACTOR'S excavation/trench zone required to complete portions of the Work. The cost of exploratory excavations, protecting, supporting, or removal and reconstruction of these facilities will be at the expense of the CONTRACTOR and included in the bid item to which the Work is appurtenant.

2.03 SUPPORT SYSTEMS

- A. Support systems used are capable of maintaining the utilities in service, undamaged for the duration of the Work.
- B. Plastic Foam if used, shall be polyethylene, foam cushioning material.

PART 3 EXECUTION

3.01 GENERAL

- A. Replace in kind street improvements, such as curbs and gutters, barricades, traffic islands, signalization, fences, signs, etc., that are cut, removed, damaged, or otherwise disturbed by the construction.
- B. Replace in kind manhole components removed for bypassing operations
- C. Before beginning pipeline excavation, determine the true location and depth of utilities and service connections which may be affected by or affect the Work. Determine the type, material, and condition of these utilities. To provide sufficient lead time to resolve

unforeseen conflicts, order materials and take appropriate measures to ensure that there is no delay in Work.

1. If a conflict exists between drawings and field information, notify CONSTRUCTION MANAGER immediately.

3.02 PROCEDURES

- A. Protection in Place: Protect utilities in place, unless abandoned, and maintain the utility in service, unless otherwise specified on the plans or in the Specifications.
- B. Remove and Reconstruct: Where so indicated on the plans or as required by the CONSTRUCTION MANAGER, remove the utility and after passage, reconstruct it with new materials. Provide temporary service for the disconnected utilities or as directed by the utility owner.

3.03 INSTALLATION

- A. Perform excavation around the utilities and installation of the support systems without damage to utilities. Maintain the utility systems during the period of the WORK. Upon completion of the WORK, the utility systems are in a condition equal to or better than the preconstruction condition and operate as prior to construction.
- B. Provide access to utilities for the purpose of operating and verifying the condition of their respective facilities.
- C. Notify affected utility and CONSTRUCTION MANAGER of any damage to facilities immediately. Subsequent to repair, condition of the facility is equal to or better than condition of the facility prior to damage.
- D. Notify affected utility and CONSTRUCTION MANAGER in the event that the existing state of repair of the utility is deemed unsafe or otherwise precludes proper support.
- E. Modification to Utility Support Systems: Notify CONSTRUCTION MANAGER if the condition or location of the facility to be supported in place will require a modification to the support system as initially proposed or installed. Coordinate the revised support system through the CONSTRUCTION MANAGER.
- F. Arrange and facilitate a meeting at the site with the CONSTRUCTION MANAGER and respective utility representatives for the utilities to be affected by the WORK at least 7 days prior to WORK in the vicinity of the specific utility unless otherwise specified. Be prepared to discuss the proposed utility protection measures as described in the Utility Protection Plan. Incorporate modifications to the plan resulting from the site meeting into the plan and resubmit to the CONSTRUCTION MANAGER at least five days prior to commencing the WORK in the vicinity of the specific utility.
- G. Gas Facilities, Telephone and Fiber Optic Facilities: Protect and support in place.

3.04 BACKFILL AND COMPACTION

- A. Utilities Protection in Place: After completing the Work and during trench zone backfill, backfill and compact under and around the utility so that no voids are left. Backfill around utilities shall be as shown and specified in the CONTRACT DOCUMENTS.

3.05 SERVICE LATERALS AND CONNECTIONS

- A. Service laterals and connections to the various utilities (water, sewer, gas, CATV, tel, etc) in the vicinity of the Work are not all shown on the plans. Information shown is based on best available data.
- B. The CONTRACTOR shall conduct advanced potholing to confirm existing utility location, size, depth and condition to adequately define and protect existing utilities when their presence cannot be inferred from the presence of other visible facilities, such as markers, valves, buildings, meter and junction boxes, on or adjacent to the site of the Work.
- C. If the CONTRACTOR discovers utility facilities not identified in the Contract Documents or in a position different from that shown in the Contract Drawings, immediately notify in writing the CONSTRUCTION MANAGER about the utility facility.

3.06 UTILITY INTERFERENCE

- A. Where existing utilities interfere with the prosecution of the Work, the CONTRACTOR, shall relocate them in accordance with the requirements of the utility owner. Relocation shall only be completed after written approval by the utility owner and/or CONSTRUCTION MANAGER is provided.
- B. When it is necessary to remove, relocate, protect, or temporarily maintain a service connection, the CONTRACTOR shall bear all expenses incidental to the Work on the utility or damage thereto. The work on the utility shall be done in a manner satisfactory to the utility owner; it being understood that the owner of the utility has the option of doing such work with his own forces, or permitting the work to be done by the CONTRACTOR.

END OF SECTION

SECTION 33 15 63
INTERNAL JOINT SEALS FOR CIRCULAR STRUCTURES

PART 1 GENERAL

1.01 SCOPE

- A. The Work covered under this section includes the furnishing of all materials, tools, equipment, and labor related to supply and install internal joint seals of 16 inch to 30 inch in diameter.
- B. The sizes and locations of internal pipe seals are shown on the Drawings and in this Specification. The seals are meant for installation in pipelines with operating pressures of up to 50 psi.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. The requirements of the following sections and divisions apply to the Work of this section. Other sections and divisions of the Specifications not referenced below shall also apply to the extent required for proper performance of Work.
 - 1. General Requirements, applicable sections
 - 2. Section 33 39 30, Fiber Reinforced Polymer Composite Repairs for Pipelines

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. All Work specified herein shall conform to or exceed the applicable requirements of the referenced portions of the following publications to the extent that the provisions thereof are not in conflict with other provisions of these Specifications.
- B. Materials used in the fabrication, assembly and installation of internal pipe seals shall comply with the following standards:
 - 1. American Society for Testing and Materials (ASTM) Standards:
 - A240 Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 - D395 Standard Test of Rubber Compression Set.
 - D412 Standard Test Method for Rubber Properties in Tension.
 - D573 Standard Test Method for Rubber Deterioration in Air Oven.
 - D1171 Standard Test Method for Rubber Deterioration Surface Ozone Cracking Outdoors or Chamber.
 - D2000 Standard Classification System for Rubber Products in Automotive Application.
 - D2240 Standard Test Method for Rubber Property Durometer Hardness.
 - D3568 Standard Test Method for Rubber Evaluation for EPDM.
 - D3900 Standard Test Methods for Rubber Determination of Ethylene Units in Ethylene- Propylene Copolymers (EPM) and in Ethylene-Propylene- Diene Terpolymers (EPDM) by Infrared Spectrometry.
 - 2. Other Standards

AWS A5.4 Specification for Stainless Steel Electrodes for Shielded Metal Arc Welding.

AWS D1.6 Structural Welding Code – Stainless Steel.

1.04 QUALIFICATIONS

- A. The CONTRACTOR shall engage either the pipe seal manufacturer or any other entity accepted by the seal manufacturer (as fully trained for installing the seals) for the installation of the seals. The installing Contractor shall have a minimum of five (5) years' experience installing this type of seal. The proposed product should have been in operation for a minimum period of five (5) years on similar installations of sizes varying from 16- to 30-inch diameter steel or RCP pipes. A reference list of at least ten (10) such installations shall be submitted. All personnel involved with the direct placement, installation and testing of the internal seal shall have proper training and shall, upon request, provide training certification.
- B. Internal pipe seals shall have an accepted testing device or mechanism to allow pressure (leak) testing after installation.

1.05 SUBMITTALS

- A. Submittals shall be made in accordance with the General Requirements and as specified herein.
- B. Drawings, Specifications, installation procedures and schedules, installer qualifications, testing procedures and details, and other data showing complete details of the fabrication, construction, and installation of internal pipe seals, together with complete data covering all materials proposed for use, shall be made in accordance with the General Requirements.
- C. Submittals shall indicate the ASTM designation for the material from which each component is fabricated.
- D. The CONTRACTOR shall submit test and verification procedure form for ENGINEER review and acceptance.

1.06 SHIPPING, HANDLING, AND STORAGE

- A. Shipping, storage, and handling shall be in accordance with Shipping, Storage and Handling section.
- B. Internal pipe seals shall at all times be handled and stored in a manner that will ensure installation in sound, undamaged condition.

1.07 ACCEPTABLE MANUFACTURERS

- A. Internal pipe seals shall be manufactured by Miller Pipeline Corporation, HydraTech Engineered Products or equal. For considering as equal, the manufacturer shall demonstrate a minimum experience of five (5) years in the design, manufacture and installation of internal pipe seals of sizes required for this Project. Reference lists including Project name, seal sizes, application, year of installation and contact details shall be submitted.

1.08 LOCATIONS

- A. Internal pipe seals shall have the sizes and location indicated on the Drawings.

PART 2 PRODUCTS

2.01 PRODUCT DESCRIPTION

- A. Each internal pipe seal shall consist of an EPDM rubber membrane, stainless steel 316L bands to hold the rubber membrane in place, shims, wedges and other items to make it a complete assembly. The named manufactures produce internal pipe seals in at least three (3) different configurations – standard, extra-wide and double-wide. The minimum overall width of the seals for the three (3) types shall be as indicated below:
1. Standard seal: 10.80 inches
 2. Extra-wide seal: 14.40 inches
 3. Double-wide seal: 18.00 inches
- B. The CONTRACTOR shall coordinate with the Carbon Fiber Reinforced Polymer (CFRP) manufacturer on the specific sizing for the seals that will be installed at the transitions and termination locations between the CFRP liner and steel pipe or RCP. The sizing for seals at these transitions is expected to vary depending on the design of the CFRP lining system.

2.02 MATERIALS AND EQUIPMENT

- A. EPDM Rubber: The EPDM rubber membrane used for the pipe seal shall fully comply with ASTM D2000, ASTM D3900 and ASTM D3568 and shall meet the following requirements:
1. Ingredients of the EPDM polymer shall be listed in Food and Drug Administration (FDA) Title 21 Code of Federal Regulations Section 177.2600 with the final material not supporting microbiological growth when used in potable or sea water or in humid aerobic conditions.
 2. The volume change of the rubber shall not exceed three (3) percent after immersion in fresh or sea-water at 212 degrees F for 70 hours.
 3. The stress relaxation shall not exceed 12 percent when tested from a time of 30 minutes to 24 hours.
 4. No voids, cracks, or similar defects shall be witnessed during visible inspection.
 5. The EPDM material shall have the following Physical Properties:

Durometer ASTM D 2240	65 plus or minus 5
Tensile (psi) ASTM D 412	1450 min
Elongation (percent) ASTM D412	250 min.
Heat Aged ASTM D573	70 hours at 700 degrees C
Durometer	plus or minus 15
Tensile change (percent)	plus or minus 30
Elongation change (percent)	50 max.
Compression set ASTM D395B	22 hours at 700 degrees C
Permanent Set (percent)	25 max.
Ozone Resistance (percent)	85 min.

B. EPDM Joint Splicing:

1. The splice in the EPDM rubber seal shall be made using compression molding method with virgin rubber of the same compound with which the seal is manufactured. A minimum width of 1/4 inch shall be maintained at the interface.
2. The joint shall be vulcanized at 330 degrees F minimum temperature.
3. The joint shall not be manufactured with any glue, adhesive or equivalent.
4. While gripping the seal at approximately 6 inches on each side of the spliced joint and bending around a 3-inch min., diameter mandrel should not produce any visible separation. No voids, cracks, or similar defect shall be witnessed during this bend test.
5. The number of joint splices shall be minimized per the manufacturer's equipment capabilities.

C. Bands, Shims and Wedges:

1. Retaining bands shall be stainless steel 316L conforming to ASTM A240 and shall be at least 2 inches wide. Thickness of retaining bands shall be selected by the manufacturer depending on seal diameter. The weld wire shall conform to AWS A5.4.
2. All materials such as push tabs, shims, and wedges shall be made of the same material as the base material.
3. The retaining bands shall be rolled to the radius of the pipe. The radius shall be obtained based on field measurements.
4. Shims shall be manually finished to the required radius and all edges shall be deburred.

D. Physical Requirements of Retaining Bands:

1. Tensile Strength (min.): 70,000 psi
2. Yield Strength (min.): 25,000 psi
3. Elongation in 2 inch (min.): 40 percent
4. Brinell Hardness (max.): 217
5. Weld Wire: 70,000 psi

E. Design Consideration: The retaining band shall not buckle under installation loading. The maximum stress in the push tab welds shall conform to AWS D1.6. The maximum stress in the push tab welds shall not exceed the ultimate tensile strength in the weld wire or stick. The compressive force created in the retaining band due to thermal expansion shall not buckle under installation loading. The hydrodynamic pressure shall not exceed the minimum friction force created by the hydraulic expander under installation loading.

F. Test Valve: A test valve shall be installed in the rubber seal to enable pressure test after pipe seals have been installed. The test valve shall be made of stainless steel 316 material and shall be equipped with a means to seal or plug the valve after testing. Means of sealing with a threaded plug or equivalent shall include a non-toxic Teflon thread sealant.

2.03 JOINT LUBRICATION

- A. The use of a joint lubricant may be necessary to assist in the installation of the rubber membrane and steel bands. The joint lubricant shall meet the following requirements.
 - 1. Joint lubricant shall be non-toxic and shall not support the growth of bacteria.
 - 2. Joint lubricant shall not have any deteriorating effect on natural or synthetic rubber.
 - 3. Joint lubricant shall not impart taste or odor to water.
 - 4. Joint lubricant shall not contain any petroleum based oils or greases.
 - 5. The joint lubricant shall be suitable for a temperature range of 0 degrees F to 120 degrees F.
 - 6. Acceptable lubrication products include J.C. Whitlam Mfg. Co. "Blue Lube", Seacord Corp. "Ease-On", or equivalent.

2.04 PIPE FILLER AND PIPE PREPARATION

- A. It may be required to fill low areas of the pipe on each side of the joint where the seating surface/ bands of the seal is to be located. For steel pipes, the filler material shall be an epoxy and/or metallic polymer based system meeting the following requirements.
 - 1. Be non-toxic and shall not support the growth of bacteria.
 - 2. Shall not have any deteriorating effect on natural or synthetic rubber.
 - 3. Shall not impart taste or odor to water.
 - 4. Shall not contain any petroleum based oils or greases.
 - 5. Minimum Compression Strength (ASTM C109) = 3,000 psi after one (1) day.
 - 6. Minimum Shore D Hardness (ASTM D2240) = 80
 - 7. Belzona 1211 or equal filler product.

2.05 HYDRAULIC EXPANDER

- A. Hydraulic expanders, if used for installation of the seal shall be capable of providing a minimum of 6,000 psi hydraulic expansion pressure for installation of stainless steel retaining bands. Two (2) hydraulic expanders should be on-site, one (1) for use and one (1) as spare.
- B. If the manufacturer or recommended installer has other ways of installing the bands, submit details to the ENGINEER prior to using them. The ENGINEER is open to accepting other proven methods of installation.

PART 3 EXECUTION

3.01 GENERAL

- A. All Work associated with the installation and testing of internal pipe seals shall comply with the applicable Federal, State, and local codes and standards. All workers shall be properly trained in the hazards and risk associated with working in confined spaces. Prior to installation, pipe seals should be visually inspected by a qualified installer to ensure that seal material is free of defects. If quality or condition of material is in doubt, the seals shall not be used.

3.02 SITE PREPARATION WORK

- A. The following steps shall be followed:
 - 1. Installation work shall be performed with pipe lines isolated from service and an adequate safety boundary has been established and accepted by all parties. All pipelines shall have been dewatered (if applicable) and are maintained at atmospheric pressure throughout the duration of the installation work.
 - 2. All permits, as required by the local and State codes, or by OWNER shall have been processed and received and shall be available for review.
 - 3. All pipe seals, materials, consumables and tools required for completion of the Work shall be verified as in good working condition. All equipment and tools required for installation and testing shall have valid calibration certificates.
 - 4. Means of providing continuous forced air ventilation shall be provided and maintained to establish a safe oxygen level for confined space entry.

3.03 CLEANING

- A. Remove all dirt, scale and other debris from pipe walls in area where pipe seals are to be installed. The cleaned area shall extend a minimum of 1 inch beyond the required sealing area. Cleaning operations shall be accomplished by hand brushing, pneumatic brushing, and/or oil-free air jet.
- B. All materials removed by the cleaning operation shall be intercepted and removed at the nearest manhole and disposed of at an accepted location.
- C. All projections at the location of the seal installation or those hindering access to the seal location shall be removed by mechanical means.
- D. During cleaning, protect pipeline and coating system from damage. Any damage that may occur during the cleaning process shall be repaired at no cost to OWNER by an acceptable and accepted method.

3.04 JOINT PREPARATION

- A. Joint preparation shall be performed in accordance with the manufacturer's installation instructions. The following general guidelines are provided for reference:
 - 1. The pipe shall be pre-marked with a grease chalk to properly define the seal position and the area of pipe to be surface prepared.
 - 2. The area of the pipe on either side of the joint, where the seal makes contact with the pipe shall be prepared to a finish which will allow the seal to interface consistently for providing a tight and permanent seal.
 - 3. High and low surface imperfections in the areas of the sealing surface shall be removed. Low areas shall be filled with a suitable non-toxic filler material as described in this Specification.
 - 4. Gaps at the joints that are produced by offset, separated or misaligned pipes shall be filled to the full depth and rendered flush with the surface of the pipe with a suitable non-toxic filler material as described in this Specification.

3.05 SEAL INSTALLATION

- A. Installation of the seal shall be performed in accordance with the manufacturer's installation instructions. The following steps are general installation guidelines any are not exhaustive.
1. Lubricate the prepared seal area with an accepted lubricant. The lubricant functions as an aid in fitting the seal as is not credited with seal tightness.
 2. Verify that the seating surface of the rubber seal is free of any dirt, scale or other debris.
 3. Position the seal such that the lip seals run parallel with the joint and are located per the markings on the pipe. The pressure test valve should be located at either the 9:00 or 3:00 position.
 4. Install metal shims underneath the wedge area in the seal grooves for each band prior to installing the metal retaining bands in the seal. These shims enable radial loads to be transmitted evenly to the rubber seal as the bands are expanded.
 5. Position the retaining bands in the seal grooves.
 6. Position the seal expander in line with the retaining band and ensure that the retaining band remains in the groove. Expand the bands using the hydraulic expander.
 7. Install a locking piece (wedge) in the exposed gap between the expanded band ends. The wedge size shall be selected so as to provide interference fit.
 8. Repeat 1 through 7 for subsequent bands on the same seal.
 9. Perform a second expansion of each of the retaining bands a minimum of 30 minutes after the first expansion using the same pressure range as the first expansion.
 10. Replace wedge pieces with larger sizes if required to provide interference fit.

3.06 SEAL TESTING

- A. Testing of the seal shall be performed in accordance with the manufacturer's installation instructions. The following general guidelines are not intended to be inclusive of all testing procedures.
1. A pressure test shall be performed to assure the seal has been installed correctly. After a minimum of 30 minutes has elapsed, the test shall be conducted.
 2. Pressurize to 10 psig (plus or minus 2 psig) through the seal test valve. Apply an accepted soap test solution to the seal ends and inspect for leakage.
 3. If the pressure test indicated leakage, determine cause and repeat installation steps.
 4. In the event a second pressure test fails, notify manufacturer for evaluation and direction before additional work on the failed seal.
 5. Depressurize the seal and isolate the test port.
 6. Remove all installation hardware, pressure gauges, and consumables from the pipe.

3.07 QUALITY CONTROL AND DOCUMENTATION

- A. The documentation described below is based on using a hydraulic expander. If a different method is used for installing the bands, relevant details like the torque to be applied shall be documented.

1. The seal manufacturer shall provide to installer documentation detailing seal installation and forms to be used as a checklist that all steps required for proper seal installation and testing have been completed.
2. The manufacturer shall appoint a qualified technician the responsibility of recording all data associated with seal installation and testing including, but not limited to, the following:
 - a. Pipe sealing surface condition has been properly prepared and all voids have been filled and high areas removed.
 - b. The sealing surface area of the seal is free of debris.
 - c. The seal has been properly located over the joint.
 - d. Record the time that each band is installed.
 - e. Record the pressure of hydraulic expander for each band and confirm expander is maintained at correct pressure.
 - f. Record the time of second expansion of each band and confirm that 30 minutes has elapsed between the first and second expansion.
 - g. Record the pressure of hydraulic expander for each band and confirm expander is maintained at correct pressure during second expansion.
 - h. Record whether larger wedge was installed for each band.
 - i. Record 30 minutes has elapsed from second expansion to begin pressure test.
 - j. Record time and pressure for first pressure test.
 - k. Record status of first pressure test.
 - l. Record seal is depressurized and test plug has been plugged.
 - m. Record that all tools, equipment, hardware and consumables have been removed from piping.
3. The manufacturer shall present a copy of a signed and dated "Installation and Testing Verification" form to OWNER for each seal installed.

END OF SECTION

SECTION 33 39 30

FIBER REINFORCED POLYMER COMPOSITE REPAIRS FOR PIPELINES

PART 1 GENERAL INFORMATION

1.01 SUMMARY

- A. The Carbon Fiber-Reinforced Polymer (CFRP) installer shall furnish labor, all materials, tools, equipment, transportation, storage, and supervision required for the design, supply, and installation of internally bonded CFRP, including protective coatings, termination rings, and substrate repair materials, to rehabilitate pipe at locations shown on the Project Drawings.
- B. Substrate preparation and repair as well as clean-up after the completion of Work shall be performed by the CFRP installer.
- C. The CFRP system shall be installed by an applicator certified by the product manufacturer by means of written verification.
- D. The Work related to the installation of CFRP system shall be coordinated with other trades working in the area.

1.02 SINGLE ENTITY UNIT TEAM AND WORK PRODUCT DEFINITIONS

- A. Installer: The installer shall furnish labor, all materials, tools, equipment, transportation, storage, and supervision required for the design, supply, and installation of internally bonded CFRP, including protective coatings, termination rings, and substrate repair materials, to rehabilitate pipe at locations shown on the Project Drawings.
- B. Manufacturer: The manufacturer of CFRP materials and any associated resins, epoxies, or other materials necessary to reflect a completed CFRP system.
- C. Designer: The Engineer of Record that designs the custom CFRP system, including any structural design necessary. The Designer will produce design information in the form of drawings, calculations, reports, etc. for the Project. The Designer shall be a licensed Structural or Civil Engineer in the State of Utah whose license is valid during the Project duration.
- D. Manufacturer's QC Representative (MQCR): Manufacturer's designated person who is present on the job site for the duration of CFRP construction activities. The MQCR shall be responsible for verifying compliance with the Manufacturer's QA/QC program and Project QC requirements as well as documenting QC details throughout the Project.
- E. Single Entity Unit (SEU): The SEU shall provide single unit responsibility for delivering the rehabilitated pipeline inclusive of material and installation, quality control and five (5) year bonded warranty for the Work described in this Specifications. The roles of the SEU may be assumed by Manufacturer, Installer, Designer (if applicable) and/or Joint Venture between the parties in order to complete the work as required in these Specifications inclusive of five (5) year bonded warranty. The SEU shall be fully responsible for all the Work including the design, manufacture, supply, installation, quality control, and

testing, related to the CFRP lining system. The SEU will be the point of contact for the coordination of efforts between the Manufacturer, Designer, Installer, and MQCR.

- F. Working Documents: The Designer signed and sealed calculations and drawings accepted by the OWNER for the Work.

1.03 SEU AND QUALIFICATIONS

- A. SEU: The CONTRACTOR shall engage a SEU who manages a team of professionals regularly engaged in the design, manufacture, supply, installation, and testing of CFRP internal lining of pipes for this Project. The team shall consist of a manufacturer of CFRP materials, the Installer, and the Designer. The SEU shall submit qualifications with the Bid as defined in Section 1.6.
- B. CFRP Lining System Material Qualifications: The CONTRACTOR shall provide testing documentation that demonstrates that properties meet or exceed those used for design of CFRP rehabilitation systems. Minimum material properties shall meet the requirements listed in Article 2.1 of this Specification.

1.04 NOT USED

1.05 REFERENCES

- A. Design and installation of the composite system must comply with pertinent provisions of the following codes and standards. These written Specifications take precedence over incorporated references. The latest revision of the code or standard in effect at the time of execution of the Contract Documents shall be used.
1. American Concrete Institute (ACI):
 - ACI 440.2R: Guide for the Design and Construction of Externally Bonded Fiber-Reinforced Polymers (FRP) System for Strengthening Concrete Structures.
 - ACI 440.3R: Guide Test methods for FRP for Reinforcing or Strengthening Concrete Structures.
 - ACI 503R: Use of Epoxy Compounds with Concrete.
 - ACI 546R: Concrete Repair Guide.
 2. American Society for Testing and Materials (ASTM):
 - ASTM C811: Standard Practice for Surface Preparation of Concrete for Application of Chemical-Resistant Resin Monolithic Surfacing's.
 - ASTM D570: Standard Test Method for Water Absorption of Plastics.
 - ASTM D638: Standard Test Method for Tensile Properties of Plastics.
 - ASTM D695: Standard Test Method for Compressive Properties of Rigid Plastics.
 - ASTM D790: Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
 - ASTM D792: Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
 - ASTM D1141: Standard Practice for the Preparation of Substitute Ocean Water.

ASTM D2247: Standard Practice for Testing Water Resistance of Coatings in 100 Percent Relative Humidity.

ASTM D2563: Standard Practice for Classifying Visual Defects in Glass-Reinforced Plastic Laminate Parts.

ASTM D3039: Standard Test Method for Tensile Properties of Polymer Matrix Composite Materials.

ASTM D4065: Standard Practice for Plastics: Dynamic Mechanical Properties: Determination and Report of Procedures.

ASTM D4258: Standard Practice for Surface Cleaning Concrete for Coating.

ASTM D4473: Standard Test Method for Plastics: Dynamic Mechanical Properties: Cure Behavior.

ASTM D4541: Standard Test Method for Pull-Off Strength of Coatings using Portable Adhesion Testers.

ASTM D7290: Standard Practice for Evaluating Material Property Characteristic Values for Polymeric Composites for Civil Engineering Structural Applications.

ASTM E104: Standard Practice for Maintaining Constant Relative Humidity by Means of Aqueous Solutions.

ASTM E2092: Standard Test Method for Distortion Temperature in Three-Point Bending by Thermomechanical Analysis.

ASTM E2160: Standard Test Method for Heat of Reaction of Thermally Reactive Materials by Differential Scanning Calorimetry.

3. American Water Works Association (AWWA):

AWWA C305: CFRP Renewal and Strengthening of Prestressed Concrete Cylinder Pipe (PCCP).

AWWA M11: Steel Water Pipe: A Guide for Design and Installation.

AWWA M45: Fiberglass Pipe Design, Manual of Water Supply Practices.

Other applicable AWWA Standards.

4. International Code Council (ICC):

ICC- AC125: Acceptance Criteria for Concrete and Reinforced and Unreinforced Masonry Strengthening Using Fiber-Reinforced Polymer (FRP) Composite Systems.

ICC- AC178: Acceptance Criteria for Concrete and Reinforced and Unreinforced Masonry Strengthening Using Externally Bonded Fiber-Reinforced Polymer (FRP) Composite Systems.

5. International Concrete Repair Institute (ICRI):

ICRI 03730: Guide for Surface Preparation for the Repair of Deteriorated Concrete Resulting from Reinforcing Steel Corrosion.

ICRI 03732: Selecting and Specifying Concrete Surface Preparation for Coatings, Sealers, and Polymer Overlays.

ICRI 03733: Guide for Selecting and Specifying Materials for Repair of Concrete Surfaces.

6. National Sanitation Foundation (NSF):

NSF 61A: Drinking Water System Components – Health Effects.

NSF 61-Annex G: Lead Content Requirement

7. Society for Protective Coatings (SSPC):
- | | |
|-------------|---------------------------|
| SSPC SP 10: | Near-White Blast Cleaning |
| SSPC SP 6: | Commercial Blast Cleaning |

1.06 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall submit the following information in accordance with the requirements of the General Requirements.
- B. Submittals Due with Bid. The CONTRACTOR shall submit the following qualifications, design submittal, and SEU documentation with the bid:
1. Installer Qualifications: List a minimum of twenty (20) separate water or waste water pipe rehabilitation projects in the last five (5) years with an internal hydraulic pressure of 10 psi or more, involve internal structural lining of reinforced concrete pipe or steel pipe, and with pipe diameters greater than or equal to 30 inches using the internally applied CFRP wet layup method. Ten (10) reference projects shall have a length greater than 50 lineal feet. Three (3) reference projects shall have internal CFRP wet layup method of a 90-degree bend. Five (5) reference projects shall have been designed for HS-20 traffic loading. Contact information for each project reference, date of installation and a summary of the Work performed for each reference shall be provided.
 2. Manufacturer's Material Qualifications: Provide documentation of a minimum of twenty (20) separate pipe rehabilitation projects using the internally applied CFRP wet layup method on pipes with diameters greater than or equal to 30 inches which have been in service for a minimum of five (5) years. Each project reference shall have a length greater than 50 lineal feet. Contact information for each project reference, date of installation and a summary of the Work performed for each reference shall be provided.
 3. The Designer Qualifications: Provide documentation that the Designer has been the Engineer of Record for twenty (20) water or wastewater pipe rehabilitation projects with an internal hydraulic pressure of 10 psi or more and HS-20 traffic loading using the internally applied CFRP wet layup method within the past five (5) years. Five (5) reference projects shall have internal CFRP wet layup method of a 90-degree bend. Contact information for each project reference, date of installation and a summary of the Work performed for each reference shall be provided.
 4. Draft Structural Calculations and Drawings. Draft Documents shall detail the type, product name, locations, dimensions, number of layers and orientation of CFRP/GFRP materials, weight of fabric, minimum overlap length circumferentially and longitudinally, product name of saturating epoxy, primer epoxy, and the top coat epoxy, and/or coatings installed. The Designer shall also provide a technical discussion and design details regarding proposed electrical isolation between the steel pipe and fittings and the CFRP liner. Draft Drawings shall include lining termination details for each end of the CFRP application, including branch line ends
 5. Provide documentation of SEU teaming agreement or joint venture between the Installer, Manufacturer, and Designer. Provide confirmation of the ability to provide a five (5) year bonded warranty as the SEU. List each member of the SEU team, contact information, and acknowledgement that each SEU team member meets the experience requirements of this specification.

- C. Submittals Due After Award of Contract: Technical and QA/QC submittals shall be submitted to the OWNER no later than 30 days after Notice to Proceed.
1. Technical Submittal:
 2. Submit a summary statement of design methodology, specific approach and compliance with Manufacturer's recommendations.
 3. Structural calculations and Drawings (Working Documents) stamped and signed by the Designer. Working Documents shall detail the type, product name, locations, dimensions, number of layers and orientation of CFRP/GFRP materials, weight of fabric, minimum overlap length circumferentially and longitudinally, product name of saturating epoxy, primer epoxy, and the top coat epoxy, and/or coatings installed. The Designer shall also provide a technical discussion and design details regarding proposed electrical isolation between the steel pipe and fittings and the CFRP liner. Working Document Drawings shall include lining termination details for each end of the CFRP application, including branch line ends.
 4. Installation and curing procedures, maintenance instructions, and general recommendations regarding CFRP material to be used.
 5. Access and ventilation plan including confined space certification for all personnel scheduled to conduct confined space entry.
 6. Noise abatement plan for equipment needed to support ventilation, dehumidification, and other equipment required as part of CFRP installation. Comply with **Contract Document requirements** for acceptable decibel levels within specific distances from occupied dwellings. Include plan and details of proposed barriers to mitigate excessive noise.
 7. Certification of Installer by the Manufacturer of the CFRP system. Documentation from the Manufacturer shall demonstrate that Installer's personnel are trained and certified in the installation of the proposed CFRP system for internal strengthening of pipelines using carbon fiber.
 8. Certification that the Installer's superintendent, the foreman, and the lead technicians scheduled to install the CFRP system for this Project have a minimum of ten (10) projects in the last three (3) years of internal water or wastewater pipe repair projects using CFRP on pressure pipes. A list of projects including CFRP internal lining of large diameter pipes shall be provided for the proposed CFRP installation superintendent, foreman, and lead technicians.
 9. Documentation that the Installer has authority to use the repair methods intended for use for the Project without infringing on U.S. patents, associated with the Work.
 10. Documentation that Designer has designed of a minimum of three (3) water or wastewater pipe rehabilitation projects which have used the internal joint seal termination details in a manner comparable to the proposed rehabilitation system.
 11. Documentation that the Designer has been the Engineer of Record for twenty (20) water or wastewater pipe rehabilitation projects with an internal hydraulic pressure of 10 psi or more and HS-20 traffic loading using the internally applied CFRP wet layup method within the past five (5) years where the proposed CFRP Designer was the Engineer of Record. Contact information for each project reference and a summary of the Work performed for each reference shall be provided.
 12. Manufacturer's certification that the proposed CFRP system can fully cure within 72 hours.
 13. Manufacturer's Product Data Sheet indicating physical, mechanical, and chemical characteristics of all materials used in proposed CFRP systems. Data sheets shall

include properties of composite materials determined by independent laboratory testing following ASTM standards listed herein.

14. Manufacturer's Material Safety Data Sheets for all materials.
15. Manufacturer's application instructions.
16. Manufacturer's written acknowledgement that materials and process used meets Occupational Safety and Health Administration (OSHA), Environmental Protection Agency (EPA) and local ordinances for health and safety. Also include a statement that confirms all materials proposed for use on this Project are Volatile Organic Compound (VOC) compliant and safe for use in confined spaces.
17. An accepted/valid International Code Council (ICC) Evaluation Service Report (ESR) for the proposed pipeline rehabilitation system. Products that do not have an ESR number shall provide all the durability tests defined in ICC AC 125 to validate the proposed system durability. No polyester or vinyl ester will be accepted as alternates to an epoxy matrix.
18. Manufacturer's Full-scale Testing Validation Report that documents pressure testing on 30-inch- diameter or greater sections of pipeline under pressures of at least 10 psi.
19. Quality Control Submittal:
20. Quality Control report describing the inspection of completed installation. Include the following, as a minimum:
21. All requirements defined in Section 1.9.
22. Name of personnel responsible for quality control.
23. Testing program for surface preparation evaluation procedure.
24. Material testing documentation of CFRP and GFRP.
25. Method for ensuring that the adhesion of FRP system will conform to specified and indicated requirements.
26. Methods for repairing defective linings.
27. Contingency plan to meet specified requirements in the event of an interruption to the CFRP placement.
 - 1) Pipeline internal environmental monitoring including the type of measurement equipment and data loggers to be used to continuously monitor and record the air temperature, surface temperature, and relative humidity within the pipeline at several representative areas during rehabilitation. In addition, a hygrometer and thermometer shall be used to take periodic relative humidity and temperature readings, respectively, as a quality control measure. Hygrometer testing shall be performed and recorded on an hourly basis during rehabilitation activities, and when requested by the ENGINEER. The monitoring plan shall include a dewpoint temperature chart and define limits of acceptable environmental temperatures and relative humidity within the pipe.
 - 2) Details on the Installer and ENGINEER training program to be provided by the Manufacturer.

D. Post CFRP Installation Submittal:

1. Submit a completed QA/QC report describing the inspection of the installation in which documents all inspection steps described in Section 1.9 of this Specification.
2. Provide a post construction survey of the completed Work.

3. Provide a warranty for the completed FRP installation work as outlined in Section 1.10 of this Specification.
4. As-Built Drawings indicating all FRP liner details and end terminations installed.

1.07 STORAGE AND SAFE HANDLING OF MATERIALS

- A. Storage and safe handling of materials shall meet the following requirements and/or Manufacturer's recommendations, whichever is more stringent.
- B. Storage:
 1. Epoxy and resin compounds shall be stored in their unopened containers in temperature range of between 40 degrees F and 100 degrees F. An optimum storage temperature is between 65 degrees F and 85 degrees F.
 2. Epoxy and resin materials have a limited shelf life. In order to preserve their properties and reactivity, these materials shall be stored in their unopened containers for periods of two (2) years or less. Materials that have exceeded their shelf life, and materials that have been stored improperly, as specified by Manufacturer, must be disposed of in accordance with the disposal instructions given in Section 3.8 of this Specification.
 3. Fabrics typically have a ten-year shelf life, which must be verified by the Manufacturer, and must be kept away from dust, moisture, chemicals, direct sunlight, physical damage, and fire.
- C. Safe Handling:
 1. CONTRACTOR shall ensure that all materials are handled with care to avoid any physical damage and also to avoid potential safety hazards. Those who are involved with handling and application of the epoxy compounds must thoroughly be informed of the safety hazards and potential dangers of the particular chemical they are handling. This includes access to and familiarity with the Safety Data Sheets (SDS). The SDS must be consistently placed in a familiar location and at all times be accessible to the work crew.
 2. CONTRACTOR is responsible for providing SDS to all personnel and inform them of the potential safety hazards and other important characteristics of epoxies and resins. Furthermore, the CONTRACTOR is responsible for making sure that all stages of the Project are executed in accordance with the federal, state, and local environmental laws and regulations in addition to the OSHA requirements and laws to protect the safety of all workers.
 3. CONTRACTOR shall ensure safe ventilation is provided when working with epoxy and resin compounds. Safety goggles or glasses are necessary when working with epoxies. Coveralls and chemical resistant gloves must be worn by all personnel in the work area. The gloves must have been tested for resistance to resins, epoxies, and solvents.
 4. CONTRACTOR shall avoid unnecessary and prolonged handling of fabrics.

1.08 CFRP MANUFACTURERS

- A. The CFRP Manufacturer shall meet all criteria listed in this Specification. The following firms meet the criteria for CFRP Manufacturer as required by this Specification:
- B. CFRP Manufacturers:

- a. Fyfe Company, 15341 Vantage Parkway east, Houston, TX 77073
2. 2. Structural Technologies, LLC, 10150 Old Columbia Road, Columbia, MD 21046

1.09 QUALITY ASSURANCE AND QUALITY CONTROL

- A. Introduction: The SEU shall be responsible for the quality control of all materials and processes in the Project and providing access to the repair areas to allow for quality assurance inspections. The Installer shall be responsible for the quality assurance aspects of the installation. The Manufacturer shall provide a project specific QA/QC training session for all Installer personnel as well as all ENGINEER's personnel involved in the QA/QC process. The QA/QC program must be reviewed and accepted by the ENGINEER. A QA/QC plan shall be submitted for review and acceptance by the ENGINEER. The QA/QC plan shall include specific procedures for personnel safety, tracking and inspection of all CFRP components prior to installation, inspection of all prepared surfaces prior to CFRP application, inspection of the Work in progress to ensure conformity to Specifications, test samples, inspection of all completed Work, repair of any defective work and clean up. The QA/QC program documentation (inspection forms, test reports, laboratory results, etc.) generated will be provided to the ENGINEER on a weekly basis.
- B. Field Quality Control: All phases of Work performed shall be inspected by the SEU prior to presenting the Work to the ENGINEER for acceptance.
- C. Materials Inspection: The packaging list and all delivered materials must be inspected for conformity to the Working Documents by the Installer prior to presenting this information to the ENGINEER for acceptance. Any material, that does not meet the requirements of the Working Documents shall be rejected and replaced with the correct material.
- D. Daily Inspection: Daily inspection by the SEU shall be performed to record: 1) date and time of repair; 2) ambient and steel/CML surface temperatures; 3) general weather conditions; 4) surface dryness per ACI 503.4; 5) surface profile and surface preparation using Society for Protective Coatings (SSPC) requirements; 6) qualitative description of surface cleanliness; 7) type of auxiliary heat source, if any; 8) fiber and epoxy batch numbers and their locations in the structure; 9) qualitative appearance of all mixed resins; 10) saturation of the fabric and documentation of weight tests; 11) observations of the progress of curing of the resins; 12) conformance with installation procedures and accepted Project Drawings; 13) adhesion test results of bond strength, failure mode, and location; 14) location and size of any delaminations or air voids; 15) photos; and 16) the general progress of the Work. CFRP properties from tests of field samples or witness panels shall be obtained following construction to allow for proper curing, shipping to laboratory, and laboratory testing constraints. All documentation is to be transmitted to the ENGINEER on a weekly basis.
- E. Fiber Orientation Inspection: Fiber orientation will be visually examined and documented by the Installer for conformity to the Working Documents. Non-conforming areas will be removed and repaired by the Installer at no additional cost to the OWNER.
- F. Debonding Inspection and Repair: Following the first 24 hours after installation, visual inspection will be conducted by the SEU to determine locations of any swellings, bubbles, air voids, or delaminations. All suspect defective locations will be documented and presented to the ENGINEER. If an air pocket is suspected, an acoustic tap test will be

carried out with a hard object to identify delaminated areas by sound, with at least one (1) strike per square foot of area. Defects smaller than 2 square inches will require no corrective actions as long as the total delaminated area is less than five (5) percent of the total laminate area, there are no more than ten (10) such delaminations per 10 square feet, and they are not located around the boundaries of the fabric or laminate. Moderate delaminations less than 25 square inches will be repaired by using low pressure epoxy injection as long as the defect is local and does not extend through the complete thickness of the laminate in case of multiple CFRP/GFRP systems. If any delamination growth is suspected between the CFRP/GFRP plies, the area around the defects to an extent of at least 1 inch on all sides shall be carefully removed, the area cleaned and patched with the same number of plies extending at least 6 inches on all sides. This repair scheme must also be conducted for defects larger than 25 square inches. Repair procedures for conditions not specifically addressed in this Specification shall be reviewed and accepted by the ENGINEER. Any required repairs shall be by the Installer at no additional cost to the OWNER.

G. Adhesion Inspection:

1. Prior to repair of pipe sections, at least three (3) pull-off tests per mock up area and at least one (1) mock up area per 100 lineal feet of pipeline, or per localized repair region, whichever is greater, must be performed on mockup areas on adjacent non-repair pipes in accordance with ASTM D4541, to verify adhesion strength of the bond between CFRP and substrate. Test locations and sampling frequency shall be as those identified on the Working Documents. The verification provided by the testing on the mockup areas serves as verification of the quality of construction. All pull-off tests are to be performed by the Installer and witnessed by the ENGINEER.
2. Failure mode shall be at least a minimum of 700 psi must be achieved as the tensile stress between the CFRP and the steel pipe in order to pass the adhesion test, or at least a minimum of 300 psi must be achieved as the tensile stress between the CFRP and the concrete pipe in order to pass the adhesion test. Failed tests will result in the work area being rejected and the CFRP must be removed and replaced by the Installer's at no additional cost to the OWNER. The test area must be patched with thickened epoxy.

H. Testing:

1. Field testing of the CFRP system is required each day of application. The Installer is responsible for all field testing, costs expected to the Bid.
2. Two (2) sample sets minimum shall be made per installation shift. The sample sets shall measure minimum dimensions of 12 inches x 12 inches, made of each composite layer. Each sample shall be coded and dated and shall be accompanied with the site environmental data such as the pipeline. The samples shall be cured following the Manufacturer's recommendations before they are sent to the lab for testing. Either two (2) panels or 20 percent of all panels fabricated during a project, whichever is greater, shall be tested.
3. The Installer shall test the tensile properties of the samples at a test laboratory with previous documented experience testing civil grade CFRP composites in accordance with ASTM D3039. A reference list of at least five (5) different projects completed by the test laboratory which involved ASTM D3039 testing of civil grade CFRP shall be submitted prior to acceptance of the test laboratory. The test laboratory shall be accredited by one (1) of the following accreditation agencies:
 - a. International Accreditation Service (IAS)

- b. American Association for Laboratory Accreditation (A2LA)
- 4. The test laboratory will perform a minimum of five (5) tensile tests per panel in accordance with ASTM D3039 with the following modification: the nominal thickness of the CFRP samples reported on the material's product data sheet rather than the actual thickness of the CFRP samples will be used for calculating material properties. The lot number for the fabric and the resin used for preparing the sample must be recorded by the lab along with the tensile strength, modulus, specimen dimensions, and percent elongation.
- 5. The tested tensile properties must meet or exceed the design tensile strength and tensile modulus as defined in the product submittal. If one (1) sample average results do not achieve the design properties, additional coupons from the same day of application shall be tested. If the second panel fails to meet the required tensile properties, the application of CFRP system for that day shall be rejected, and the ENGINEER shall be contacted for review and acceptance of remedial measures proposed.

1.10 WARRANTY

- A. The SEU shall warranty the CFRP system against defects in the workmanship and material for a period of five (5) years. Warranty period shall commence after final acceptance of the Project by the OWNER. The Warranty documentation shall be issued by the SEU and submitted by the CONTRACTOR prior to final acceptance of the Project by the OWNER.
- B. The SEU shall provide a five-year bonded warranty for the CFRP system, which is bonded by an "A rated surety" licensed to provide surety bonds in the state of Utah. Documentation of ability to provide a bonded warranty shall be provided with bid. The warranty shall include, but not be limited to, covering workmanship and/or material defects such as bubbles, delamination, fabric tears spanning more than five (5) percent of the estimated surface area of the pipe, interfacial peel-off of CFRP layers and top coat, and debonding from concrete substrate. The warranty shall cover materials and labor for repair of material and/or workmanship defects during the warranty period.
- C. The ENGINEER will schedule a condition field walk of completed CFRP work areas after repaired pipes are placed back in service within the warranty period. The Installer and Manufacturer shall have a representative present for the condition field walk. The cost of the warranty condition field walk preparation and attendance shall be included in the Bid. The ENGINEER will give a minimum of 30 days' notice regarding the field walk date. The SEU shall be prepared to participate in the condition field walk and mobilize resources and materials to address any areas requiring warranty-related remediation during the same scheduled pipeline shutdown.
- D. If, in the opinion of the OWNER, defective Work is detected during the warranty period which creates a dangerous condition or requires immediate correction or modification to prevent further loss to the OWNER or to prevent interruption of the OWNER operations, the OWNER will attempt to give the **notice required by the General Conditions**. If the CONTRACTOR cannot be contacted or does not comply with the OWNER's request for correction within a reasonable time as determined by the OWNER, the OWNER may, notwithstanding the provisions of this section, proceed to make such correction or provide such modification. The costs of such correction or modification shall be charged against the CONTRACTOR. Such action by the OWNER will not relieve the CONTRACTOR of

the warranties required by this section or elsewhere in the Contract Documents. In the event of failure to comply with the above-mentioned conditions within one (1) week after being notified in writing, the OWNER is hereby authorized to proceed to have the defects remedied at the expense of the CONTRACTOR who hereby agrees to pay the cost and charges thereof immediately on demand. The CONTRACTOR's warranty shall continue as to any corrected deficiency until the remainder of the original five-year warranty period.

PART 2 PRODUCTS

2.01 CFRP LINING SYSTEM

- A. The CFRP system shall consist of a combination of epoxy resin matrix reinforced with carbon and glass fibers.
- B. Use materials for the CFRP system from a single manufacturer and ensure the consistency of compatible products for primer, surface rendering, saturation resin, carbon fiber, intermediate thickened epoxy coats, and final top intended and tested for use in wastewater immersion environments.
- C. Products shall be certified by the product manufacturer to have the following properties:
 - 1. Carbon Fiber and Glass Fiber Fabrics: Only unidirectional carbon fiber shall be used for strengthening applications. Bidirectional glass fiber fabrics are permitted for use on non-structural applications.
 - 2. Saturation resin shall be a two-component epoxy and shall have: 1) a maximum water absorption of two (2) percent when tested in accordance with ASTM D570 (24 hours); 2) a minimum compressive yield strength of 10,000 psi when tested in accordance with ASTM D695 (75 degrees F, 7-day cure); 3) a minimum tensile modulus of 400,000 psi; 4) a minimum tensile strength of 6,000 psi with an elongation of greater than two (2) percent when tested in accordance with ASTM D638 (14-day cure); 5) a minimum flexural strength of 7,500 psi and a minimum flexural modulus of 350 ksi when tested in accordance with ASTM D790 (14-day cure); and 6) a minimum shore D hardness of 70 at a minimum of 85 percent cure when tested in accordance with ASTM D2240.
 - 3. Epoxy/carbon fiber composite shall have: 1) a minimum tensile modulus of elasticity of 9,000 ksi; 2) a minimum laminate thickness of 0.07 inch; 3) a maximum laminate thickness of 0.10 inch; 4) a minimum tensile strength of 100 ksi; 5) a minimum flexural modulus of 8,000 ksi; 6) a minimum flexural strength of 14,000 psi; and 6) a minimum strain at CFRP rupture of 0.7 percent when tested in accordance with ASTM D3039.
 - 4. Epoxy/glass fiber composite shall have: 1) a minimum tensile modulus of elasticity of 2,000 ksi; 2) a minimum laminate thickness of 0.01 inch; 3) a maximum laminate thickness of 0.10 inch; 4) a minimum tensile strength of 30 ksi; 5) a minimum flexural modulus of 4,000 ksi; and 6) a minimum strain at GFRP rupture of 1.0 percent when tested in accordance with ASTM D3039.
- D. A thickened epoxy system, which consists of the saturating epoxy and silica fume mixed at the site according to the Manufacturer's recommended procedure, shall be used to provide a smooth surface for the application of the CFRP laminate. Silica fume used shall consist of Cab-O-Sil TS 720, Aerosil R202, or equal.

- E. The CFRP system shall be top coated with a protective epoxy coating intended and tested for use in wastewater immersion environments, approved by Manufacturer and compatible with the CFRP system. All products installed inside the pipeline shall be VOC compliant. Polyester or vinyl ester will not be accepted as an alternate to an epoxy structural CFRP system matrix component.
- F. Termination of CFRP:
 - 1. A termination detail involving termination of the CFRP lining system into the joint region, flange, or structure, as well as implementation of specialized joint rings shall be provided to ensure durable water tightness and prevent water from getting behind the CFRP liner.
 - 2. To prevent galvanic corrosion, a layer of epoxy saturated glass fiber reinforced polymer composite (GFRP) shall be applied in direct contact with the steel substrate prior to implementation of the CFRP laminate.
 - 3. The Installer shall provide and install appropriately sized double or single band Type 316L stainless steel expansion rings, as called out in Specification Section 3.7 Joint Termination of CFRP System, with 1/4 in elastomeric rubber strips at the terminations between the CFRP liner and the host piping system.

2.02 DESIGN REQUIREMENTS

- A. The CFRP lining system, consisting of CFRP and GFRP layers, shall include full 360-degree coverage of the entire length of each designated repair area. No localized CFRP/GFRP patches shall be permitted.
- B. Design repair for areas shown on the design drawings using fully-structural, standalone CFRP liners without reliance on the host pipes.
- C. Loadings:
 - 1. The CFRP system shall be designed to resist loads from internal pressures, and all other loads specified herein. The design shall be based on the maximum of the forces resulting from different load combinations as required by the Load and Resistance Factor Design (LRFD) approach of AWWA Standard C305.
 - a. Internal Working Pressure of 11 psi.
 - b. Temperature Differential (with respect to installation temperature) of plus or minus 40 degrees F.
 - c. A vacuum pressure of 1 psi maximum.
 - d. Hydraulic thrust force due to tees, reducers, and branches.
- D. Additional Design Requirements:
 - 1. The CFRP design shall be performed according to the LRFD procedure specified in AWWA Standard C305, including but not limited to all applicable loads, load combinations, material adjustment factors, resistance factors, and watertightness requirements. Other manuals and standards referenced by AWWA C305 shall be used only to the extent directed within AWWA C305.
 - 2. The CFRP liner system shall satisfy the material qualification requirements of AWWA C305.
 - 3. The CFRP system shall be designed to provide strength, durability, reliability and watertightness for each of the following potential limit states, as applicable,

subjected to the combined factored loads, considering the distress state of the host pipe:

- a. Rupture of CFRP laminate in the circumferential direction due to internal pressure.
 - b. Rupture of CFRP laminate in the circumferential direction due to bending of empty pipe.
 - c. Rupture of CFRP laminate in the circumferential direction due to combined pressure and bending due to gravity loads.
 - d. Buckling of the CFRP laminate in the circumferential direction due to external loads and pressures and internal negative pressure.
 - e. Rupture of the CFRP laminate in the longitudinal direction due to pressure induced thrust, Poisson's effect of internal pressure, and temperature change.
 - f. Shear bond failure of CFRP at all CFRP terminations (e.g., pipe ends, branches, etc.).
 - g. Buckling of the CFRP laminate in the longitudinal direction due to temperature change.
 - h. Rupture of the CFRP laminate in the longitudinal direction due to longitudinal bending under pipe and water weights between pipe supports and wall penetrations, including consideration of local stresses at such supports.
4. The CFRP liner shall be able to bridge over locally degraded areas of the host pipe as demonstrated by both design calculations and laboratory testing of watertightness per AWWA C305.
 5. The CFRP liner shall have a minimum bond strength of 700 psi on steel substrate as required by AWWA C305, and minimum bond strength of 300 psi on concrete substrate as required by ASTM D4541, to be verified by pull-off testing performed in mockup areas prepared inside the pipeline at the beginning on construction. The selected repair material shall be resistant to the environmental conditions expected after repairs. Designer shall review data on the environmental condition in the pipelines and the condition of repair substrates (e.g., steel, mortar lining, etc.), and the literature on the performance of available FRP materials (fibers and resins) used for lining sewers with the hand lay-up method, and recommend a material that has sufficient chemical resistance to the expected environment in this application and has good long term bond properties to concrete.
 6. The CFRP system shall include intermediate joint detailing at each pipe joint which allows the pipeline to maintain the level of flexibility present in the original pipeline. At a minimum, this intermediate joint detailing shall include an additional layer of CFRP, a minimum 3 feet in length, centered over each joint for the full circumference of the pipe. Prior to installation of this additional CFRP layer at the intermediate joints, the SEU shall provide a bond breaker material centered over the joint consisting of one (1) of the following: 100 percent acrylic elastomeric coating, paraffin wax, or equal. See Drawings for a conceptual representation of this joint detail.
 7. The CFRP liner system shall include additional local layers and details as needed in the vicinity of special features such as tees, outlets, and branches.

E. CFRP Liner Design:

1. Determine the number of layers of carbon fiber-reinforced composite material and the layout of the layers, circumferentially and longitudinally, required to resist the

specified loadings in all applicable design limit states with adequate strength/demand ratios per AWWA C305.

2. The design shall be based on properties of the CFRP repair system determined in accordance with the testing required in Section 2.2E.3 of this Specification based on AWWA C305.
3. The design mechanical properties of the single-ply CFRP laminate shall be the characteristic values of strength and modulus defined as the 5th-percentile of a two-parameter Weibull distribution with 80 percent confidence based on ASTM D7290 using results of tests performed in accordance with the Test Method ASTM D3039 test procedure. For multi-ply applications, the characteristic values of strength and modulus in circumferential and longitudinal directions shall be adjusted statistically based on statistical distribution of test results of single-ply strength and modulus.
4. Documentation shall be provided in the calculations to determine the minimum development length between the CFRP lining system and the steel substrate to ensure water tightness at all CFRP terminations based on the calculated longitudinal stresses and shear bond strength of the CFRP lining system on steel substrate prepared to the specified surface profile.

PART 3 EXECUTION

3.01 INSPECTION

- A. CFRP system shall be inspected during all phases of construction by the ENGINEER subsequent to training provided by the Manufacturer. The ENGINEER shall examine substrates, areas, and conditions under which structural epoxy-resin fabric composite systems will be applied for compliance with requirements. The CONTRACTOR shall coordinate with the ENGINEER to allow access to the work area under the CONTRACTOR'S confined space permit. The ENGINEER will direct the SEU to correct any unsatisfactory conditions prior to continuing the CFRP installation process.
- B. The Installer shall examine existing conditions to identify potential obstructions and constraints, verify dimensions, geometry and manhole locations and map all voids and cracks in the host pipe wall.
- C. The CONTRACTOR shall utilize video inspection to document the condition of pipe prior to any repair, after preparation of the surface and before the liner is installed, after completion of liner installation. A copy of each video shall be made available to the ENGINEER for reviewing within 24 hours after the recording of the video. Any defects or changed conditions revealed on the video should be brought to the ENGINEER's attention in writing along with video images showing the defect.

3.02 ENVIRONMENTAL CONDITIONS

- A. Maintain the temperature within acceptable curing range provided by epoxy manufacturer. In cold conditions, auxiliary heat sources may be used to raise the ambient temperature to level recommended by the Manufacturer.
- B. The humidity shall be maintained to meet the recommendation of the Manufacturer. Humidity levels must be low enough to allow for epoxy to cure and reach design strengths. Portable barriers and blowers shall be erected at the repair location to dehumidify the concrete substrate's surface in the pipe.

- C. Water leakage is known to exist through cracks or joints, stop water flow prior to installation. Coordinate with the ENGINEER for accepted leak repair method. Chemical grout injection or other leak repair method shall be performed by the CONTRACTOR at no additional cost to the OWNER. CONTRACTOR shall direct ENGINEER's attention to any leaks observed during or just after the pre-construction survey.
- D. CONTRACTOR shall provide proper dust control and ventilation to meet OSHA requirements.
- E. For internal pipeline repairs, the work area is a confined space that will require an entry permit in accordance with Occupational Safety and Health Administration (OSHA) regulations. The CONTRACTOR shall comply with General Conditions and General Requirements for safety and permit compliance.

3.03 ACCESS

- A. Access to the pipelines will require that the CONTRACTOR isolate the pipeline at the splitter box structure. The pipelines will require dewatering and debris removal prior to initial inspection, to be performed by the CONTRACTOR at no additional cost to the OWNER. The pipelines are known to have I/I leaks at cracks, joints, and other locations that will have to be addressed by the CONTRACTOR at no additional cost to the OWNER.

3.04 PREPARATION

- A. Installer shall ensure that the preparation and soundness of the substrate is complete and fully cured prior to installing the CFRP composite. Installer shall ensure a complete bond between the fiber-reinforced composite system and the substrate is constructed.
 - 1. Removal of Cement Mortar Lining and/or Epoxy Lining: All cement mortar lining and/or epoxy lining shall be removed prior to installation of CFRP. Determination of where CML and epoxy linings are currently installed will be determined by the Installer after access to the pipeline has been established.
 - a. Repair of Steel Surface: All CFRP systems must be bonded to clean, sound, dust free, and dry substrate as verified by ENGINEER. The Manufacturer shall have a dedicated MQCR who is present on the job site for the duration of CFRP construction activities for the Project. The MQCR shall be responsible for verifying compliance with the QA/QC program and Project QC requirements as well as documenting QC details throughout the Project. The steel surface may require repair by welding on steel patches in areas that are too thin to install CFRP or completely corroded through the steel wall. In addition, welding on a steel flange per the Drawings may require steel patching to ensure proper structural integrity of the flange. Steel patching is to be compensated based on a square foot basis per bid table unit costs.
 - 2. Surface Preparation: The steel pipeline shall be abrasively blasted (dry methods only) to SSPC SP10 Near White Metal Blast or SSPC SP 6 - Commercial Blast Cleaning. All termination zones must be a SSPC-10, minimum. The RCP pipeline shall be abrasively blasted (dry methods only) to ICRI CSP3 surface roughness profile.
 - a. All surfaces to receive the CFRP rehabilitation system must be completely cleaned of any dust, grease, oil, curing compounds, wax, stains, paint, surface lubricants, foreign particles, weathered layers, or any other bond inhibiting materials. The surface shall be dry to the touch and have no standing water in the pipe before installation of CFRP.

- b. Inflow and infiltration (I/I) into the pipelines or structures at cracks, joints, or other locations is known to exist and shall be repaired to stop all I/I prior to application of CFRP lining system and no additional cost to the OWNER.

3.05 MIXING OF EPOXY RESINS AND ADHESIVES

- A. Epoxy resins (including primers) shall be mixed according to the Manufacturer's installation instructions.
- B. Installer shall thoroughly mix two-part resin and epoxy compounds for proper development of the adhesives properties.
- C. No organic solvents or thinners are allowed to be used to thin the epoxies.
- D. Installer shall not mix more resin than can be used during the pot-life of the specific resin system.
- E. Any mixed resin that begins to generate heat or increased viscosity, shall not be used and must be disposed of properly according to the instructions. Mix only small quantities in containers with large surface area to volume ratio to allow heat dissipation and prevent potential fire hazards.

3.06 APPLICATION OF CFRP SYSTEM

- A. The application of the CFRP system, including topcoat, shall be performed in accordance with the Manufacturer's instructions.
- B. The epoxy coating shall be installed on surfaces that have been prepared by Section 3.4. of this Specification. After the surface is properly prepared and dry, a high-solids epoxy primer shall be applied. The cleaned and prepared surfaces must be protected against recontamination until the CFRP system is applied.
- C. The wet-layup method shall be the only accepted method for CFRP installation. The Installer shall utilize a fabric saturator and rolling mechanism such that the epoxy saturated fabric is transported to the point of application through the manhole, which is then applied to the surface of the pipe in a wet lay-up process. No dry-layup application of carbon fiber fabric shall be permitted.
- D. The saturation machine shall be calibrated to ensure accurate fiber resin ratio. The Installer shall confirm complete impregnation of CFRP in epoxy to ensure it is completely wet out through the thickness of the fabric through measuring the gap between the rollers on the mechanical saturator and performing a weight test at the beginning of each shift where CFRP installation takes place, as requested by the ENGINEER, and following any substantial break of one (1) hour or more in CFRP installation where no CFRP material saturation is taking place. A weight test consists of weighing an approximately 1 foot x 1 foot piece of fabric before and after impregnation in the impregnation machine, and ensuring that the fabric-to-resin weight ratio is within the range recommended by the Manufacturer. The Installer shall adjust the impregnation machine as necessary and as specified by the Designer.
- E. Saturated fabric shall be pressed into the surface to achieve thorough contact. Entrapped air between layers shall be released or rolled without wrinkling of the fibers.

- F. A thickened epoxy system, which consists of the saturating epoxy and silica fume mixed at the site according to the Manufacturer's recommended procedure, shall be used to provide a smooth surface for the application of the CFRP laminate. The thickened epoxy shall be used to fill in surface voids and even out the concrete substrate. It is permissible to use a thin coat of thickened epoxy between lamina to enhance adhesion.
- G. The plies and the fibers in the fabric shall be oriented in the directions that are shown on the Working Documents. Misalignments greater than 1 inch per foot or more than 5 degrees will be rejected. Any fabric kinks, folds, waviness, or misalignments shall be reported to the ENGINEER immediately.
- H. The fibers must be fully continuous or lapped in their primary direction. Whenever there is an interruption in the primary direction of the fibers, a lap joint must be designed and fibers need to be overlapped. Designer shall include a detail for such instances as part of the design and be shown on the Working Documents. In no case shall such overlap be less than 6 inches. Additionally, the lap joints on multiple plies and adjacent strips, and termination points must be staggered. No lap joint is necessary for unidirectional fabrics or laminates in a direction perpendicular to the direction of the primary fibers, unless specified in the Working Documents.
- I. When multiple plies are installed, the sequence and stacking shall follow the special instructions in the Working Documents. Each ply shall be installed before the onset of complete gelation of the previous layer. Multiple plies may be applied after the previous ply is cured, provided that the surface is roughened by sanding and is cleaned from dust and residue.
- J. Following the application of all CFRP/GFRP layers, a final epoxy coating in accordance with the Manufacturer's recommendation shall be applied over the composite material to seal the surface.
- K. The final top coat shall be cured to a minimum level of 85 percent confirmed by time-temperature cure data provided by the Manufacturer prior to putting the pipe back in service.

3.07 JOINT TERMINATION OF CFRP SYSTEM

- A. A termination detail involving termination of the CFRP lining system utilizing specialized joint rings shall be provided on the Working Documents to ensure durable water tightness and prevent water from getting behind the CFRP liner. See Drawings for Internal Joint Seals requirements.
- B. The Installer shall provide and install appropriately sized single or double band 316L stainless steel expansion rings with 1/4 inch elastomeric rubber strips at the terminations between the CFRP liner and the host piping system. The stainless steel expansion rings shall be installed in joints at each end of the CFRP rehabilitation at least 24 hours after CFRP installation. The jacking pressure for the expansion ring shall be selected to achieve a minimum of 100 psi interface pressure in accordance with Manufacturer's recommended procedures and installed per the requirements shown on the Drawings.

3.08 CLEAN-UP AND DISPOSAL

- A. Any material that has exceeded its shelf life, is damaged, or has not been stored according to the specified instructions, is in excess or not used when opened must be disposed of in accordance to the SDS and all other Federal, State, and local laws.
- B. CONTRACTOR must thoroughly be familiar with the environmental laws and regulations governing the disposal of chemicals, and is responsible for the complete clean-up of the Project site, removal of the excess and unused materials (waste), empty containers, and other aesthetically unpleasing materials.

SECTION 40 05 57.23
ELECTRIC MOTOR ACTUATORS, LIFT GATE PEDESTALS

PART 1 GENERAL

1.01 SUMMARY

- A. This Section includes requirements for electric motor actuators to produce rotary and linear motion to activate gates in open-close, throttling, and modulating services and for lift gate pedestals.

1.02 REFERENCES

- A. This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section prevail.
- B. Unless otherwise specified, references to documents mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ANSI/AWWA C542-16	Electric Motor Actuators for Valves and Slide Gates.
ANSI/NEMA 250	Enclosures for Electrical Equipment (1,000 Volts Maximum).
ANSI/NEMA MG1	Motor and Generators.
ANSI/NFPA 70	National Electrical Code.
UL 429	Electrically Operated Valves.
UL 1002	Electrically Operated Valves for Use in Hazardous (Classified) Locations.
NEMA ICS-2	Industrial Control Devices, Controllers and Assemblies

1.03 DEFINITIONS:

- A. Use ANSI/AWWA C542-16, Electric Motor Actuators for Valves and Slide Gates definitions, unless otherwise noted.

- B. For purposes of this Section, the word “valve” refers to both valves and gates.
- C. Electric motor actuators are defined using the following code system which appears in the actuator specification (ACTUSPEC) sheets:

Actuator Type (ACTUSPEC)	Service	Definition
EMTT	Throttling (Modulating)	Electric motor multi-turn
EQTT	Throttling (Modulating)	Electric motor quarter-turn
EMTI	Isolating (Open-Close)	Electric motor multi-turn
EQTI	Isolating (Open-Close)	Electric motor quarter-turn

- D. Service:
1. Modulating: Operation characterized by the continuous positioning of a gate between between fully open and closed, in response to a continuous control signal.
 2. Open-Close or Isolation: To move gate to fully open or fully closed position in one continuous operation. Alternative terms used are ON-OFF and isolating.
 3. Throttling: Operation characterized by the deliberate and/or the infrequent movement of a to an intermediate position, between fully open and fully closed, and maintaining that position for periods of time.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
1. Data: Ensure the gate data is provided to the actuator manufacturer. Transmit the required torque or thrust, shaft diameter, thread characteristics (including right or left-hand), keyway dimensions, seating requirements (torque or position) for open and close.
 2. Conditions: Identify most adverse conditions to be encountered at any time when actuation is necessary.
 - a. For multi-turn, the following additional data is required for actuator sizing:
 - 1) Maximum torque and thrust running load over the full cycle.
 - 2) Desired speed of actuation or stroking time.
 - 3) The stall torque or maximum thrust output of the actuator not to exceed the torque or thrust capability as determined by the lift gate manufacturer.
 - b. For quarter-turn, the following additional data is required for actuator sizing:
 - 1) The required actuator torque over the full cycle of operation.
 - 2) Desired speed of actuation or stroking time.

1.05 SUBMITTALS

- A. Procedures: Submittal shall be provided in accordance with Section 01 33 00 and the following:
- B. Action Submittals.
1. A copy of this Section, addendum updates included, with each paragraph check-marked to indicate compliance or marked to indicate requested deviations from Section requirements.

2. A copy of the contract document control diagrams and process and instrumentation diagrams relating to the submitted equipment, with addendum updates that apply to the equipment in this Section, marked to show specific changes necessary for the equipment proposed in the submittal. If no changes are required, mark the drawing or drawings with "no changes required".
 3. Manufacturer's catalog information and other data confirming conformance to design and material requirements.
 4. Lift Gate Pedestal Data Sheet: An information data sheet for each lift gate pedestal showing required mounting and gear box information. Provide pedestal identification (tag) number clearly for each application on the data sheet.
 5. Actuator Data Sheet: An information data sheet for each actuator showing required mounting, operating torque for driven equipment, torque capacity of actuator, actuator speed, associated lift gate torque ratings, motor data (power, hp; full load amps, locked rotor amps, rpm, duty rating). Provide actuator identification (tag) number clearly for each application on the actuator data sheet.
 6. List of components being provided for each actuator.
 7. Shop drawings:
 - a. Actuator assembly.
 - b. Dimensions.
 - c. Electrical wiring diagrams.
- C. Informational Submittals:
1. Application manuals for configuring and set up of actuator for control, monitoring and alarming.
 2. Application software and software manuals for programming communication network bus when specified. Include electronic data sheet or generic station description files for network configuration.
 3. Recommended storage practice. In addition, place this information on the outside of the actuator or shipping container as delivered to the site.
- D. Closeout Submittals:
1. Operation and Maintenance Data: Submit manufacturer's standard operating and maintenance instructions as specified in Section 01 78 23.
 2. Training Certification Section 43 05 11-Form B.
 3. Maintenance Material:
 - a. Spare Part Inventory Listing.
 - b. Spare Parts.
 - c. Special Tools.
 - d. Lubrication guide.
 - e. Certified drawings.
 4. Actuator Configuration Settings: The final settings used for configuration of the actuator to meet field operation requirements. Include both the electronic files and a hard copy printout in pdf format.

1.06 QUALITY ASSURANCE

A. Identification of Listed Products:

1. Provide equipment and materials listed for the purpose for which they are to be used, by an independent testing laboratory. Three such organizations are Underwriters Laboratories (UL), Canadian Standards Association (CSA), and Electrical Testing Laboratories (ETL). Provide independent testing laboratory acceptable to the inspection authority having jurisdiction.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Procedures: In accordance with Section 01 66 00.

1.08 WARRANTY

- A. Manufacturer to warrant all actuators furnished under this Section against defects in materials and workmanship for a period of two years, unless otherwise specified.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Candidate manufacturers are specified on the actuator specification (ACTUSPEC) sheets. The manufacturer's standard models or products may require modification to conform to the specified requirements.

2.02 PERFORMANCE

- A. Size actuators to produce an operating torque equal to twice the maximum required lift gate operating torque under the specified flow and pressure conditions. Specific requirements for each type of actuator are specified on the actuator specification (ACTUSPEC) sheets located at the end of this Section.
- B. Seat gate or stopping method based on lift gate manufacturer's recommendation:
 1. Torque
 2. Position/Limit
- C. Ambient Temperature Range: -20 to +140 degree Fahrenheit (up to 100% relative humidity).
- D. Rotation:
 1. Quarter-Turn: 90 degrees, with +/- 5 degree adjustable mechanical travel stops. Stops designed to withstand maximum actuator torque.
 2. Multi-Turn: Position setting range of 2.5 to 8,000 turns with a minimum angular resolution of 7.5 degrees at the output.

2.03 CONFIGURATION, COMPONENTS AND FEATURES

- A. General: Unless otherwise specified, provide electric motor actuators in accordance with the actuator specification (ACTUSPEC) sheets and the following requirements.
- B. Motor:
 1. General:
 1. Specifically designed for lift gate actuator service.

2. Totally-enclosed, non-ventilated construction.
3. Internal heater for anti-condensation protection.
4. Compliance to ANSI/NEMA MG1.
2. Duty Rating based on Actuator Service:
 1. Modulating: 50% (30 minutes) or 100% (continuous) duty motor rated for minimum of 900 starts per hour.
 2. Open-Close: 25% (15 minutes) or 50% (30 minutes) duty motor rated for minimum of 60 starts per hour.
 3. Throttling: 25% (15 minutes) or 50% (30 minutes) duty motor rated for minimum of 60 starts per hour.
3. Motor Starter: Provide actuator with a full voltage reversing starter rated for the motor's locked rotor and full load currents for 10,000 cycles with mechanical and electrical interlocks and overload protection in each phase pole.
4. Three Phase:
 1. Reversible, Squirrel Cage Motor.
 - 1) 460 volt, 3 phase, 60 hertz power with +/- 10 percent voltage fluctuation.
 - 2) Four-pole 1800 RPM or provide pole-speed as required for the application.
 - 3) NEMA Class F insulation.
 - 4) Thermistor or thermostat for thermal protection embedded in the motor windings.
 - 5) Automatic motor thermal reset once motor has cooled sufficiently after overload.
 - 6) Three conduit openings, minimum.
 2. Control Transformer:
 - 1) Epoxy encapsulated and impregnated with short-circuit and overload protection.
 - 2) Rated, at a minimum, to handle 80 percent of the connected load with 120 VAC secondary or other secondary voltage of 24 VDC as required.
 - 3) Adequately rated to provide power for the following functions:
 - a. Energizing of the contactor coils.
 - b. Internally sourced power for remote controls.
 - c. Internal electrical circuits.
 - d. Heater.
- C. Enclosure: Provide NEMA 250 electrical enclosures rated for the application and location specified:
 1. Non-hazardous, indoor and outdoor locations.
 1. Type 4, Weatherproof.
 2. Type 4X, Corrosive.
 3. Type 6, Submersible.
 2. Hazardous locations, indoor and outdoor locations.
 1. Type 4/7, Class I, Divisions 1 and 2, Groups C & D certification.
 3. All external fasteners stainless steel.

- D. Disconnect Switch: Provide a lockable, heavy-duty, NEMA 4X, non-fused, UL listed disconnect switch for mounting near actuator. Where actuated lift gate is out-of-reach, locate the disconnect switch on an adjacent wall at an accessible level.
 - 1. Where depicted on the drawings provide auxiliary contact. The contact to close when disconnect switch is in close position. The contact to open when disconnect switch is in open position.
- E. Gearing:
 - 1. Totally enclosed in an oil or grease filled gearcase suitable for operation at any angle.
 - 2. All drive gearing and components must be of metal construction and machine cut.
 - 3. For rising stem lift gate (multi-turn), provide hollow output shaft accepting a rising stem and incorporating thrust bearings of the ball or roller type at the base of the actuator. Permit the opening of the gearcase for inspection, and disassembly without releasing the stem thrust or taking the lift gate out of service.
 - 4. For quarter-turn, self-locking drive gearing to prevent the lift gate back-driving the actuator. Multi-turn actuator combined with part-turn gearbox for 90-degree rotation can be used for high torque applications or for large nominal diameter quarter-turn lift gates being used for isolating, throttling or modulating service.
 - 5. Design all gearing to withstand a 100 percent overload.
- F. Torque Switches: Provide electric motor actuators with a double-torque switch set to disengage motor power at 40 to 100 percent of actuator rated torque and less than 75 percent of the shaft's design torque. Operate the torque switch in both the opening and closing directions and operate during the complete cycle without the use of auxiliary relays, linkages, latches, or other devices.
 - 1. Provide each side of the torque switch with set point adjustment. Mount a calibration tag near each switch for correlating the settings with output torque activation.
- G. Position Switches: Provide electrical or electro-mechanical confirmation of lift gate position. Position limit switches to indicate various positions between the fully opened and fully closed. Provide limit switches for visual local position indication of the lift gate and for external position monitoring through solid-state relay or electro-mechanical relays. Provide at least two relays with dry contacts for external position monitoring.
- H. Hammer Blow Device: Provide electric motor actuators with a built-in lost-motion device that allows sufficient travel of the motor, prior to engaging the stem nut, for the motor to reach full speed. This action to impart a "hammer blow" to start the lift gate in motion in either direction. Share the load equally by two lugs cast integrally on the drive sleeve.
- I. Handwheel: Provide electric motor actuators with a handwheel for manual operation. Do not rotate the handwheel during motor operation. Do not prevent handwheel operation when motor is locked. Accomplish motor or manual selection by a positive declutching knob or lever which disengages the motor and motor gearing mechanically but not electrically. Prohibit manual and motor simultaneous operation. Do not require more than 80 pounds of rim effort at maximum torque for hand operation.
- J. Electrical actuator setting tool: Bluetooth setting tool to be provided with all of the electrical actuators.

2.04 SPARE PARTS

A. Electrical actuators:

1. 1 spare motor
2. 1 spare seal kit

2.05 CONTROL PANEL

A. Provide an integral operator control unit to serve as a control station for each actuator unless otherwise specified.

B. Control station to include pilot devices:

1. LOCAL (or HAND), OFF, REMOTE (or AUTO), STOP, OPEN, and CLOSE controls through selector switches and/or pushbuttons.

1. In LOCAL, use the control station's OPEN and CLOSE devices to position the lift gate to full open or full close. Configure for inching "maintained or sealed in" action in either travel direction.

2. In REMOTE:

1) Open-Close (Isolating) Service:

- a) Contacts Closure: Use momentary operation of external OPEN or CLOSE contacts to open and close the lift gate.

2) Modulating or Throttling Service:

- a) Analog: Use external 4-20 mA input DC isolated signal to position the lift gate with maximum impedance of 250 ohms. On loss of 4-20 mA input DC provide adjustable configuration to fail to the "open", "closed", "% open" or "last" position. Unless otherwise specified initially set to fail to the "last" and reconfigure during system start-up if required for operations to go to a percent open position on loss of the external 4-20 mA.

3) Prevent the controls station's local OPEN and CLOSE devices from operating the lift gate.

3. In STOP, prevent travel in either open or close direction in both LOCAL and REMOTE.

2. Indication:

1. OPEN and CLOSE Status Lights

2. Position for Modulating/Throttling Service: In addition to the above status lights, provide digital readout display for the lift gate position in 1 percent increments from 0 to 100 percent.

C. Location of Control Station:

1. Local: NEMA 4X/7 Control station factory mounted directly to the electric motor actuator.

2. Remote: NEMA 4X/7 Control station mounted separate from the electric motor actuator when specified. Provide one of the following options:

1. Add another control station if the factory mounted control station can not be detached from the electric motor actuator. If two control stations are provided then both control stations must have identical operations.

2. Remote mount the entire actuator control package compartment including control power transformers, motor contactors and positioners.

D. External Monitoring:

1. Status and Alarms: Provide single pole double throw (SPDT) or single pole single throw (SPST) dry contacts rated at 0.5 amps for 24V DC, and 3 amps for 120 V AC. Provide contacts as normally open or normally closed:
 1. Open Status: Representing lift gate in full open position.
 2. Close Status: Representing lift gate in full close position.
 3. Remote or Auto Status: LOR or HOA in Remote or Auto, representing actuator operation from external source enabled.
 4. Local or Hand Status: LOR or HOA in Local or Hand, representing actuator operation from the control station enabled.
 5. Alarm Status: Representing lift gate or actuator trouble.
2. Position:
 1. Modulating or Throttling Service: In addition to the above external status and alarms, provide a 4-20 mA DC isolated output signal to indicate lift gate position at a minimum impedance of 500 ohms.

2.06 NAMEPLATES

- A. Control Station: Provide nameplates for each control station.
 1. Functional Nameplate: Engrave a white phenolic plate with black lettering with lift gate functional description and lift gate equipment number as specified or shown. Permanently fasten functional nameplate to control station. Nameplate wording may be changed without additional cost or time, if changes are made prior to commencement of engraving.
 2. Marking Nameplate: Engrave or stamped stainless steel. Permanently fasten nameplate to the control station. Provide the information on nameplate as required by NFPA 70 (NEC) for industrial control panel markings.
- B. Motor: Engrave or stamped stainless steel. Permanently fasten nameplate to the motor frame and ensure visibly positioned for inspection. Provide the information on nameplate as required by NFPA 70 (NEC).
- C. Actuator: Engrave or stamped stainless steel. Provide the following information on nameplate: manufacturer, model number, serial number, ambient temperature minimum/maximum, rated torque, and opening time.
- D. Lift Gate Pedestals: Engrave or stamped stainless steel. Provide the following information on nameplate: gate manufacturer, model number, serial number. Contractor to coordinate with Owner and Engineer regarding existing lift gate pedestal nameplate information.

2.07 ASSEMBLY/FABRICATION

- A. Factory-mount electric motor actuators on the lift gate pedestals as a unit. Provide each lift gate body or actuator with the word "OPEN" cast thereon, an arrow indicating the direction to open, and flow direction arrows.

2.08 GATE PEDESTALS

- A. Gate pedestals are to be compatible with all existing clarifier lift gate components (including but not limited to gate lift screws)
- B. New gear box to be supplied with gate pedestals that is compatible with all lift gate components and new electric actuators
- C. Contractor and electric actuator equipment supplier to coordinate with lift gate manufacture / supplier to obtain the correct gate pedestal replacement.
- D. Gate pedestals to be ductile iron and coated as per 09 90 00.
- E. New gate pedestals are to be drilled to match Actuator mounting base.
- F. New gate pedestals to be supplied by the electrical actuator supplier.
- G. New gate pedestals to be installed by the General Contractor.
- H. Electrical actuators are to be supplied with PVC stem covers and Rotork Adapters for rising stem gates.

PART 3 EXECUTION

3.01 PREPARATION

- A. Prior to ordering and installation of the electric motor actuators and gate pedestal assemblies, field measure and check all equipment locations, pipe alignments, and structural installations. Ensure that sufficient space and accessibility is available for electric motor actuators.
- B. Contractor and electrical actuator supplier to include site visit(s) to confirm lift gate stem measurements prior to ordering (of electrical actuators).
- C. Electrical actuator drive bushing to be machined to match existing gate stem.
- D. Design, submit, furnish, and install all hardware required to connect the new motorized actuator to the existing gates such that the motorized actuator can move the gate through its complete range of motion. Coordinate directly with the original gate supplier to obtain any required information.

3.02 INSTALLATION

- A. Equipment Mounting.
 - 1. Locate actuator with unobstructed access for operation and maintenance.
 - a. Do not obstruct walkways.
 - b. Do not attach to handrails, process piping, or mechanical equipment.
 - c. Do not locate where shock or vibration impairs its operation.
 - 2. Locate remote control station with unobstructed access for operation and maintenance between 48 inches and 60 inches above the floor or a permanent work platform, and within site of the actuator.

3. Mount actuators to have their manual operating accessory, where possible, located between 48 inches and 60 inches above the floor or a permanent work platform.
 4. Mount actuators on new gate pedestals
 5. Gate pedestals
 - a. Gate pedestals are to be compatible with all existing gate components (including but not limited to gate lift screws)
 - b. New gear box to be supplied with gate pedestals that is compatible with all existing gate components and new electric actuators
 - c. Contractor and actuator equipment supplier to coordinate with lift gate manufacture / supplier to obtain correct gate pedestal replacement
 - d. Gate pedestals to be installed where existing pedestals have been removed. Refer to 05 05 20 for anchor bolts and 43 05 13 for mounting.
 - e. Gate pedestals shall be mounted on an equipment pad per detail M7006, PM-08-0002.
- B. Nameplates:
1. Locate nameplates on electrical actuators in a clearly visible location. If necessary, reposition and reattach with stainless steel screws or wire.
 2. Locate nameplates on the lift gate pedestals in the same position as on the existing lift gate pedestals.
- C. Electrical Interconnection: Comply with Division 26 for power wiring, control wiring and signal wiring.

3.03 FIELD QUALITY CONTROL

- A. Provide a factory-trained manufacturer's representative at the site for the following activities.
1. Inspect actuator's electrical power, control, signal, communication and grounding wiring for proper termination.
 2. Configure actuator and include:
 - a. Actuator Settings: Limit switch, torque position, travel speed, emergency shutdown function, loss of position signal function, and relay functions.

3.04 SYSTEM START UP

- A. General Requirements:
1. Perform testing in accordance with **Section 01 45 20**, and this Section. Apply no required test without prior notice to the Construction Manager to witness any test. At least 14 days before the commencement of any testing activity, provide a detailed step-by-step test procedure, complete with forms for the recording of test results. Provide all equipment necessary to perform the required tests.
 2. Test each electric motor actuator for each mode of operation including but not limited to both local and remote- open, close, stop, emergency shutdown, position control, and network operation, as well as, the travel rates, limit switches, jam and torque settings, and loss of control signals.
 3. Ensure electric motor actuator control can be re-initiated locally and remotely after power loss recovery without faulting.

4. Provide a factory-trained manufacturer's representative at the site to conduct startup of electrical actuators.
5. Provide a factory-trained manufacturer's representative at the site to re-adjust actuator setting under normal operating conditions with the specified design process fluid.

3.05 TRAINING

- A. Provide operation and maintenance training for the equipment provided under this Section for the Owner's personnel in accordance with Section 01 79 00 and taught by a factory-trained manufacturer's representative. Certify training on Form 43 05 11-B specified in Section 01 99 90.
- B. Include in training sessions preventive maintenance requirements, overhaul and troubleshooting instructions, normal operating practices, actuator parameter configuration set-up, changing actuator parameter settings.

PART 4 APPENDIX – ACTUSPECS

4.01 ACTUATOR SPECIFICATION SHEETS (ACTUSPEC)

- A. General requirements for actuators specified in this Section are listed on ACTUSPEC sheets herein.

Table A

ACTUSPEC Symbol	Actuator Description	Actuator Service Power
EMTI	Electric Multi-Turn Actuator for Isolating (Open-Close) Service	480 V AC, 3 phase
EMTM	Electric Multi-Turn Actuator for Modulating Service	480 V AC, 3 phase
EMTT	Electric Multi-Turn Actuator for Throttling Service	480 V AC, 3 phase
EQTI	Electric Quarter-Turn Actuator for Isolating (Open-Close) Service	480 V AC, 3 phase
EQTM	Electric Quarter-Turn Actuator for Modulating Service	480 V AC, 3 phase
EQTT	Electric Quarter-Turn Actuator for Throttling Service	480 V AC, 3 phase
EQTI	Electric Quarter-Turn Actuator for Isolating (Open-Close) Service	120 V AC, 1 phase
EQTI	Electric Quarter-Turn Actuator for Isolating (Open-Close) Service, Spring Return CW or CCW	120 V AC, 1 phase

4.02 ACTUATOR IDENTIFICATION: EMTI (480V)

- A. Actuator Description: Electric Multi-Turn Actuator for Isolating (Open-Close) Service.
- B. Manufacturers:
 1. Rotork, IQ3 Range IQ.
- C. Features:
 1. Actuator Power Supply: 480 V AC, 3-phase, 60 Hz.

2. Controller: Unfused disconnect type combination starter in compliance with NEMA ICS.
3. Controls:
 1. Power Source: Internal or external 120 volts AC or 24 volts DC.
 2. Remote Control Type: Contact Closure
 3. Emergency Shutdown: A minimum of one independent signal when applied to the actuator overrides any existing command signal and sends lift gate in a preselected shut down position.
 4. Location of Control Station: Local unless otherwised specified

4.03 ACTUATOR IDENTIFICATION: EMTM (480V)

- A. Actuator Description: Electric Multi-Turn Actuator for Modulating Service.
- B. Manufacturers:
 1. Rotork, IQ3 Range IQM.
- C. Features:
 1. Actuator Power Supply: 480 V AC, 3-phase, 60 Hz.
 2. Controller: Solid-state electronic, servo-amplifier comparator and an electro-mechanical reversing starter.
 3. Controls:
 1. Power Source: Internal or external 120 volts AC or 24 volts DC.
 2. Emergency Shutdown: A minimum of one independent signal when applied to the actuator overrides any existing command signal and sends lift gate in a preselected shut down position.
 3. Location of Control Station: Local unless otherwised specified

4.04 ACTUATOR IDENTIFICATION: EMTT (480V)

- A. Actuator Description: Electric Multi-Turn Actuator for Throttling Service.
- B. Manufacturers:
 1. Rotork, IQ3 Range IQM.
- C. Features:
 1. Actuator Power Supply: 480 V AC, 3-phase, 60 Hz.
 2. Controller: Solid-state electronic, servo-amplifier comparator and an electro-mechanical reversing starter.
 3. Controls:
 1. Power Source: Internal or external 120 volts AC or 24 volts DC.
 2. Emergency Shutdown: A minimum of one independent signal when applied to the actuator overrides any existing command signal and sends lift gate in a preselected shut down position.
 3. Location of Control Station: Local unless otherwised specified

4.05 ACTUATOR IDENTIFICATION: EQTI (480V)

- A. Actuator Description: Electric Quarter-Turn Actuator or Multi-Turn Actuator with 90-Degree Gearbox for Isolation Service.
- B. Manufacturers:
 - 1. Rotork, IQT or IQ Pro Series.
- C. Features:
 - 1. Power Supply: 480 V AC, 3-phase, 60 Hz.
 - 2. Controller: An unfused disconnect type combination starter in compliance with NEMA ICS.
 - 3. Controls:
 - 1. Power Source: Internal or external 120 volts AC or 24 volts DC.
 - 2. Emergency Shutdown: A minimum of one independent signal when applied to the actuator overrides any existing command signal and sends lift gate in a preselected shut down position.
 - 3. Location of Control Station: Local unless otherwised specified
 - 4. Gear Train: 90-degree gear box.

4.06 ACTUATOR IDENTIFICATION: EQTM (480V)

- A. Actuator Description: Electric Quarter-Turn Actuator or Multi-Turn Actuator with 90-Degree Gearbox for Modulating Service.
- B. Manufacturers:
 - 1. Rotork, IQ Pro Series.
- C. Features:
 - 1. Power Supply: 480 V AC, 3-phase, 60 Hz.
 - 2. Controller: Solid-state electronic, servo-amplifier comparator and an electro-mechanical reversing starter.
 - 3. Controls:
 - 1. Power Source: Internal or external 120 volts AC or 24 volts DC.
 - 2. Emergency Shutdown: A minimum of one independent signal when applied to the actuator overrides any existing command signal and sends lift gate in a preselected shut down position.
 - 3. Location of Control Station: Local unless otherwised specified
 - 4. Gear Train: 90-degree gear box.

4.07 ACTUATOR IDENTIFICATION: EQTT (480V)

- A. Actuator Description: Electric Quarter-Turn Actuator or Multi-Turn Actuator with 90-Degree Gearbox for Throttling Service.
- B. Manufacturers:
 - 1. Rotork, IQ Pro Series.

C. Features:

1. Power Supply: 480 V AC, 3-phase, 60 Hz.
2. Controller: Solid-state electronic, servo-amplifier comparator and an electro-mechanical reversing starter.
3. Controls:
 1. Power Source: Internal or external 120 volts AC or 24 volts DC.
 2. Emergency Shutdown: A minimum of one independent signal when applied to the actuator overrides any existing command signal and sends lift gate in a preselected shut down position.
 3. Location of Control Station: Local unless otherwise specified
4. Gear Train: 90-degree gear box.

4.08 ACTUATOR IDENTIFICATION: EQTI (120V)

A. Actuator Description: Electric Quarter-Turn Actuator for Isolation (Open/Close) Service.

B. Manufacturers:

1. Flowserve Worchester, Series 75.
2. GE Remote Control Series (RCS), Model MAR.
3. Emerson Bettis TorqPlus, Series EM.
4. Approved equal.

C. Features:

1. Power Supply: 120 V AC, 1-phase, 60 Hz.
2. Applications:
 1. Stall Torque: 150 to 900 lb-in.
 2. Current at Rated Stall Torque: Less than 2 amps for 25% duty.
3. Controls:
 1. Voltage: 120 V AC.
 2. Voltage Source: External fed.
 3. Remote Control Type: Contact Closures.
 4. Location of Control Station: Remote and specified in Section 40 76 00.
 5. Manual Override: Required.
4. Indication- Open/Close Position: Required.
5. Gear Train: Direct attach to actuator with no intermediate gearings or linkage.
 1. Lubrication: Permanently lubricated.

4.09 ACTUATOR IDENTIFICATION: EQTI (120V-O OR C)

A. Actuator Description: Electric Quarter-Turn Actuator for Isolation Service, Spring Return CW or CCW.

B. Manufacturers:

1. GE Remote Control Series (RCS), Model SURE.
2. Emerson Bettis TorqPlus, Series EM.

3. Approved equal.

C. Features:

1. Power Supply: 120 V AC, 1-phase, 60 Hz.
2. Fail Position: Open or Close (OC) as specified in Section 40 06 20.13.
3. Applications:
 1. Stall Torque: 300 to 1200 lb-in.
 2. Current at Rated Stall Torque: Less than 1.5 amps for 50 % duty or better.
4. Controls:
 1. Voltage: 120 V AC.
 2. Voltage Source: External fed.
 3. Remote Control Type: Contact Closures.
 4. Location of Control Station: Remote and not specified in this Section.
 5. Manual Override: Required.
5. Indication- Open/Close Position: Required.
6. Gear Train: Direct attach to actuator with no intermediate gearings or linkage.
7. Lubrication: Permanently lubricated.

END OF SECTION

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SECTION 43 05 11
GENERAL REQUIREMENTS FOR EQUIPMENT

PART 1 GENERAL

1.01 DESCRIPTION

A. Scope:

1. This section specifies general requirements which are applicable to all mechanical equipment. The Contractor is responsible for ensuring that all mechanical equipment meets the requirements of this section in addition to the specific requirements of each individual equipment specification section.

B. Equipment Lists:

1. Equipment lists, presented in these specifications and as specified on the drawings, are included for the convenience of the Construction Manager and Contractor and are not complete listings of all equipment, devices and material required to be provided under this contract. The Contractor shall prepare his own material and equipment takeoff lists as necessary to meet the requirements of this project manual.

1.02 QUALITY ASSURANCE

A. Arrangement:

1. The arrangement of equipment shown on the drawings is based upon information available to the Owner at the time of design and is not intended to show exact dimensions conforming to a specific manufacturer. The drawings are, in part, diagrammatic, and some features of the illustrated equipment installation may require revision to meet actual submitted equipment installation requirements; these may vary significantly from manufacturer to manufacturer. The contractor shall, in determining the cost of installation, include these differences as part of his bid proposal. Structural supports, foundations, connected piping, valves, and electrical conduit specified may have to be altered to accommodate the equipment actually provided. No additional payment shall be made for such revisions and alterations.

B. References:

1. This section contains references to the documents listed below. They are a part of this section as specified and modified. Where a referenced document cites other standards, such standards are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.
2. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that

date, regardless of whether the document has been superseded by a version with a later date, has been discontinued or has been replaced.

Reference	Title
ABMA Std 9	Load Ratings and Fatigue Life for Ball Bearings
ABMA Std 11	Load Ratings and Fatigue Life for Roller Bearings
ANSI B1.1	Unified Inch Screw Threads (UN and UNR Thread Form)
ANSI B1.20.1	Pipe Threads, General Purpose (Inch)
ANSI B16.1	Gray Iron Pipe Flanges and Flanged Fittings, (Classes 25, 125, and 250)
ANSI B18.2.1	Square and Hex Bolts and Screws (Inch Series)
ANSI B18.2.2	Square and Hex Nuts (Inch Series)
ISO 1940-1	Mechanical Vibration – Balance Quality Requirements for Rotors in a Constant (Rigid) State: Part 1: Specification and Verification of Balance Tolerances

C. Unit Responsibility:

1. The Contractor shall cause equipment assemblies made up of two or more components to be provided as a working unit by the unit responsibility manufacturer, where specified. The unit responsibility manufacturer shall coordinate selection, coordinate design, and shall provide all mechanical equipment assembly components such that all equipment components furnished under the specification for the equipment assembly, and all equipment components specified elsewhere but referenced in the equipment assembly specification, is compatible and operates reliably and properly to achieve the specified performance requirements. Unless otherwise specified, the unit responsibility manufacturer shall be the manufacturer of the driven component equipment in the equipment assembly. The unit responsibility manufacturer is designated in the individual equipment specifications found elsewhere in this project manual. Agents, representatives or other entities that are not a direct division of the driven equipment manufacturing corporation shall not be accepted as a substitute for the driven equipment manufacturer in meeting this requirement. The requirement for unit responsibility shall in no way relieve the Contractor of his responsibility to the Owner for performance of all systems as provided in the General Conditions of the Contract Documents.

- D. The Contractor shall ensure that all equipment assemblies provided for the project are products for which unit responsibility has been accepted by the unit responsibility manufacturer(s), where specified. Unit responsibility for related components in a mechanical equipment assembly does not require or obligate the unit responsibility manufacturer to warranty the workmanship or quality of component products not manufactured by them. Where an individual specification requires the Contractor to furnish a certificate from a unit responsibility manufacturer, such certificate shall conform to the content, form and style of Form 43 05 11-C specified in Section 01 99 90, shall be signed by an officer of the unit responsibility manufacturer's corporation and shall be notarized. No other submittal material will be processed until a Certificate of Unit Responsibility has been received and has been found to be satisfactory. Failure to provide acceptable proof that the unit responsibility requirement has been satisfied will result in withholding approval of progress payments for the subject equipment even though the equipment may have been installed in the work.

E. Balance:

1. Unless specified otherwise, for all machines 10 HP and greater, all rotating elements in motors, pumps, blowers and centrifugal compressors shall be fully assembled, including coupling hubs, before being statically and dynamically balanced. All rotating elements shall be balanced to the following criteria:

- a.
$$U_{per} = 6.015 \frac{GW}{N}$$

- b. Where:

- 1) U_{per} = permissible imbalance, ounce-inches, maximum
 - 2) G = Balance quality grade, millimeters per second
 - 3) W = Weight of the balanced assembly, pounds mass
 - 4) N = Maximum operational speed, rpm
2. Where specified, balancing reports, demonstrating compliance with this requirement, shall be submitted as product data. Equipment balance quality grade shall be G 2.5 ($G = 2.5$ mm/sec) or better in accordance with ANSI S2.19.

1.03 SUBMITTALS

- A. Submittals in accordance with Section 01 33 00.
- B. The following information shall be provided at a minimum equipment:
 1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Seller, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation.
 - a. The Owner's Representative shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Seller with the specifications.

Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration

PART 2 PRODUCTS

2.01 FLANGES AND PIPE THREADS

- A. Flanges on equipment and appurtenances provided under this section shall conform in dimensions and drilling to ANSI B16.1, Class 125. Pipe threads shall conform in dimension and limits of size to ANSI B1.1, coarse thread series, Class 2 fit.
- B. Threaded flanges shall have a standard taper pipe thread conforming to ANSI B1.20.1. Unless otherwise specified, flanges shall be flat faced.

- C. Flange assembly bolts shall be heavy pattern, hexagonal head, carbon steel machine bolts with heavy pattern, hot pressed, hexagonal nuts conforming to ANSI B18.2.1 and B18.2.2. Threads shall be Unified Screw Threads, Standard Coarse Thread Series, Class 2A and 2B, ANSI B1.1.

2.02 COUPLINGS

- A. Unless otherwise specified in the particular equipment sections, equipment with a driver greater than 1/2 HP, and where the input shaft of a driven unit is directly connected to the output shaft of the driver, shall have its two shafts connected by a flexible coupling which can accommodate angular misalignment, parallel misalignment and end float, and which cushions shock loads and dampens torsional vibrations. The flexible member shall consist of a tire with synthetic tension members bonded together in rubber. The flexible member shall be attached to flanges by means of clamping rings and cap screws, and the flanges shall be attached to the stub shaft by means of taper lock bushings which shall give the equivalent of a shrunk-on fit. There shall be no metal-to-metal contact between the driver and the driven unit. Each coupling shall be sized and provided as recommended by the coupling manufacturer for the specific application, considering horsepower, speed of rotation, and type of service.
- B. Where torque or horsepower capacities of couplings of the foregoing type is exceeded, Thomas-Rex, Falk Steel Flex, or equal, couplings will be acceptable provided they are sized in accordance with the equipment manufacturer's recommendations and sizing data are submitted. They shall be installed in conformance to the coupling manufacturer's instructions.

2.03 GUARDS

- A. Exposed moving parts shall be provided with guards which meet all applicable OSHA requirements. Guards shall be fabricated of 14-gage steel, 1/2-13-15 expanded metal screen to provide visual inspection of moving parts without removal of the guard. Guards shall be galvanized after fabrication and shall be designed to be readily removable to facilitate maintenance of moving parts. Reinforced holes shall be provided. Lube fittings shall be extended through guards.

2.04 NAMEPLATES

- A. Nameplates shall be provided on each item of equipment and shall contain the specified equipment name or abbreviation and equipment number. Equipment nameplates shall be engraved or stamped stainless steel and fastened to the equipment in an accessible and visible location with stainless steel screws or drive pins.
- B. Contractor to provide nameplate information in submittal format for Engineer and Owner review prior to installation. Name plate information to contain the following:
 - 1. Device Identifier (equipment / valve)
 - 2. Train or phase: (east side facility)
 - 3. Process Area: (clarifiers)
 - 4. Sub-process: (mixing)
 - 5. Item number

Per request, the Owner to provide asset management equipment naming information for Contractor review.

2.05 LUBRICANTS

- A. The Contractor shall provide for each item of mechanical equipment a supply of the required lubricant adequate to last through the specified commissioning period. Lubricants shall be of the type recommended by the equipment manufacturer and shall be products of the Owner's current lubricant supplier.
- B. The Contractor shall limit the various types of lubricants by consolidating them, with the equipment manufacturer's approval, into the least number of different types.
- C. Not less than 90 days before the date shown in his construction schedule for starting, testing and adjusting equipment (Section 01 45 20), the Contractor shall provide the Owner with three copies of a list showing the required lubricants, after consolidation, for each item of mechanical equipment. The list shall show estimated quantity of lubricant needed for a full year's operation, assuming the equipment will be operating continuously.

2.06 ANCHOR BOLTS

- A. Anchor bolts shall be designed for lateral forces for both pullout and shear in accordance with the provisions of Section 05 05 20. Unless otherwise stated in the individual equipment specifications, anchor bolt materials shall conform to the provisions of Section 05 05 20.

2.07 SPARE PARTS

- A. Spare parts, wherever required by detailed specification sections, shall be stored in accordance with the provisions of this paragraph. Spare parts shall be tagged by project equipment number and identified by part number, equipment manufacturer, and subassembly component (if appropriate).
- B. Spare parts subject to deterioration, such as ferrous metal items and electrical components, shall be properly protected by lubricants or desiccants and encapsulated in hermetically sealed plastic wrapping.
- C. Spare parts with individual weights less than 50 pounds and dimensions less than 2 feet wide, or 18 inches high, or 3 feet in length shall be stored in a wooden box with a hinged wooden cover and locking hasp. Hinges shall be strap type. The box shall be painted and identified with stenciled lettering stating the name of the equipment, equipment numbers, and the words "spare parts." A neatly typed inventory of spare parts shall be taped to the underside of the cover.

PART 3 EXECUTION

3.01 GENERAL

- 1. Installation of equipment accessories included in this section shall be as recommended by the equipment manufacturer unless otherwise specified in the individual equipment specification section.

END OF SECTION – FORMS FOLLOW

43 05 11-A. MANUFACTURER'S INSTALLATION CERTIFICATION FORM

Contract No: _____ Specification section: _____

Equipment name: _____

Contractor: _____

Manufacturer of equipment item: _____

The undersigned manufacturer of the equipment item described above hereby certifies that he has checked the installation of the equipment and that the equipment, as specified in the project manual, has been provided in accordance with the manufacturer's recommendations, and that the trial operation of the equipment item has been satisfactory.

Comments: _____

Date

Manufacturer

Signature of Authorized Representative

43 05 11-B. MANUFACTURER'S INSTRUCTION CERTIFICATION FORM

Contract No: _____ Specification section: _____

Equipment name: _____

Manufacturer of equipment item: _____

The undersigned manufacturer certifies that a service engineer has instructed the wastewater treatment plant operating personnel in the proper maintenance and operation of the equipment designated herein.

<u>Operations Check List</u> (check appropriate spaces)	
Start-up procedure reviewed	
Shutdown procedure reviewed	
Normal operation procedure reviewed	
Others:	
<u>Maintenance Check List</u> (check appropriate spaces)	
Described normal oil changes (frequency)	
Described special tools required	
Described normal items to be reviewed for wear	
Described preventive maintenance instructions	
Described greasing frequency	
Others:	

Date

Manufacturer

Signature of Authorized Representative

Date

Signature of Owner's Representative

(Project Title)

CERTIFICATE OF UNIT RESPONSIBILITY

for Specification Section _____

(Section title)

In accordance with paragraph 43 05 11-1.02 C of the contract documents, the undersigned manufacturer of driven equipment ("manufacturer") accepts unit responsibility for all components of equipment furnished to the Project under specification Section _____, and for related equipment manufactured under Sections _____, _____, and _____.

We have reviewed the requirements for Sections 43 05 11 (and 43 23 03 where applicable) and all sections referencing this (these) section(s), including but not limited to drivers, supports for driving and driven equipment and all other specified appurtenances to be furnished to the Project by manufacturer. And, we have further reviewed, and modified as necessary, the requirements for associated variable speed drives and motor control centers. We hereby certify that all specified components are compatible and comprise a functional unit suitable for the specified performance and design requirements whether or not the equipment was furnished by us. We will make no claim nor establish any condition that problems in operation for the product provided under this specification Section _____ are due to incompatibility of any components covered by this Certificate of Unit Responsibility. Nor will we condition or void any warranty for the performance of the product of this specification Section _____ due to incompatibility of any components covered under this Certificate of Unit Responsibility.

Our signature on this Certificate of Unit Responsibility does not obligate us to take responsibility for, nor to warrant the workmanship, quality, or performance of related equipment provided by others under specification Sections _____, _____, and _____. Our obligation to warranty all equipment provided by us shall remain unaffected.

Notary Public

Name of Corporation

Commission expiration date

Address

Seal:

By: _____

Duly Authorized Official

Legal Title of Official

Date: _____

SECTION 43 05 13
RIGID EQUIPMENT MOUNTS

PART 1 GENERAL

1.01 SUMMARY

1. Section includes: This Section specifies requirements for rigid equipment mounts. Rigid equipment mounts consist of equipment pads, equipment anchors, and mounting plates (baseplates, soleplates, or fabricated steel frames) set in grout.
2. Conform to the requirements specified in the Equipment Mounting Schedule (Part 4 of this Section) or equipment mounting configuration requirements specified in individual equipment specifications . Where equipment mounting requirements are not specifically identified, the default mounting configuration for equipment consists of Pad Anchored Equipment Pads per Process Mechanical Details with adhesive dowels anchoring the equipment pad to the foundation, equipment and driver mounted on a common mounting plate, mounting plate leveled within 0.005 inch/foot, equipment anchored to the equipment pad with cast-in-place equipment anchors per Process Mechanical Details, equipment anchor sleeve length is 10 times the bolt diameter, and the mounting plate is grouted in position using non-shrink grout.
3. If a conflict exists between this Section and requirements of individual equipment manufacturers, the more restrictive requirements shall prevail.
4. Requirements for non-rigid equipment mounts (vibration isolation systems) are specified in the associated equipment specification. Furnish rigid equipment mounts conforming to the requirements of this Section for the equipment pad and other equipment mounting components supporting the vibration isolation system.

1.02 RELATED SECTIONS

- A. This Section contains specific references to the following related sections. Additional related sections may apply that are not specifically listed below.
 1. Section 01 61 45 – Area Exposure Designations
 2. Section 01 73 23 - Structural Design and Anchorage Requirements for Nonstructural Components and Non-Building Structures
 3. Section 01 99 90 - Reference Forms
 4. Section 03 60 00 – Grouting
 5. Section 05 05 20 – Anchor Bolts
 6. Section 09 90 00 – Painting and Coating
 7. Section 43 05 11 – General Requirements for Equipment
 8. Section 43 05 14 – Machine Alignment
 9. Section 43 05 17 – Vibration and Critical Speed Limitations

1.03 REFERENCES

- A. This Section contains references to the following documents. They are a part of this Section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this Section as if

referenced directly. In the event of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section prevail.

Reference	Title
ACI 318, Appendix D	Building Code and Commentary, Anchorage to Concrete
HI 14.3	Rotodynamic Pumps –for Design and Application
HI 14.4	Rotodynamic Pumps –for Installation, Operation and Maintenance
API RECOMMENDED PRACTICE 686	Recommended Practices for Machinery Installation and Installation Design
ASCE 7	Minimum Design Loads and Associated Criteria for Buildings and Other Structures
ASME B1.1	Unified Inch Screw Threads (UN and UNR Thread Form)
ASTM E329	Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction
ASTM F593	Stainless Steel Bolts, Hex Cap Screws, and Studs
ASTM F1554	Anchor Bolts, Steel, 36, 55 and 105 ksi Yield Strength
MIL-PRF-907E	Anti-Seize Thread Compound, High Temperature
SSPC	Society for Protective Coatings Specifications, Vol. 2
IBC	International Building Code (including local amendments)

1.04 DEFINITIONS

A. Terminology used in this Section conforms to the following definitions:

1. Baseplate: A mounting plate configured with a top plate and a perimeter edge of the mounting plate that is below the top plate. Baseplates have a cavity between the top plate and a horizontal plane at the bottom edge of the perimeter of the mounting plate.
2. Soleplate: A machined or pre-formed mounting plate with a uniform horizontal surface across the entire underside of the mounting plate, excepting shear lugs/keys, grout pour holes, vent holes, and attachment hardware (nuts, bolts, tapped holes, etc.). Soleplates have a top plate but lack the perimeter bottom edge that extends below the underside of the top plate that is a defining feature of baseplates.
3. Fabricated Steel Frame: An equipment mounting plate constructed of rolled steel shapes and plates welded into a frame. Fabricated steel frames do not have top plates.
4. Equipment Pad: Concrete foundation (block or slab) supporting and elevating mounting plates above the supporting structural floor slab or local grade.
5. Mounting Pads: Milled/machined areas of baseplates, soleplates, and fabricated steel frames where the feet or mounting surfaces of mounted equipment and drivers are bolted to the baseplate, soleplate, or fabricated steel frame.
6. Leveling Blocks: Steel blocks temporarily placed under baseplates, soleplates, or fabricated steel frames at leveling positions (at equipment anchors) for the purpose of leveling baseplates, soleplates, or fabricated steel frames prior to grouting.
7. Shims: Thin stainless steel plates of uniform thickness used for fine adjustment of level. Shims are used on top of leveling blocks for mounting plate leveling or used between equipment drivers and baseplates, soleplates, or fabricated steel frames for equipment alignment.

8. **Wedges:** Pairs of uniformly tapered metal blocks that are stacked with the tapered surfaces reversed (relative to the other wedge) so that the top and bottom surfaces of the wedges are parallel. Wedges are used between equipment pads and baseplates, soleplates, or fabricated steel frames for the purpose of leveling mounting plates.
9. **Mounting Stud:** Threaded rod or bolts anchored to baseplates, soleplates, or fabricated steel frames for the purpose of mounting equipment or ancillary devices onto baseplates, soleplates, or fabricated steel frames.
10. **Reinforcement Dowels or Reinforcement Hooks:** Steel reinforcement rods embedded in concrete, across a cold joint, for the purpose of transferring loads or force across the joint.
11. **Leveling Position:** A location on the top of a concrete equipment pad where leveling tools and equipment will be temporarily installed or used for the purpose of leveling baseplates, soleplates, and fabricated steel frames prior to grouting.
12. **Grout Manufacturer:** Refers to the manufacturer of the grout product used for installation of rigid equipment mounts.
13. **Grout Manufacturer's Technical Representative(s):** Refers to the technical representative(s) of the Grout Manufacturer. The Grout Manufacturer's Technical Representative shall not be an employee of the Contractor.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. **Pre-installation Meetings:**
 1. Conduct a pre-installation meeting with the Construction Manager's representative prior to installation of equipment mounts.
 2. Schedule a pre-installation meeting for the equipment mounts associated with each system or group of identical equipment items.
 3. Where equipment anchors are cast in the floor slab or foundation, schedule the pre-installation meeting prior to pouring the floor slab or foundation.

1.06 SUBMITTALS

- A. **Action Submittals:**
 1. **Procedures:** Section 01 33 00.
 2. A copy of this Section, including addendum updates, (referenced sections need not be included for this Section) with each paragraph check-marked to indicate compliance or marked to indicate requested deviations from specification requirements. Check marks denote full compliance with a paragraph as a whole. Underline each deviation and denote with a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. Mark copies of this Section with the specification number and equipment number for inclusion (filing) with submittal materials furnished for individual equipment specifications.
 3. Name, employer, and a copy of the employee's Qualified Millwright card or other equivalent certificate of journeyman qualifications for millwrights who will install rigid equipment mounts, as specified in paragraph 3.02, Leveling.
 4. Certificates or other documentation issued by the epoxy grout manufacturer that demonstrates that the grout manufacturer's technical representative has been

factory trained on installation of epoxy grout for equipment mounts, as specified in paragraph 1.07 Quality Control by Contractor.

5. List of Contractor's equipment installation staff that have completed epoxy grout manufacturer's grout installation training specified in paragraph 3.03, Manufacturer's Services.
 6. Shop drawings for equipment pads, equipment anchors, and baseplate, soleplate or fabricated steel frame depict size and location of equipment pads and reinforcement; equipment drains; equipment anchor, size, location, and projection; expansion joint locations; grout formwork; elevation of top of grout and grout thickness; elevation of top of baseplate, soleplate, or mounting block; size and location of electrical conduits; and any other equipment mounting features embedded in equipment pads. Shop drawings for equipment pads, equipment anchors, and baseplate, soleplate, or fabricated steel frames to be numbered and marked (specification number and equipment number) for inclusion (filing) with the associated equipment submittal requirements.
- B. Informational Submittals:
1. Procedures: Section 01 33 00
 2. Submit equipment anchor calculations demonstrating compliance with paragraph 2.04, Equipment Anchor Design. Submit equipment anchor calculations with submittal information specified in the associated equipment specification.
 3. Results of grout strength tests, as specified in paragraph 3.02, Grouting.
 4. Completed Rigid Equipment Mount Installation Inspection Checklist Forms (43 05 13-A), as specified in paragraph 3.03, Manufacturer's Services.

1.07 QUALITY ASSURANCE

- A. Quality Control By Contractor:
1. Except where union rules require installation by another trade, all machinery to be mounted and leveled by journeyman millwrights.
 2. Epoxy grout installation performed by employees that have completed the epoxy grout manufacturer's grout installation training specified in this Section.
 3. Provide the services of an independent testing laboratory that complies with the requirements of ASTM E329. Testing laboratory to sample and test materials installed as part of rigid equipment mounts specified in this Section. Testing laboratory services costs borne by the Contractor.
 4. Where epoxy grout is specified for bedding mounting plates, furnish the services of a grout manufacturer's technical representative who has been factory trained by the grout manufacturer. The grout manufacturer's technical representative performs training and quality control for epoxy grout installation for rigid equipment mounts as specified in paragraph 3.03, Manufacturer's Services.
- B. Special Inspection for Equipment Anchors:
1. Equipment anchors shall comply with special inspection requirements specified in Section 05 05 20.

PART 2 PRODUCTS

2.01 GENERAL

- A. Configure rigid equipment mounts as specified in the Equipment Mounting Schedule (See Part 4 of this specification) or as specified in individual equipment specifications. Equipment mounting configuration requirements in individual equipment specifications govern over configuration requirements specified in the Equipment Mounting Schedule. In the absence of equipment mounting configuration requirements in either of these locations, mount equipment per the default requirements specified in paragraph 1.01.
- B. Pumps installed in accordance with this Section, HI 14.3, and HI 14.4.

2.02 MATERIALS FOR EQUIPMENT MOUNTING

- A. Equipment pads: Reinforced concrete as specified in Process Mechanical Details.
- B. Mounting Plates: Cast iron, cast steel, plate steel, fabricated steel frame, polymer concrete, or FRP as specified in the equipment specification.
- C. Grout type for equipment mounting as specified in the Equipment Mounting Schedule or in individual equipment specification.
 - 1. Epoxy Grout for Equipment Mounting: Where epoxy grout is specified in the Equipment Mounting Schedule or in individual equipment specifications, provide Epoxy Grout for Equipment Mounting as specified in Section 03 60 00. Where the term epoxy grout is used in the context of details and specifications for equipment mounting it means Epoxy Grout for Equipment Mounting as specified in Section 03 60 00.
 - 2. Cementitious Nonshrink Grout: Where non-shrink grout is specified in the Equipment Mounting Schedule or in individual equipment specifications, Cementitious Non-shrink Grout, specified in Section 03 60 00, may be used for setting bearing surfaces of baseplates, soleplates, or fabricated steel frames. Where the term non-shrink grout or cementitious grout is used in the context of details and specifications for equipment mounting it means Cementitious Non-shrink Grout as specified in Section 03 60 00.
- D. Equipment anchors: Materials per the following table and per the area exposure condition where the equipment is installed. Section 01 61 45 specifies area exposure conditions.

Area Exposure	Equipment Anchor Materials
Indoor, Dry	Carbon Steel, ASTM F1554, Grade 36, weldable per S1 for threaded rod
Indoor, Wet	Galvanized Carbon Steel, ASTM F1554, Grade 36, weldable per S1 for threaded rod
Outdoor	304 Stainless, ASTM F593, Cond. CW
Submerged, Immersed	316 Stainless, ASTM F593, Cond. CW
Process Corrosive	316 Stainless, ASTM F593, Cond. CW
Chemical Corrosive	316 Stainless, ASTM F593, Cond. CW

- E. Anchor sleeves: Flexible polyurethane foam, steel cylinder/tubes, or corrugated/ribbed plastic sleeves.

- F. Epoxy Primer: High-strength, lead free, chrome free, rust inhibiting two-component epoxy primer specifically designed for use on metal substrates and in conjunction with epoxy grout. Bond strength to sandblasted metal not less than 1500 psi.
 - a. ITW Performance Polymer MS-7CZ primer
 - b. Approved equal.
- G. Anti-seize/Anti-galling compound: Molybdenum disulfide and graphite combination in aluminum complex base grease conforming to MIL-PRF-907E.
 - a. Jet Lube 550 by Jet Lube, Inc.
 - b. E-Z Break by LA-CO
 - c. or approved equal.

2.03 EQUIPMENT PADS

- A. Minimum dimensions for equipment pads are shown on structural drawings where a minimum equipment pad mass is required for vibration dampening/control.
- B. Equipment Pad Drainage:
 - 1. Furnish equipment pads with 2-inch drains.
 - 2. Locate equipment pad drains at drainage outlets from equipment or mounting plates
 - 3. Route equipment drainage outlets or mounting plate drainage outlets to equipment pad drains
 - 4. Route equipment pad drains to the floor drainage collection system.
 - 5. Drainage piping for equipment pads shall be routed below the finished floor elevation.
 - 6. Exposed drain lines mounted on the floor are not acceptable.

2.04 EQUIPMENT ANCHORS:

- A. Equipment Anchors:
 - 1. All thread rod with heavy hex welded nuts, heavy hex bolts, post-installed anchors (wedge, sleeve, undercut, expansion, and adhesive anchors), or adjustable canister anchors as specified in the Equipment Mounting Schedule or in individual equipment specifications.
 - 2. Bolt length as required for the specified embedment and sleeve length. Reduce equipment anchor sleeve length as necessary to fit within finished height of equipment pad if equipment pad height is insufficient to provide specified equipment anchor sleeve length. Unified Coarse Thread Series per ASME B1.1.
 - 3. Post-installed anchors (wedge, sleeve, undercut, expansion, and adhesive anchors) conforming to the requirements of Section 05 05 20.
 - 4. Adjustable canister anchors consist of cast-in-place pre-manufactured adjustable anchor inserts. Provide a minimum of 6 inches of vertical bolt height adjustment and lateral adjustment of the anchor bolt while maintaining the anchor bolt in a true vertical orientation.
 - a. Jakebolts as manufactured by Unisorb
 - b. Heavy Duty Adjustable Anchors as manufactured by Deco
 - c. Rowan Adjustable Canister Anchor Bolt

d. or approved equal.

B. Equipment Anchor Design:

1. Size (diameter) of anchors for clamping/fastening mounting plates to equipment pads determined by the equipment manufacturer.
2. Comply with Local Governing Building Code for equipment anchor size, embedment, and edge distance. Provide equipment anchors that are sufficient to resist the maximum lateral and vertical forces specified.
3. Resistance to lateral (horizontal) loads based on the static friction between the mounting plate and its supporting grout pad. Include the clamping force applied by equipment anchors and the weight of the equipment for calculating static friction resistance to lateral loads. Do not include lateral (shear) loading on equipment anchors or adhesion between mounting plates and supporting grout in lateral loading resistance calculations.
4. Furnish equipment anchor calculation submittals for all equipment unless one of the following exceptions is applicable:
 - a. The importance factor, I_p , for the equipment is equal to 1.0, flexible connections are provided for all electrical and mechanical connections to the equipment, the center of mass of the equipment is less than 48 inches above the floor when it is mounted or attached to the structure, and the equipment weighs less than 400 pounds.
 - b. The importance factor, I_p , for the equipment is equal to 1.0, flexible connections are provided for all electrical and mechanical connections to the equipment, and the equipment weighs less than 20 pounds.
5. Equipment anchor calculations sealed by a registered structural or civil engineer licensed in the State of Utah.

C. Equipment Anchor Tension:

1. Unless alternate bolt torque/tension requirements are specified by the equipment manufacturer, tighten equipment anchors to provide a final clamping force that produces a tensile stress of 15,000 psi in each equipment anchor. Tighten adjustable canister anchors to the manufacturer's maximum safe working load. Tighten post-installed anchors to manufacturer's recommendations.
2. Bolt torque values required to produce the specified bolt tension based on well lubricated plain finish national coarse thread bolts are presented in the following table. Revise bolt torque values per equipment manufacturer's recommendations for alternate thread patterns, thread lubrication, bolt material, or bolt finish.

Bolt Diam. (in)	3/8	1/2	5/8	3/4	7/8	1	1-1/8	1-1/4	1-1/2
Final bolt torque for 15,000 psi bolt stress (ft*lbs)	8	15	30	50	80	125	180	250	400

3. Prior to leveling and grouting mounting plates, pull test grouted equipment anchors to the values specified in the following table.

Anchor Diam. (in)	3/8	1/2	5/8	3/4	7/8	1	1-1/8	1-1/4	1-1/2
Pull test load (kips)	2.1	3.8	6.1	9.1	13	17	22	28	43

D. Anchor Sleeves:

1. Provide sleeves for equipment anchors as specified in the Equipment Mounting Schedule or in individual equipment specifications.
2. Adjust equipment anchor length/embedment depth shown in Process Mechanical Details if sleeves are not required.
3. Sleeves may be installed at the Contractor's option if not specified in the Equipment Mounting Schedule or in individual equipment specifications provided they do not interfere with specified embedment lengths.
4. Fill steel cylinders/tubes and ribbed plastic sleeves with a flexible room temperature vulcanizing (RTV) sealant prior to embedment/installation.

2.05 MOUNTING PLATES

A. General:

1. Round edges of surfaces of baseplates, soleplates, and fabricated steel frames that bear on grout to a radius of not less than 0.25 inch.
2. Round perimeter corners of baseplates, soleplates, or fabricated steel frames to a radius of not less than 2.0 inches to avoid producing stress risers on the grouted foundation.
3. Provide grout pouring holes (minimum 4 inches in diameter for epoxy grout, minimum 2.5 inches in diameter for cementitious non-shrink grout) and air release holes in all baseplates and soleplates.
4. Provide grout relief or vent holes (minimum 1 inch in diameter) in all baseplates and soleplates.
5. Drill mounting holes for equipment anchors through baseplates, soleplates, and fabricated steel frames. Open slots or burned out holes for equipment anchors are not permitted.
6. Provide acorn nuts welded to the underside of the baseplate or soleplate or nuts welded to the underside of the baseplate or soleplate and plugged with cork, plastic plugs or grease where terminations to baseplates and soleplates are required.
7. Where fasteners terminate only into the baseplate, soleplate, or fabricated steel frame, threaded lengths (tapped or embedded in mounting plates) shall be not less than the bolt diameter.
8. Where baseplates, soleplates, or fabricated steel frames are leveled using jackscrews, tap jackscrew threads in thickened pads or otherwise in sufficient metal to provide ease in adjusting level.
9. Mill mounting pads and/or mounting surfaces of baseplates, soleplates, and fabricated steel frames flat and coplanar within 0.0005 inch per foot in all directions after all welding and stress relieving.
10. Pre-grout baseplates prior to milling.
11. Baseplates, soleplates, and fabricated steel frames provide common support for the equipment and driver (and flywheel, if one is specified).
12. For equipment with drivers 20 horsepower and greater, provide transverse alignment (horizontal) positioning jackscrews for alignment of equipment drivers on horizontal surfaces of baseplates, soleplates, and fabricated steel frames.
13. Provide alignment/positioning jackscrews in perpendicular directions in a horizontal plane at the mounting position for each corner or foot of the equipment driver.

(Additional jackscrews provided for transverse alignment of the flywheel, if flywheels are specified in the equipment specification.)

14. Where specified in individual equipment specifications; baseplates, soleplates, and fabricated steel frames fitted with RK Fixators as manufactured by Unisorb, or approved equal.
 - a. Fixators installed at mounting surfaces for drivers.
 - b. Fixators consist of a three-piece wedge leveling adjustment device incorporating a spherical washer assembly to provide true level height adjustment at each mounting surface for the equipment driver.

B. Fabricated Steel Frames:

1. Fabricated steel frames consist of structural steel shapes welded to form mounting plates.
2. Fabricated steel frames to be rectangular in shape, excepting fabricated steel frames for centrifugal refrigeration machines and pumps which may be T- or L-shaped to accommodate the equipment driver and accessories.
3. Fabricated steel frames for split case pumps include supports for suction and discharge elbows, if required by the specified configuration.
4. Perimeter members consist of I-beams or C-channel with a minimum depth equal to 1/10 of the longest dimension of the fabricated steel frame. Beam depth need not exceed 14 inches provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer.
5. Fabricated steel frames furnished with thickened steel mounting pads welded to the fabricated steel frame for bolting equipment to the mounting plate.
6. Sandblast surfaces of fabricated steel frames in contact with grout to white metal per SSPC SP-5.
7. Apply a high-strength epoxy primer as specified in **paragraph 2.02** within 8 hours of sandblasting the fabricated steel frame.

C. Baseplates:

1. Baseplates may be welded steel, cast steel, or cast iron with thickened mounting pads for bolting equipment to the baseplate.
2. Provide internal stiffeners on all cast and fabricated baseplates. Stiffeners designed to allow free flow of grout from one section of the baseplate to another.
3. Provide a minimum 2 inches high by 6 inches wide opening in cross bracing and stiffeners for grout flow between sections of the baseplate.
4. All welds continuous and free from skips, blowholes, laps and pockets.
5. Pre-grout baseplates at the factory after all welding has been completed and prior to machining the mounting pads on the baseplate. Pre-grout baseplates in the field if they have not been pre-grouted at the factory. Remove the equipment from the baseplate, invert the baseplate, and pre-grout as specified in this Section.
6. Prior to pre-grouting, sandblast the underside of baseplates to white metal per SSPC SP-5.
7. Complete pre-grouting within 8 hours of sandblasting.
8. Fill the underside of the baseplate to the bottom edges of the baseplate.
9. Seal cast iron baseplates to prevent surface bleeding prior to shipment to the project site.

D. Plate Steel Soleplates:

1. Not less than 1.0 inch thick for equipment with drivers greater than 30 horsepower.
2. Furnished with grout keys/lugs or stiffeners on the underside of the soleplate.
3. Flat uniform horizontal surface on underside of plate steel soleplates, excepting grout keys, grout pour holes, vent holes, and attachment hardware (nuts, bolts, tapped holes, etc.).
4. Prior to milling the mounting pads for equipment or mounting surfaces, scribe the words "THIS SIDE DOWN", using welding rod material, on the underside of plate steel soleplates.
5. Plate steel soleplates without grout pouring holes are acceptable provided that no dimension of the soleplate (width or length) exceeds 18 inches.
6. Sandblast surfaces of plate steel soleplates in contact with grout to white metal per SSPC-SP-5, prior to shipment to the project site.
7. Apply a high-strength epoxy primer as specified in **paragraph 2.02** within 8 hours of sandblasting the underside of plate steel soleplates.
8. Where equipment is fabricated or cast with feet or mounting surfaces that are not fastened to a common baseplate or soleplate, as in dry-pit bottom-suction pumps, the equipment may be supported on individual concrete piers or equipment pads in lieu of mounting on a common equipment pad and soleplate. In such instances, support the equipment at the feet or mounting surfaces on individual plate steel soleplates. Level individual plate steel soleplates and grout into place on the individual piers or equipment pads as specified in this Section. Where multiple soleplates are installed to support one piece of equipment, soleplates shall be coplanar within 0.002 inch/foot.

E. Polymer Concrete Soleplates:

1. Pre-cast soleplates consisting of polymer concrete with stainless steel inserts for equipment mounting.
2. Mounting surfaces shall be coplanar within 0.002 inch/foot.
3. Furnished with a uniform horizontal surface over the entire underside of the mounting plate, excepting grout keys, grout pour holes and vent holes.
 - a. PoxyBase as manufactured by Basetek
 - b. Chembase as manufactured by Goulds
 - c. Approved equal.

F. Corrosion Resistant FRP Baseplates:

1. Pre-formed fiber reinforced plastic fabrications.
2. Product of the manufacturer of the equipment that is mounted on the baseplate.

PART 3 EXECUTION

3.01 PREPARATION

A. Concrete Equipment Pad Preparation:

1. Roughen the top of the equipment pad after the concrete has reached its 28-day compressive strength.
2. Remove all laitance and defective or weak concrete.

3. Roughen surface profile to 0.25 inch amplitude, minimum.
4. Expose broken aggregate without dislodging unbroken aggregate from the cement matrix and without fracturing concrete and aggregate below the concrete surface.
5. Roughen using a light-duty (15 pounds or less), hand-held chipper with a chisel type tool.
6. Abrasive blast, bush-hammer, jack hammers with sharp chisels, heavy chipping tools, or needle gun preparation of concrete surfaces to be grouted are not acceptable.
7. Demonstrate removal of defective or weak concrete to the Construction Manager prior to leveling.
8. Chip the surface of the concrete such that the final elevation of the equipment pad provides the grout manufacturer's recommended thickness between the surface of the equipment pad and the lower baseplate flange, underside of the soleplate, or underside of the fabricated steel frame.
9. Remove all dust, dirt, chips, oil, water, and any other contaminants and protect the surface with plastic sheeting until grout is installed.
10. Protect concrete equipment pad surfaces that have been finished smooth and level for use as leveling positions. Protect from damage during chipping activities. Alternatively, leveling positions may be restored on chipped surfaces. Restore leveling positions by installing leveling blocks or leveling plates for jackscrews on a high compressive strength epoxy putty (Philadelphia Resins, Phillybond Blue 6A, or equal). Leveling blocks and leveling plates installed level on the epoxy putty.

B. Grout Form Construction:

1. Design forms for a minimum of 6 inches hydrostatic head above the final elevation of the grout and manufacturer's recommendations for form edge clearance for intended pour scheme, but not less than two inches.
2. Install grout expansion joints at 4 to 6 foot intervals, perpendicular to the centerline of baseplates. Design expansion joints in accordance with the grout manufacturer's written instructions.
3. Coat forms with three coats of paste wax on all areas of the forms that will be in contact with the grout.
4. Wax forms before assembly.
5. Prevent accidental application of wax to surfaces where the grout is to bond.
6. Remove any foreign material, such as oil, sand, water, wax, grease, etc., from concrete surfaces that will contact grout before forms are installed.
7. Forms must be liquid tight. Seal any open spaces or cracks in forms, or at the joint between forms and the foundation using sealant, putty, or caulking compound.
8. Chamfer vertical and horizontal edges of the grout with 45-degree chamfers as specified in equipment pad details. Locate 45-degree perimeter chamfer strips at the final elevation of the grout.
9. Match chamfers in concrete portions of the equipment pad.
10. Install block outs at all leveling positions to allow removal of leveling equipment and leveling nuts to be backed off after the grout has cured.
11. Coat jackscrews with a light oil or other acceptable bond-breaking compound prior to grouting.
12. Seal equipment anchor sleeves to protect the sleeved length of the anchor from contact with grout.

13. Wrap exposed portions of equipment anchors with duct tape to protect them from grout splatter and to prevent bonding to grout.

C. Mounting Plate Preparation:

1. Roughen the underside of soleplates and fabricated steel frames and wipe with a residue-free solvent as recommended by the epoxy primer manufacturer before placement of the baseplate, soleplate, or fabricated steel frames on the equipment pad for leveling. Roughen surfaces of mounting plates that will be in contact with grout by power tool cleaning. Cleaning performed by power wire brushing, power sanding, power grinding, power tool chipping or power tool descaling. Impart a minimum profile of 1.0 mil.
2. Prior to placement on the equipment pad for leveling, roughen exposed grout surfaces of pre-grouted baseplates and wipe with a residue-free solvent as recommended by the manufacturer of the epoxy grout used for pre-grouting.
3. Prepare the underside of corrosion-resistant FRP baseplates and polymer concrete baseplates per the baseplate manufacturer's recommendations and prior to placement of the baseplate on the equipment pad for leveling.
4. Grouting for installation of mounting plates on equipment pads completed prior to connecting any field piping or electrical and instrumentation systems.
5. Unless the Construction Manager accepts an alternate installation procedure in writing, baseplates, soleplates, and fabricated steel frames leveled and grouted with the equipment removed.

3.02 INSTALLATION

A. Leveling:

1. Except where union rules require installation by another trade, all equipment and machinery mounted and leveled by a Qualified Millwright.
2. Use precision surveying equipment for leveling.
3. Machinists' spirit levels will not be permitted for leveling purposes for any baseplate, soleplate, or fabricated steel frame with a plan dimension greater than 4 feet.
4. Baseplates, soleplates, and fabricated steel frames leveled to the tolerance specified in the Equipment Mounting Schedule, in the individual equipment specification, or as otherwise required by the equipment manufacturer, if more stringent.
5. Apply an anti-seize or anti-galling compound, specified in [paragraph 2.02](#), to all equipment anchor threads prior to beginning baseplate, soleplate, or fabricated steel frame leveling.
6. Level all baseplates, soleplates, and fabricated steel frames against steel surfaces (jackscrew plates, leveling blocks, leveling nuts, support plates, or other steel surfaces). Use of other materials for leveling purposes is strictly and specifically prohibited.
7. Use stainless steel leveling blocks and shims, steel wedges, or jackscrews bearing on leveling plates.
8. Leveling nuts may be used for leveling baseplates, soleplates, and fabricated steel frames weighing less than 200 pounds (inclusive of the weight of the equipment if leveled with the equipment on the mounting plate).
9. Leveling blocks shall be stainless steel, 4 inches square and 1.5 inches thick with an open-ended slot terminating in the center for the equipment anchor.

10. Machine leveling blocks flat on all horizontal surfaces and place under the baseplate or soleplate at each equipment anchor.
11. Provide pre-cut stainless steel shims, slotted for removal after grouting. Coat leveling blocks and shims with a light oil just prior to beginning the leveling and grouting work. Place shims so the tabs on the shims are easily accessible.
12. Clamp baseplates, soleplates, or fabricated steel frames in position (after leveling) by installing the equipment anchor nuts and washers.
13. Apply bolt tension to fix the position of mounting plates during grouting (30 to 60 percent of the final clamping force applied to clamp the mounting plate to the equipment pad).
14. Prior to grouting, verify that the correct level and position of the baseplate, soleplate, or fabricated steel frame has been maintained after clamping it to the equipment pad.

B. Grouting:

1. Adjust ambient temperature to maintain mounting plate, foundation, and grout temperatures to grout manufacturer's recommended temperature.
2. Mix grout for equipment mounting in accordance with the grout manufacturer's written recommendations.
3. Place epoxy grout using a method that avoids air entrapment.
4. Place grout at one end of the baseplate or soleplate and work grout toward the opposite end to force the air out from beneath the baseplate or soleplate.
5. Pour grout through a head box into grout pouring holes.
6. When the head box is moved to the next grout hole, place a 6 inch standpipe over the grout hole and fill with grout.
7. Pour grout to the top of the lower flange of the perimeter I-beams or C-channel of fabricated steel frames.
8. Pour grout at least 0.125 inch but not more than 0.5 inch above the bottom or underside of the perimeter edge of a baseplate or soleplate.
9. Use of vibrating tools and/or jarring (rapping or tapping) forms to facilitate grout flow is not permitted during placement of epoxy grout.
10. Never allow the grout in the head box to fall below the top of the baseplate or soleplate once the grout has made contact with the baseplate or soleplate.
11. Grout placement applied in one continuous pour, until all portions of the space beneath the baseplate, soleplate, or fabricated steel frame have been filled.
12. Prepare subsequent batches of grout prior to depleting the preceding batch.
13. Maintain grout height in standpipes after the space under the baseplate, soleplate, or fabricated steel frame has been filled.
14. When the grout has started to take an initial set (typically this is determined by a noticeable increase in temperature and no flow of grout at the vent holes) remove the standpipes and clean excess grout from all surfaces.
15. Check for leaks throughout grout pours. Repair leaks immediately to prevent formation of voids.
16. Check baseplate, soleplate, or fabricated steel frame level and elevation before the grout sets.
17. Cure grout in accordance with the grout manufacturer's written instructions.

18. Collect at least one grout sample from each grout pour. Where specified in the individual equipment specifications, collect a grout sample from the grout pour for each equipment pad.
 - a. Place samples in a cylinder of sufficient size to yield three 2-inch cubes as test samples.
 - b. Label samples with project name, date, time, the equipment number, and ambient temperature at the time of placement.
 - c. Place samples next to the foundation of the equipment being grouted and cure for 48 hours.
 - d. Test grout samples in accordance with the grout manufacturer's recommendations.
 - e. Grout samples tested by the independent testing laboratory specified in paragraph 1.07 Quality Control by Contractor.
 - f. Report test results directly to the Construction Manager.

C. Completion:

1. Upon acceptance by the Construction Manager and the equipment manufacturer's representative and after the grout has reached sufficient strength, remove grout forms and block outs at leveling positions. Remove leveling blocks and shims or wedges and support plates. Back off leveling nuts and jack screws to allow the grout to fully support the baseplate, mounting block, or soleplate. Take care not to damage the grout during removal of extended shimming material or leveling equipment and tools.
2. Tighten equipment anchor nuts using calibrated indicating torque wrenches, to develop the full bolt tension specified in paragraph 2.04 Equipment Anchor Tension.
3. Tighten equipment anchor nuts in increments of not more than 25 percent of the final torque value in an alternating pattern to avoid stress concentration on the grout surface. After tightening equipment anchor nuts to final values, apply additional wax, grease, or mastic to all exposed portions of the equipment anchor beneath the baseplate, soleplate, or mounting block.
4. After applying additional wax or mastic to exposed portions of equipment anchors and tightening to final torque values, fill and point block outs (pockets) for access to leveling nuts, leveling blocks, shims, or wedges with the grout material installed under baseplates, soleplates, or fabricated steel frames. Remove jackscrews and fill holes in the baseplate, soleplate, or fabricated steel frame with a flexible sealant (silicone rubber) or a short cap screw.
5. Check for baseplate, soleplate, or fabricated steel frame movement (soft foot) by individually loosening and re-tightening each equipment anchor. Measure and record vertical movement at each equipment anchor during loosening and retightening. Measure vertical movement using a magnetic-based dial indicator on the baseplate, soleplate, or fabricated steel frame referenced to the epoxy grout surface of the equipment pad, or other approved method. Vertical movement exceeding 25 micrometers (0.001 inch) indicates a soft foot condition. Soft foot conditions are sufficient cause for removal and reinstallation of grout and baseplates, soleplates, or fabricated steel frames.
6. Check for grout voids by tapping along the upper surfaces of the baseplate, soleplate, or mounting block. Mark grout voids. A grout void is sufficient cause for removal and reinstallation of grout and baseplate, soleplate, or fabricated steel frame. At the

discretion of the Construction Manager, grout voids may be repaired as specified in Chapter 5, Section 3.16 of API RP 686.

D. Piping Connections:

1. Anchor piping connecting to flexible connections and/or expansion joints such that the intended function of these connections/joints is maintained in the piping system without imposing strain on the equipment connections.
2. Where an equipment manufacturer's installation requirements include a rigid connection between the machine and connecting piping systems, delete any flexible coupling (including equipment connection fittings) shown on the drawings and install the equipment in the following manner, in lieu of installing the flexible coupling:
 - a. Install equipment pad as shown in the detail specified in the Equipment Mounting Schedule or in the individual equipment specification.
 - b. Install the baseplate, soleplate, or fabricated steel frame supporting the equipment and grouted in place as specified in this Section.
 - c. Install and align the equipment in place as specified in **Section 43 05 14**.
 - d. Install and align piping between equipment connections and field piping without welding one of the joints for one section of pipe between the equipment connection and the field piping and all valving. All flanged joints bolted up and pressure-tested.
 - e. All piping must be fully supported by supports designed to accept their full weight and thrust forces.
 - f. Install the final section of piping. Align the final section of pipe with the equipment and field connections without the use of jacks, chain falls, or other devices to force it into alignment.
 - g. Do not weld the final piping joints until after the previous steps have been completed and accepted by the Construction Manager.

3.03 FIELD QUALITY CONTROL

A. Manufacturer's Services

1. **Epoxy Grout Training:** Prior to commencing rigid equipment mount installation work on equipment pads, furnish the services of a grout manufacturer's technical representative to conduct a training school for the workers who will be using epoxy grout for rigid equipment mount installations. Epoxy grout training school duration to be not less than 4 hours duration and covers all aspects of using the products, including form construction for each equipment installation, surface preparation, mixing, application, void prevention/elimination, and clean up. This requirement does not relieve the Contractor of overall responsibility for this portion of the work. Epoxy grout manufacturer to furnish a list of school attendees who have been satisfactorily trained to perform epoxy grout installation for equipment mounting.
2. **Epoxy Grout Quality Control:** The epoxy grout manufacturer's technical representative provides quality control services for equipment mounted with epoxy grout. The epoxy grout manufacturer's technical representative must be present (on site) to inspect and verify that the installation personnel have successfully performed surface preparation, epoxy grout application, and Quality Control Inspection in accordance with these specifications for a representative portion of the epoxy grout installation work.

3. Epoxy grout manufacturer's technical representative performs the following services for at least one rigid equipment mount installation for each equipment type and size installed with epoxy grout:
 - a. Inspect ambient conditions during various phases of epoxy grouting installation for conformance with the epoxy grout manufacturer's requirements.
 - b. Inspect the surface preparation of concrete substrates onto which epoxy grout materials are to be applied. Inspect surface for conformance to the specified application criteria, including but not limited to substrate profile, degree of cleanliness, and moisture.
 - c. Inspect the surface preparation of the metallic substrates onto which the epoxy primer is to be applied.
 - d. Inspect the epoxy-primed metallic substrate for coverage and adhesion.
 - e. Inspect preparation and application of epoxy grout form work for conformance to the specifications and manufacturer's recommendations for form edge clearance.
 - f. Inspect and record that the "pot life" of epoxy grout materials is not exceeded during installation.
 - g. Inspect epoxy grout for cure.
 - h. Inspect and record that localized repairs made to grout voids conform to the specification requirements.
 - i. Conduct a final review of completed epoxy grout installation for conformance to these specifications.
 - j. Attest to conformance of the Contractor's work by signing appropriate entries in the "Rigid Equipment Mount Inspection Checklist," Form 43 05 13-A in Section 01 99 90.
- B. Training and quality control by the grout manufacturer's technical representative is not required for rigid equipment mounts installed with cementitious non-shrink grout.

3.04 FINAL INSPECTION

- A. The Construction Manager will conduct a final inspection with the Contractor for conformance to requirements of this Section.

PART 4 EQUIPMENT MOUNTING SCHEDULE

Equipment Mounting Schedule

Equipment Number	Specification Section	Specification Title	Equipment Pad Detail	Mounting Plate Leveling Tolerance (inch/foot)	Equipment Anchor Type	Equipment Anchor Sleeve Length	Grout Type	Application Notes
Default Config.	<i>Various</i>	<i>Various</i>	<i>D01007</i>	<i>0.005</i>	<i>D01002</i>	<i>10D</i>	<i>Non-shrink</i>	<i>Default equipment mounting configuration for all equipment not otherwise specified in this schedule</i>
Freestanding floor-mounted electrical panels and equipment	<i>Various</i>	<i>Various</i>	<i>D01006</i>	<i>Not applicable</i>	<i>D01004</i>	<i>Not required</i>	<i>Not required</i>	
P 210,212 P 210,222 P 210,232 P 210,242	<i>11328</i>	<i>Custom-Engineered Vertical Mixed Flow Pumps</i>	<i>Det. B/ 2109-M-201</i>	<i>0.0005</i>	<i>D01003</i>	<i>15D</i>	<i>Epoxy</i>	<i>The Equipment Pad Detail entry for this row refers to a project specific detail for the equipment pad detail rather than one of the standard details for equipment pads.</i>
P 310,234 P 310,236 P 310,244 P 310,246	<i>11325</i>	<i>Recessed Impeller Pumps</i>	<i>D01007</i>	<i>0.002</i>	<i>D01002</i>	<i>15D</i>	<i>Non-shrink</i>	
T 625,401 T 625,501	<i>13216</i>	<i>Cross-Linked Polyethylene Tanks</i>	<i>Existing</i>	<i>No mounting plate</i>	<i>D01003</i>	<i>Not required</i>	<i>None</i>	<i>Retrofit tank on existing equipment pad. See specification for special mounting requirements.</i>
P 700,368	<i>11342</i>	<i>Screw Centrifugal Pumps</i>	<i>D01007</i>	<i>0.002</i>	<i>D01003</i>	<i>10D</i>	<i>Epoxy</i>	<i>Retrofit equipment pad on existing foundation</i>
P 710,257	<i>11390</i>	<i>Progressing Cavity Pumps for Sludge Service</i>	<i>D01008</i>	<i>0.005</i>	<i>D01005</i>	<i>15D</i>	<i>Non-shrink</i>	

Equipment Mounting Schedule

Equipment Number	Specification Section	Specification Title	Equipment Pad Detail	Mounting Plate Leveling Tolerance (inch/foot)	Equipment Anchor Type	Equipment Anchor Sleeve Length	Grout Type	Application Notes
P 840,861 P 840,862 P 840,863	11347	Submersible Non-Clog Pumps for Sewage Service	None	0.002	D01002	Not required	Epoxy	Grout discharge elbow base to slab at el. 2162.50
F 990,111 F 990,121 F 990,131	15828	Centrifugal Fiberglass Reinforced Plastic Fans	D01006	Not required	D01004	Not required	Not required	Mount vibration isolation system on equipment pad.

Equipment Mounting Schedule

Equipment Mounting System	Equipment Pad Detail	Mounting Plate Leveling Tolerance (inch/foot)	Equipment Anchor Bolt Detail	Equipment Anchor Sleeve Length	Grout Type	Application Notes
Default	D01007	0.005	D01002	10D	Non-shrink	The default equipment mounting configuration, unless this schedule or the equipment specifications specify another mounting configuration. (general purpose)
Group A	D01008	0.0005	D01003	15D	Epoxy	(critical service, existing space, in adequate mass in equipment pad)
Group B	D01007	0.0005	D01002	15D	Epoxy	(critical service w/ dampening mass in equipment pad)
Group C	D01006	0.02	D01004	Not required	Non-shrink	(static/non-critical, mounted on housekeeping pad)
Group D	D01007	No mounting plate	D01001	No sleeve	Non-shrink	Install anchor without sleeves. (tanks/scrubbers/ process vessels)
Group E	No pad	0.02	D01001 or D01002	Not required	Epoxy	(submersible pumps)
Group F	D01006	Not Applicable	D01004	Not required	Not required	(Freestanding floor-mounted electrical panels and equipment)

END OF SECTION

SECTION 43 05 21
COMMON MOTOR REQUIREMENTS FOR EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
1. Squirrel cage type, AC induction motors, up to 500 HP, for up to 4 poles (3600 or 1800 rpm nominal), or up to 250 HP for over 6 poles (1200 rpm or slower) shall be per NEMA MG1, Small or Medium.
 2. Special purpose motors with features or ratings which are not specified herein, are specified in the particular equipment specifications.

1.02 RELATED SECTIONS

- A. This section contains specific references to the following related sections. Additional related sections may apply that are not specifically listed below.
1. Section 26 29 23 Variable Frequency Motor Controllers

1.03 REFERENCES

- A. This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
ABMA 9	Load Ratings and Fatigue Life for Ball Bearings
ABMA 11	Load Ratings and Fatigue Life for Roller Bearings
IEEE 112	Standard Test Procedures for Polyphase Induction Motors and Generators
IEEE 841	Standard for Petroleum and Chemical Industry- Premium-Efficiency, Severe Duty Totally Enclosed Fan-Cooled (TEFC) Squirrel Cage Induction Motors - Up to and Including 500 HP
NEMA ICS 2	Industrial Control and Systems Controllers, Contactors and Overload Relays Rated Not More Than 2000 Volts AC or 750 Volts DC
NEMA 250	Enclosures for Electrical Equipment (1000 volts maximum)
NEMA MG 1	Motors and Generators
Department of Energy	Energy Policy and Conservation Act, Final Rules EERE-2010-BT-STD-0027-0117
UL 674	Electric Motors and Generators for Use in Division 1 Hazardous (Classified) Locations
UL 1004	Electric Motors

1.04 DEFINITIONS

- A. Terminology used in this Section conforms with NEMA MG-1. Motors covered in this specification are those defined in NEMA MG1 as Small (Fractional) and Medium (Integral) AC induction motors.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Unit Responsibility: Where Unit Responsibility is specified in the driven equipment sections of these specifications, the motor supplier shall coordinate with the provider of the driven equipment to verify that the motor provided under this section is fully compatible with and meets the specified performance requirements for that equipment.

1.06 SUBMITTALS

A. Action Submittals:

1. Procedures: **Section 01 33 00**.
 - a. Copy of this Section, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.
 - b. Check-marks (✓) to denote full compliance with a paragraph as a whole. Underline deviations and denote by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance. Include a detailed, written justification for each deviation.
 - c. Failure to include a copy of the marked-up specification sections with justification(s) for any requested deviation will cause rejection of the entire submittal with no further consideration.
2. Motor Data Sheets specified in this Section and **Division 01**.
 - a. Motors in conformance with IEEE 841: Manufacturers to complete IEEE Standard 841 Data Sheet for AC Induction Motors.
 - b. Motors not in conformance with IEEE 841: Motor supplier to complete **Form 43 05 21-A in Section 01 99 90** with required factory data.
 - c. Motor Speed-Torque curve, where specified.
3. Routine Factory test data for polyphase motors.
 - a. High-potential test.
4. Factory test data, from required dynamometer tests, where specified.
5. Vibration level when measured in accordance with NEMA MG 1, for all IEEE 841 motors, and where elsewhere specified.
6. Motor heating curve, where specified,
7. Motor mounting, outline, dimensions, and weight.
8. Motor bearing and winding RTDs (resistance temperature detector), where specified.
9. Motor winding thermostat or thermistor, where specified.
10. Motor winding space heaters, where specified.
11. Motor nameplate data.

B. Informational Submittals:

1. Procedures: **Section 01 33 00 and 01 78 23**.
2. Submittal requirements for operation and maintenance manuals as per requirements of Section **01 78 23**.

1.07 QUALITY ASSURANCE

A. Factory Testing:

1. All polyphase motors shall be factory tested in conformance with routine tests per NEMA MG1 and IEEE 112. Provide the following tests:
 - a. Measurement of winding resistance.
 - b. No-load readings of current and speed at normal voltage and frequency.
 - c. Current input at rated frequency with rotor at standstill.
 - d. High potential test.
- B. Where specified for use in corrosive or hazardous locations, motor testing shall additionally be per IEEE 841. Test report shall be certified by the motor manufacturer's test personnel and submitted to the Engineer.
 1. For motors larger than 100 horsepower, test and submit results for the following:
 - a. Routine tests per NEMA MG1 and IEEE 112. Provide tests as noted in paragraph 1.07 Factory Testing. Test report shall be certified by the motor manufacturer's test personnel and submitted to the Engineer.
 - b. For motors larger than 200 horsepower, efficiency and power factor by Test Method B, IEEE 112. Submit Form B and B-2.

1.08 DELIVERY, STORAGE AND HANDLING

- A. Procedures shall be in accordance with Section 01 66 00.

1.09 SPECIAL WARRANTY

- A. Provide warranty in accordance with Section 01 77 00.
- B. Submit warranties in writing to include 100 percent full payment coverage for parts and labor for repair or replacement of the motor (s) during the warranty period.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. The following candidate manufacturers are capable of producing equipment and/or products that will satisfy the requirements of this Section. The manufacturer's standard product may require modification to conform to specified requirements:
 1. Baldor
 2. General Electric
 3. Siemens
 4. US Motors
 5. WEG
 6. Approved Equal

2.02 PERFORMANCE/DESIGN CRITERIA

- A. Service Conditions:
 1. Temperature: -25-degree C to [+40] [+50] degree C.
 2. Altitude: See 01 11 80 Environmental Conditions

3. Derate motors for higher ambient temperature and for higher altitude with motor size based on brake-horsepower.
- B. Design Requirements:
1. Operation: Continuous.
 2. Compliance: Energy Policy Act of 1992 (EPAAct), Final Rule 2014.
 3. Tolerance: +/- 10-percent of rated voltage at rated frequency; +/- 5-percent of rated frequency at rated voltage.
 4. Standard design: NEMA Design B.
- C. Service Factor (percent of additional horsepower):
1. 1.15 for Sine-wave motors.
 2. Dual rating: 1.15 Sine-wave and 1.0 Inverter Duty for Inverter Duty motors.
- D. Motor Efficiency:
1. NEMA Premium™ efficiency electric motor, single-speed, polyphase, 1-500 horsepower, 3600-rpm 2-pole, 1800-rpm 4-pole, and 1200-rpm 6-pole (1-250 HP), squirrel cage induction motors, NEMA Design B, continuous rated. NEMA Standards Publication MG 1 2011, in Table 12-12.

Table 12-12
Full-Load Efficiencies for 60 HZ Premium Efficiency Electric Motors
Rated 600 Volts or Less (Random Wound)

Open 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	77.0	74.0	85.5	82.5	82.5	80.0	75.5	72.0
1.5	84	81.5	86.5	84.0	86.5	84.0	77.0	74.0
2	85.5	82.5	86.5	84.0	87.5	85.5	86.5	84.0
3	85.5	82.5	89.5	87.5	88.5	86.5	87.5	85.5
5	86.5	84.0	89.5	87.5	89.5	87.5	88.5	86.5
7.5	88.5	86.5	91.0	89.5	90.2	88.5	89.5	87.5
10	89.5	87.5	91.7	90.2	91.7	90.2	90.2	88.5
15	90.2	88.5	93.0	91.7	91.7	90.2	90.2	88.5
20	91.0	89.5	93.0	91.7	92.4	91.0	91.0	89.5
25	91.7	90.2	93.6	92.4	93.0	91.7	91.0	89.5
30	91.7	90.2	94.1	93.0	93.6	92.4	91.7	90.2
40	92.4	91.0	94.1	93.0	94.1	93.0	91.7	90.2
50	93.0	91.7	91.5	93.6	94.1	93.0	92.4	91.0
60	93.6	92.5	95.0	94.1	94.5	93.6	93.0	91.7
75	93.6	92.4	95.0	94.1	94.5	93.6	94.1	93.0
100	93.6	92.4	95.4	94.5	95.0	94.1	94.1	93.0
125	94.1	93.0	95.4	94.5	95.0	94.1	94.1	93.0
150	94.1	93.0	95.8	95.0	95.4	94.5	94.1	93.0
200	95.0	94.1	95.8	95.0	95.4	94.5	94.1	93.0

Table 12-12
Full-Load Efficiencies for 60 HZ Premium Efficiency Electric Motors
Rated 600 Volts or Less (Random Wound)

Open 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
250	95.0	94.1	95.8	95.0	95.8	95.0	95.0	94.1
300	95.4	94.5	95.8	95.0				
350	95.4	94.5	95.8	95.0				
400	95.8	95.0	95.8	95.0				
450	96.2	95.4	96.2	95.4				
500	96.2	95.4	96.2	95.4				

Table 12-12
Full-Load Efficiencies for 60 HZ Premium Efficiency Electric Motors
Rated 600 Volts or Less (Random Wound)

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	77.0	74.0	85.5	82.5	82.5	80.0	75.5	72.0
1.5	84.0	81.5	86.5	84.0	87.5	85.5	78.5	75.5
2	85.5	82.5	86.5	84.0	88.5	86.5	84.0	81.5
3	86.5	84.0	89.5	87.5	89.5	87.5	85.5	82.5
5	88.5	86.5	89.5	87.5	89.5	87.5	86.5	84.0
7.5	89.5	87.5	91.7	90.2	91.0	89.5	86.5	84.0
10	90.2	88.5	91.7	90.2	91.0	89.5	89.5	87.5
15	91.0	89.5	92.4	91.0	91.7	90.2	89.5	87.5
20	91.0	89.5	93.0	91.7	91.7	90.2	90.2	88.5
25	91.7	90.2	93.6	92.4	93.0	91.7	90.2	88.5
30	91.7	90.2	93.6	92.4	93.0	91.7	91.7	90.2
40	92.5	91.0	94.2	93.0	94.1	93.0	91.7	90.2
50	93.0	91.7	94.5	93.6	94.1	93.0	92.4	91.0
60	93.6	92.5	95.0	94.1	94.5	93.6	92.4	91.0
75	93.6	92.4	95.4	94.5	94.5	93.6	93.6	92.4
100	94.1	93.0	95.4	94.5	95.0	94.1	93.6	92.4
125	95.0	94.1	95.4	94.5	95.0	94.1	94.1	93.0
150	95.0	94.1	95.8	95.0	95.8	95.0	94.1	93.0
200	95.4	94.5	96.2	95.4	95.8	95.0	94.5	93.6
250	95.8	95.0	96.2	95.4	95.8	95.0	95.0	94.1
300	95.8	95.0	96.2	95.4				
350	95.8	95.0	96.2	95.4				
400	95.8	95.0	96.2	95.4				
450	95.8	95.0	96.2	95.4				
500	95.8	95.0	96.2	95.4				

2.03 MATERIALS

A. Motor frames:

1. TEFC motors shall be cast iron.
2. Aluminum frame motors are not permitted.

B. Stator windings:

1. Shall be copper with Class F minimum insulation not to exceed Class B temperature rise of 80-degree C at rated load and with Design B torque /current characteristics for all Medium (Integral) motors.

- 2. Small (fractional) motors shall be supplied with Class F insulation where available.
- C. Rotor material shall be aluminum or copper.
- D. Fans shall be non-sparking fan blades.
- E. Motor leads shall be non-hygroscopic.

2.04 MOTOR TYPES

- A. General Requirements for motors 1/2 horsepower through 500 horsepower:
 - 1. Three phase, squirrel cage, with copper windings.
 - 2. Rated for full voltage starting and continuous duty.
 - 3. Rating shall be:
 - a. 460/ 230 volts, three-phase, 60-Hertz
 - 4. General Purpose Type motors, which may also be called Type 1 per the project equipment specifications shall be:
 - a. Open Drip Proof Motors, shall be as defined per NEMA MG1, self-cooled by convection air.
 - b. Weather-Protected Type I Motors (WP-I), shall be as defined per NEMA MG1, similar to ODP construction with addition of screens to prevent entry of rain, snow, and particles, or objects into the motor. Suitable for clean indoor and protected outdoor installations.
 - c. Weather Protected Type II Motors (WP-II) shall be as defined per NEMA MG1, with maximum protection from entry of airborne particles, moisture and high velocity air. Suitable for unprotected outdoor installations.
 - 5. Severe Duty Type Motors, which may also be called Type 2 per the project equipment specifications, shall be in accordance with IEEE 841.
 - a. Totally Enclosed Fan-Cooled Motors (TEFC) shall be defined per NEMA MG1.
 - b. Enclosure: totally enclosed, fan cooled, with external fan blowing air to the motor frame cooling fins for cooling.
 - c. Applications: severe duty and most outdoor installations.
 - 6. Explosion Proof Type Motors, which may also be called Type 3 per the project equipment specifications.
 - a. Enclosures: UL listed explosion proof
 - b. Applications: hazardous locations including Class I and Class II (Division 1 and 2), and Class III classified areas.
- B. Motors Less Than 1/2 Horsepower:
 - 1. Type shall be:
 - a. Squirrel cage, capacitor start with Class F insulation and copper windings.
 - b. Fan motors rated 1/8 horsepower or less: split-phase or shaded-pole type.
 - 2. Rating shall be:
 - a. 115Volts, single phase, 60 Hz.
 - b. 208 Volts, single phase, 60 Hz.
 - c. 230 Volts, single phase, 60 Hz.

2.05 COMPONENTS

- A. Inverter-Fed Polyphase Motors per NEMA MG1 Part 31:
 - 1. Applications: variable torque or constant torque loads, for vertical or horizontal motors with variable frequency drive controllers (VFD).
 - 2. Features shall include:
 - a. Insulation design to meet 2000-Volt peak at a minimum of 0.1 micro-second rise time.
 - b. Built-in motor winding protection as specified.
 - c. Electrically insulated bearings or,
 - d. Provide Electro Static Technology's AEGIS Shaft Grounding Ring for Bearing Protection or equal. The shaft grounding ring shall be solidly bonded per manufacturer's recommendations.
- B. Vertical Motors:
 - 1. Features: Inverter duty or non-inverter duty with solid shaft P-base and high thrust bearing compatible with loads imposed by the driven equipment.
- C. Thermal Protection:
 - 1. Inverter duty motors:
 - a. Motors up to 50 horsepower:
 - 1) Protection to be NEMA Type 2 bi-metallic thermal switch (Klixon) type.
 - 2) Motor Nameplate: Marked "OVER TEMP PROT 2" in accordance with NEMA MG 1 12.43.
 - 2. Motors larger than 50 horsepower up to and including 250 horsepower:
 - a. Unless another form of thermal protection is specified in the driven equipment specification, provide a NEMA Type 1 temperature sensing device embedded in the motor winding which is sensitive to motor running over temperature.
 - b. Sensor: Wired to a temperature relay in a NEMA 4 box located near or on the motor, or to the variable frequency drive controller.
 - c. Motor Nameplate: Marked "OVER TEMP PROT 1" in accordance with NEMA MG 1 12.43.
 - 3. Motors larger than 250 horsepower:
 - a. Unless another form of thermal protection is specified in the driven equipment specification, provide 100 ohm platinum RTDs, two per phase embedded in each winding phase.
 - b. RTDs shall be brought out to a separate control terminal box mounted on the motor.
 - c. Motor Nameplate: Marked "OVER TEMP PROT 1" in accordance with NEMA MG 1 12.43.
 - 4. Explosion proof motors:
 - a. Protection to be NEMA Type 2 bi-metallic thermal switch (Klixon) type:
 - 1) Constant speed motors (non-explosion proof).
 - b. Motors up to 50 horsepower:
 - 1) Where thermal protection is specified in the driven equipment specifications, provide NEMA Type 2 bi-metallic thermal switch (Klixon) type.

- 2) Motor Nameplate: Marked "OVER TEMP PROT 2" in accordance with NEMA MG 1 12.43.
 - c. Motors larger than 50 horsepower up to 250 horsepower:
 - 1) Where thermal protection is specified in the driven equipment specifications, provide a NEMA Type 1 temperature sensing device embedded in the motor winding which is sensitive to both motor running over temperature and with fast response to rate of temperature rise for locked rotor protection.
 - 2) Sensor: Wired to a NEMA 4 temperature monitor box located near or on the motor
 - 3) Temperature Sensing System: Automatic reset, normally closed contact, rated 2A at 115 VAC.
 - 4) Motor Nameplate: Marked "OVER TEMP PROT 1" in accordance with NEMA MG 1 12.43.
 - d. Motors larger than 250 horsepower:
 - 1) Unless another form of thermal protection is specified in the driven equipment specification, provide 100 ohm platinum RTDs, two per phase embedded in each winding phase.
 - 2) RTDs shall be brought out to a separate control terminal box mounted on the motor.
 - 3) Motor Nameplate: Marked "OVER TEMP PROT 1" in accordance with NEMA MG 1 12.43.
- D. Motor Nameplates:
1. Materials: Engraved or stamped stainless steel.
 2. Features shall be as follows:
 - a. NEMA Standard MG 1 motor data.
 - b. Permanently fastened to the motor frame.
 - c. ABMA bearing identification number for motors meeting IEEE 841.
 - d. NEMA nominal efficiency for all motors.
 - e. NEMA nominal and minimum efficiency for motors meeting IEEE 841.
 - f. UL frame temperature limit code for explosion proof motors.
 - g. Space heater data.
 - h. Over Temperature Protection Type Number.
 - i. Temperature device rating and alarm and shutdown setpoint.
 - j. Provide motor nameplates for motors with space heaters located in Class I, Division 2, Groups C, and D areas in accordance with NEC 501.125(B).
- E. Conduit Boxes:
1. Provide oversized boxes, with split construction with threaded hubs and petroleum-resistant gaskets.
 2. Conduit boxes can be rotated in order to permit installation in any of four positions 90 degrees apart.
 3. Provide grounding lug located within the conduit box for ground connection.
 4. Provide separate conduit boxes for temperature devices and space heaters.

5. Separate terminal box for any signal leads (RTD, thermistor, vibration transmitter, etc.).
- F. Bearings:
1. Provide oil or grease lubricated ball bearings, angle contact roller bearings for axial thrust loads, and cylindrical bearings for radial-only loads.
 2. Rated for a minimum L-10 life of 50,000 hours for direct-connected loads.
 3. Cartridge type bearings will not be accepted.
 4. Fitted with lubricant fill and drain or relief fittings.
 5. Belt loads not to exceed forces calculated from NEMA MG 1 Table 14-1 and 14-1A.
- G. Bearing lubrication shall be either grease or oil as per the requirements in either 1 or 2:
1. Grease lubricated bearings:
 - a. Shall be for electric motor use only.
 - b. Grease shall be capable of higher temperatures associated with electric motors and shall be compatible with Polyurea-based greases.
 - c. Provide grease fittings, similar to Alemite™ type (or equivalent).
 - d. Shielded bearings with regreasable provisions are permissible.
 2. Provide oil lubricated bearings with externally visible sight glass to view oil level.
- H. Lifting Eyes:
1. Provide lifting eyes with a safety factor of 5.
 2. Provide one lifting eye for motors more than 50 pounds.
 3. Provide two lifting eyes for motors over 150 pounds.
- I. Winding Space Heaters when specified or shown:
1. Provide winding space heaters to prevent condensation.
 2. Rating: 120 volts, single phase, 60 Hertz.
 3. Motor nameplate to show space heater rating in watts and volts.
 4. Provide terminal block in motor conduit box for heater leads termination.

2.06 FINISHES

- A. Paint Finish:
1. Provide standard manufacturer paint finish.
 2. Provide motors with semi-gloss finish, scratch and heat resistance electric motor paint.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Delivery Inspection:
1. Inspect driven equipment-motor assembly and components immediately upon delivery and unloading at the job site for damages.
 2. Take photos of damage(s) if any, to substantiate the delivery inspection report.

3.02 INSTALLATION

- A. Grounding of Motors:
 - 1. Connect the motor feeder ground cable (green) to the grounding lug terminal in the conduit terminal box.
- B. Supplemental Grounding of Motors: Provide for motors fed from VFDs, all motors above 100 horsepower, and all motors in classified areas, where feasible.
 - 1. Bond the motor frame to the grounding grid/electrode system to provide supplemental grounding.
- C. Field Coating of Motors:
 - 1. Refer to the driven equipment specification section and **Section 09 90 00** for coating requirements.

3.03 FIELD QUALITY CONTROL

- A. Field Testing:
 - 1. Measure winding insulation resistance of motors to no less than 10-megohm with a 1000-Vac megohmmeter.
 - 2. Perform motor phases current imbalance testing for motors 20 horsepower and larger.
 - 3. Test motors for proper rotation prior to connection to the driven equipment.
 - 4. Perform thermographic survey per NETA ATS, for motors over 100 horsepower.
- B. Field Inspection:
 - 1. Compare equipment nameplate data with drawings and specifications.
 - 2. Inspect physical and mechanical condition.
 - 3. Inspect anchorage, alignment, and grounding.
 - 4. Verify the installation of breather/drain fittings as specified herein.
 - 5. Check for proper connections of space heaters, winding and RTDs and or thermostats.
 - 6. Visually check for correct phase and ground connections:
- C. Manufacturer Services: Provide where specified or shown on the drawings.
 - 1. Provide services to the driven equipment manufacturer for the inspection and certification of the installation of the motor driven equipment.
 - 2. Provide assistance in the start up and operational testing of the motor driven equipment.

3.04 SYSTEM START UP

- A. Commissioning Test: Provide where specified or shown on the drawings.
 - 1. Provide assistance during the commissioning test of the motor driven equipment.

3.05 CLOSEOUT ACTIVITIES

- A. Operation and Maintenance:

1. Provide the operation and maintenance manual of the motor(s). Include testing result information in the O&M manual.

END OF SECTION

SECTION 46 43 21.11
CIRCULAR SECONDARY CLARIFIER LAUNDER COVERS

PART 1 GENERAL

1.01 DESCRIPTION

A. Scope:

1. The work specified in this Section includes furnishing and installation of launder covers on the east secondary circular clarifiers 1, 2 and 3. Dimensions as per the Record Drawings are as follows. East clarifiers 1 and 2 each have inner diameters of 90 feet and outer diameters of 96'-8". East clarifier 3 has an inner diameter of 110 feet and an outer diameter of 116'-8". Contractor to field verify clarifier diameter and all required dimension information for proper launder cover design. The east facility clarifiers have outboard launders. Refer to the Record Drawing plans provided in the supplemental documents for more information. The purpose of the covers is to reducer/inhibit the growth of algae on the launder troughs and weirs of the tank by minimizing the incident sunlight on these surfaces. In addition, the cover is intended to assist in the containment of odors and keep airborne debris from entering the launder.

1.02 RELATED SECTIONS

- A. This section contains specific references to the following related sections. Additional related sections may apply that are not specifically listed below.
1. Section 01 12 16: Work Sequence
 2. Section 01 33 00: Submittal Procedures
 3. Section 01 78 23: Operation and Maintenance Information
 4. Section 05 05 14: Hot-Dip Galvanizing
 5. Section 05 10 00: Structural Metal Framing
 6. Section 05 50 00: Metal Fabrications
 7. Section 09 90 00: Painting and Coating
 8. Section 43 05 11: General Requirements for Equipment

1.03 SUBMITTALS

- A. The following information shall be submitted in accordance with **Section 01 33 00**:
1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Failure to include a copy of the marked-up specification sections,

along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

2. Detailed drawings using field verified existing condition showing all assemblies, equipment fabrication, cover dimensions, method of attachment, mounting configurations, number of cover units, locations, and size of brackets and fasteners, and weights of fabrications.
3. Manufacturer storage instructions, installation instructions and field trimming instructions.
4. Manufacturer's catalog information, descriptive literature, specifications, and identification of materials of construction.
5. Calculations and information ensuring that the design includes provisions for the expansion of aluminum without warping or buckling.
6. Design calculations stamped by an engineer registered in the State of Utah demonstrating the adequacy of the mounting brackets and supports to resist the weight of the launder covers and structural loads specified in 2.03 Performance/Design Criteria.
7. Certified test reports of the physical and mechanical properties of the products.
8. A list of at least 10 installations of similar size and scope that have been in continuous operation for 10 years.
9. Certificate of Unit Responsibility attesting that the Contractor has assigned, and that the manufacturer accepts, unit responsibility in accordance with the requirements of this Section and **Section 43 05 11-1.02 Unit Responsibility**. No other submittal material will be reviewed until the certificate has been received and found to be in conformance with these requirements.
10. Detailed drawings showing all assemblies. This shall include equipment fabrication, dimensions, method of attachment including number, location and size of fasteners and weight of fabrications.
11. Proposed on-site testing and training procedures.
12. Quality Control Submittals:
 - a. Manufacturer's Certificate of Compliance.
 - b. Special shipping, storage, protection, and handling instructions.
 - c. Manufacturer's installation and maintenance instructions.
 - d. Materials of construction to be 304/304L stainless steel for support arms and accessories, aluminum alloy 5052 for covers.
 - e. Covers shall be designed for a minimum wind load of 100 mph, dead loads, and capable of a live load of 250 lbs.
 - f. Covers are to be manufactured in the USA and AIS (American Iron and Steel Step Certification) requirements.

B. Closeout Submittals

1. Procedures: Section 01 33 00.
2. Manufacturer's operation and maintenance information in accordance with Section 01 78 23.
3. Spare parts:
 - a. Procedures: Section 01 33 00

- b. Provide the following spare parts:
 - 1) Cover sections, two of each type provided
 - 2) Cover hardware, two of each type provided

1.04 QUALITY ASSURANCE

- A. Qualifications
 - 1. Manufacturer Experience
 - a. The laundry cover Manufacturer shall have at least 10 installations of laundry covers of similar size and scope that have been in continuous operation for at least 10 years.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Laundry covers shall be shipped, handled, stored, and installed in ways which will prevent damage to the items. Damaged items will not be permitted as part of the Work except in cases of minor damage that have been satisfactorily repaired and are acceptable to the Construction Manager.
 - 1. Store and protect laundry covers per manufacturer instructions.
 - 2. Laundry covers shall be covered and stored at least 6 inches above ground.

1.06 WARRANTY

- A. Manufacture shall expressly warrant the laundry cover system to be free of defects in materials and workmanship for a period of three years from the date of installation. Installation Contractor shall be responsible for damage due to misuse, negligence, or accident on the part of the manufacture, shipping and installation contractor.

1.07 COORDINATION

- A. The General Contractor shall coordinate the laundry cover design and installation requirements with the clarifier mechanism, scum box, scum spray piping and laundry effluent channel sizes, materials and configurations with the laundry cover Manufacture.

PART 2 PRODUCTS

2.01 MANUFACTURES

- A. Materials, equipment, and components in this section shall be the product of the following approved manufacture.
 - 1. Rebuild-it Services Group
 - or
 - 2. Engineer approved equal

2.02 DESIGN

- A. The laundry covers shall consist of a system of stainless steel support arms that are anchored to the tank wall at approximately PI spacing or spacing as per manufacture requirements, with removable aluminum panels that hook into the support arms. The arm and cover sections shall be designed to cover the laundry trough, weir and come within 1"

± of the baffle within the clarifier. The covers shall be designed and manufactured to reduce/inhibit incident sunlight from striking the surface of the launder and weir. The cover is to extend over the trough and weir and within 1" ± of the baffle such that the cover does not interfere with the skimmer arm operation.

- B. The covers are to be supported in such a manner that the panels are held securely in place; the panels are to be hinged to provide access to the launder and weir for inspection and maintenance. The cover or support arms shall not interfere with the effluent flow over the weir or within the trough. Cover supports that cantilever from the tank wall without a vertical support to the weir wall are unacceptable.
- C. The cover system shall be designed to withstand code required wind and snow loads, in addition the cover shall be designed for a personnel load of 250 lbs. The covers even though designed for personnel loading are not intended to be walked on.

2.03 TYPE

- A. Launder covers for secondary clarifiers shall have hinged non-walkable flat aluminum covers, Covers over the outboard launder are to open toward the center of the clarifier.

2.04 PERFORMANCE/DESIGN CRITERIA

- A. Environmental Conditions
 - 1. Launder covers will be installed outdoors and shall be designed for a maximum temperature of 110 deg F and minimum temperature of -15 deg F.
 - 2. Launder covers shall be designed to resist the following structural loads:
 - a. Snow Loads

Parameter	Value
Code:	IBC 2021 & ASCE 7-16
Risk Category:	III
Ground Snow Load (p_g):	30 psf
Exposure Factor (C_e):	C
Thermal Factor (C_t):	1.2
Importance Factor (I_s):	1.1
Flat Roof Snow Load (p_f):	27.7 psf
Drifting:	Per ASCE 7

- b. Wind Loads

Parameter	Value
Code:	IBC 2021 & ASCE 7-16
Risk Category:	III
Basic Wind Speed (Ultimate, 3-second gust) for Risk Category Shown Above:	109 mph
Exposure:	C
Topographic Factor (K_{zt})	1.0

c. Seismic Loads

Parameter	Value
Code:	IBC 2021 & ASCE 7-16
Risk Category:	III
0.2 Sec. Mapped Spectral Response, S_s :	1.29 g
1.0 Sec. Mapped Spectral Response, S_1 :	0.53 g
Site Class:	E
0.2 Sec. Design Spectral Response, S_{DS} :	1.03 g
1.0 Sec. Design Spectral Response, S_{D1} :	0.76 g
Importance Factor (I_e):	1.5 (Intentionally higher than code minimum)
Component Importance Factor (I_p):	1.0, except $I_p=1.5$ for components identified in Section 13.1.3 of ASCE 7
Seismic Design Category	D

Notes:

1. Calculate seismic loads on the basis of governing building code. Include equipment operating loads in structure dead load.
2. Check individual members for seismic and full member live load acting simultaneously, except that flooded equipment loads (infrequent occurrence) need not be combined with seismic loads. Combine equipment operating loads with seismic loads.

2.05 MATERIALS

- A. Cover support arms, prop rod, wall bracket, anchors, and all assembly fasteners to be 304 or 304L stainless steel.
- B. Launder covers shall be made from 5052 alloy aluminum.

2.06 CONFIGURATION, COMPONENTS, FEATURES

- A. Launder covers shall have the following configuration:
 1. Launder covers shall block sunlight from the surfaces of the launder and weir.
 2. Covers shall not impede personnel from entering or traversing the launder.
 3. Provide a cover system where adjacent panels are level and fit together properly. Ensure that the seams between panels are covered.
 4. Provide design that allows alternate panels to open independent of every other panel.
 5. Provide a hook to facilitate the opening of the launder covers that will be installed directly under walkways.
 6. Provide covers that allow for easy opening by the operators for inspection and maintenance.
 7. Provide mounting brackets that allow the launder covers to be fully supported over the launder. When the cover is closed, it shall rest on a support mounted to the launder. No loads from the launder cover shall be transferred to the mechanical components of the clarifier.
 8. Provide capability to lock the covers with a locking pin latch when in the closed position.
 9. Provide tool to unlock and open covers from the clarifier walkway.

10. Provide a resting structure with locking mechanism to limit the travel of the cover.
11. Covers in opened or closed position and cover support system shall not impede travel of rotating clarifier scum collection arm.
12. The cover system must remain continuous around the entire tank.
13. Design with provisions for the expansion of aluminum without warping and buckling.
14. Cover systems supported by brackets that cantilever from the one launder wall without additional support at the other launder or clarifier wall are not acceptable.
15. Attachment design shall be based around the structural members and field verified by the Contractor.
16. Mounting brackets shall be provided with sufficient flexibility at the launder to permit adjustment for leveling and optimum fit. Slotted bolting holes shall be provided in the mounting brackets installed in the secondary clarifiers to allow +/- 2-inch vertical adjustment and leveling.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Contractor shall field verify existing conditions.
 1. Confirm critical elevations and dimensions required by the manufacturer for fabrication of launder covers.
 2. Field verification shall take place prior to shop drawing submittal preparation.

3.02 PREPARATION

- A. Coordination
 1. Refer to Section 01 12 16 Work Sequence for construction sequencing requirements.
 2. Refer to Section 01 11 00 Summary of Work for dewatering requirements.

3.03 INSTALLATION

- A. Align, connect, and install launder covers in accordance with the Manufacturer's written instructions.
- B. Field cut panels to accommodate in-tank obstructions. Sand and coat all field cut or drilled edges per the manufacturer's recommendations.
- C. Manufacturer to supply all of the fasteners required for installation. Install covers around entirety of the clarifier.
- D. Provide a post-installation survey of launder cover mounting brackets installed on launder walls in Secondary Clarifier 3, verifying the brackets are level and documenting adjustments made.
- E. The cover support arms shall be anchored to the tank wall with a support resting on the weir wall, used for leveling of the support arm. The tank wall closure piece is placed between the support arms to act as rest for the cover and block sunlight.

The cover then clips into the support arm and rotates towards the tank wall, the prop rod then locks into the wall bracket.

- F. The installation contractor shall install the cover in accordance with the contract drawings, manufacturing drawings and manufacturer's recommendations.

3.04 TESTING

- A. Installation contractor to demonstrate to the Owner and Engineer the following:
 - 1. Panels operate as designed and are free from binding
 - 2. Verify that the panels are set such that all open position lock features function as intended
 - 3. Verify that there are no interferences with and not limited to the water surface, weirs, baffles, scum collection system

3.05 FIELD QUALITY CONTROL

- A. Corrective Actions: Replace or repair work to eliminate defects, deficiencies, and irregularities.

END OF SECTION

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SECTION 46 43 21.13
CIRCULAR SECONDARY CLARIFIER EQUIPMENT

PART 1 GENERAL

1.01 DESCRIPTION

A. Scope:

1. This section specifies secondary sedimentation tank equipment as follows: sludge and scum collection equipment, scum troughs, drive equipment, bridges for access to the drive equipment, sludge sampler, and miscellaneous appurtenances as shown and specified. The equipment shall be suitable for use in the gravity separation of mixed liquor solids from the activated sludge process.
2. This project will include work on (3) of the east secondary clarifiers. All carbon steel components at and below the waterline are to be replaced with 304 stainless steel. The existing painted carbon steel walkways are to be replaced with new painted carbon steel walkways. Existing clarifier carbon steel components are coated with a lead based paint. Contractor to comply with all required lead abatement and disposal requirements as required. The existing FRP weirs, baffles and Stamford current density baffles are to be replaced with 304 stainless steel materials. The sidewalls of the feedwells are to be constructed of corrugated FRP panels with a profile of 4.2x1-1/16" and attached with 316 stainless steel self driving screws with neoprene washers. The clarifier drives are to be removed and replaced on east clarifiers 1, 2 and 3. The existing duck skimmer and scum trough systems are to be removed and replaced with a 4-foot traditional scum box with two full radius skimmers. The existing scum spray system is to be removed and replaced with an anti-rotation spray system in clarifiers 1, 2 and 3. The new scum spray systems are to be manually controlled. Stainless steel launder covers are to be furnished and installed on east clarifiers 1, 2 and 3, see specification 46 43 21.11.

B. Type:

1. Equipment furnished under this section shall be suitable for installation in circular secondary clarifier tanks with outboard effluent launders. The equipment shall have an energy dissipating center feedwell supplied from the center column and spiral blade type sludge collectors. The equipment shall be specifically designed for the conditions described and shown.

C. Definitions:

1. The following definitions apply to this section:
 - a. Continuous operating torque: The continuous operating torque is defined as the AGMA design torque which is the torque load that is assumed to be continuously applied on the drive system through a 24-hour operating period, 365 days per year for a 20-year life.
 - b. Alarm Torque:
 - 1) The torque at which an alarm sounds to serve as a warning of increased torque loading. The alarm torque is defined to be equal to 110 percent of the continuous operating torque.

c. Cutout Torque:

- 1) The torque load at which a motor cutout switch is activated to shut down the unit. The cutout torque is defined to be not less than 120 percent of the continuous operating design torque.

d. Momentary Peak Torque:

- 1) The maximum or peak torque of the drive unit assumed to be equal to twice the calculated AGMA torque rating of the spur gear set or 3 times calculated AGMA torque rating of the worm gear set, whichever is lower.

D. Equipment List:

1. Equipment numbers are as follows:

Item	Equipment No.
Drive units	SC-1-08-11-01, SC-1-08-12-01, SC-1-08-1301

E. Performance and Design Requirements:

1. All structural members shall be designed in accordance with AISC standards and shall be capable of transmitting the momentary peak torque without undue or permanent deflection. AISC recommended slenderness limits shall not be exceeded for the design of all members. In addition to the specified operating loads, each member shall be designed to withstand a point load of 200 pounds applied perpendicular to its weak axis at the midpoint between its support areas.
2. Mixed liquor is conveyed from the east bioreactor basins to a central east clarifier splitter box. Mixed liquor flow is then conveyed from this clarifier splitter box to each east secondary clarifier (1, 2, 3) through individual 36-inch diameter center feed pipes. Each of the east clarifiers have a dedicated 36-inch diameter center feed pipe that spans from east clarifier splitter box that terminates as the center feed of the clarifiers.
3. Kinetic energy available at the outlet of the sedimentation tank's center column inlet ports shall be dissipated through the dual effects of hinged, adjustable baffle gates at the periphery of the tank's energy dissipating inlet and a feed well. The system shall be arranged to direct the flow entering the tank into a spiral flow pattern within the feedwell to achieve nearly zero kinetic energy when it passes the secondary baffle.
4. Sludge accumulations shall be removed from the floor of the tank through the combined operation of the continuously rotating sludge collection mechanism with spiral blades and the return sludge pumping system. The header and orifice design shall achieve hydraulic balance through the sludge collection mechanism and uniform removal of sludge from the floor of the tank through the application of controlled head loss at the orifices.
5. The central influent pier and column assembly shall be designed to support the drive mechanism, the sludge collection mechanism, scum removal system components, utility piping, access bridge beams and walkway. No vertical thrust load shall be placed on any underwater bearing. All drive gears shall be located above water level and all gearing shall be completely enclosed and oil lubricated. The drive cage, each sludge collector arm, and associated supports and connecting members shall be designed to withstand application of 200 percent of the continuous operating torque at the AISC allowable stresses. The drive cages shall be designed to withstand these forces resulting from operation in the clockwise and counter-clockwise directions.

6. The access bridge and operating platform shall be designed for a live load of 100 pounds per square foot. Deflection under full live load and dead load shall not exceed 1/360 of the span. The feedwell and its supports shall be designed for stable, safe, distortion-free operation when full of water and the tank empty, and vice versa. A platform for access to and cleaning of the scum trough shall be incorporated into the design of the access bridge.
7. Other specific design requirements are as follows:

Internal tank diameter, feet	East Clarifiers 1 and 2 = 90 feet, East Clarifier 3 = 110 feet	
Sidewater depth, feet	12 feet	
Tank Slope	12:1	
Depth at center column, feet	[18.95 feet (approx.) _____]	
Freeboard at maximum flow, feet	[1.95 feet (approx.) _____]	
Influent column internal diameter, inches	[36-inches	
Stamford Current Density Baffle:	L = 5 feet	
• Diameter, feet	East Clarifiers 1 and 2 = 90 feet (approximate). East Clarifier 3 = 110 feet (approximate)	
• Depth below water surface, feet	[4.80 feet (approximate) _____]	
Influent energy distribution inlet (EDI)	Clarifier 1 and 2	Clarifier 3
• Diameter, feet	[12'-0 _____]	15'-0
• Depth, feet	[3'-0 _____]	3'-6
Feedwell		
• Diameter, feet	32'-0	40
• Depth, feet	7'-0	7'-0
Rake arms with spiral blades, number	Two	
• Spiral blade depth at edge of tank, inches	8"	
• Spiral blade depth at sludge hopper, inches	20"	
Continuous operating torque, foot-lb applied at output of drive unit	[33,000 _____]	
Nominal minimum bearing race diameter, inches	[43 _____]	
Motor output, horsepower	[1.5 _____]	

G-20

As part of the design and submittal preparation process, the equipment manufacturer or representative shall visit the site and confirm all dimensions of the existing secondary clarifiers 1, 2, and 3 that are necessary to prepare design drawings and submittals and to accurately manufacture equipment to be retrofit into the existing concrete tanks.

F. Operating Conditions:

1. The equipment shall be designed and operable for the following conditions:

	Clarifier 1 and 2	Clarifier 3
Maximum inlet flow, mgd (peak flow with maximum return sludge return)	[9.1 _____]	13.6
Minimum inlet flow, mgd (minimum flow with minimum return sludge return)	[2.7 _____]	4.0
Maximum return sludge flow, mgd	[3.8 _____]	5.7
Minimum return sludge flow, mgd	[0.62 _____]	0.92
Maximum overflow, mgd	[5.3 _____]	7.9

Minimum overflow, mgd	[2.1] 3.1
Maximum center column mixed liquor inlet port head loss at maximum inlet flow, feet	0.5
Mixed liquor suspended solids concentration range, mg/l	[3,500 to 5,000]
Maximum sludge collector peripheral speed, feet per minute	8
Sludge viscosity, N-sec/m ²	0.001 to 0.01

G. Single Manufacturer:

1. A single manufacturer shall furnish a complete and integrated package including the following (per clarifier):
 - a. Bridge and grating walkway with handrails and toe plates.
 - b. Support column
 - c. Center cage
 - d. Rake Arms with spiral blades
 - e. Energy Dissipating Inlet (EDI)
 - f. Feedwell
 - g. Center Drive mechanism
 - h. Overload devices
 - i. Anchor bolts
 - j. Baffle Plates
 - k. Weir Plates
 - l. Spare parts and assemblies.
 - m. Any other components required for a complete, operable unit.

1.02 QUALITY ASSURANCE

A. References:

1. This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.
2. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ABMA-9	Load Ratings and Fatigue Life for Ball Bearings

Reference	Title
AGMA 2001-B	Fundamental Rating Factors and Calculation Methods for Involute Spur and Helical Gear Teeth
AGMA 6010-E	Standard for Spur, Herringbone, and Bevel Enclosed Drives
AGMA 6019-E	Gearmotors Using Spur, Helical, Herringbone, Straight Bevel or Spiral Bevel Gears
AGMA 6034-B	Enclosed Cylindrical Worm Gear Speed Reducers and Gear Motors
AISC	American Institute of Steel Construction, Manual of Steel Construction, Allowable Stress Design-9th Ed.
AISI	Pocketbook of AISI Standard Steels
ASTM A36/A36M	Structural Steel
ASTM A240 Type 304	Stainless steel Plates
ASTM A276 Type 304	Stainless Steel Shapes, bars, and similar items
ASTM A48-REV A	Gray Iron Castings
ASTM A536	Ductile Iron Castings
ASTM B247	Aluminum-Alloy Die Forgings, Hand Forgings and Rolled Ring Forgings
ASTM E18	Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials
AWS D1.1	Structural Welding Code-Steel
NEMA 250	Enclosures for Electrical Equipment

B. Standards:

1. Structural Steel and Welds:

- a. All structural steel and stainless steel used for equipment fabrication shall conform to the requirements of the Standard Specifications for Steel for Bridges and Buildings, ASTM A36, and ASTM A276. All welding shall conform to the latest standards of the American Welding Society (AWS). Continuous seal welds shall be provided at all welded joints. Skip welds will not be permitted.

2. Structural Design:

- a. All steel and stainless steel structural components shall be so designed that the stresses developed under the specified conditions will not exceed the allowable stresses defined by the AISC standards and the aforementioned standards. Except where specifically indicated otherwise, all plate and structural members designed for submerged service shall be stainless steel with a minimum thickness of 3/16 inch. AISC recommended limits for slenderness shall not be exceeded on any steel member.

C. Unit Responsibility:

1. The Contractor shall assign unit responsibility as specified in **Section 43 05 11-1.02 Unit Responsibility** to the secondary sedimentation equipment manufacturer for the equipment specified in this section and section 46 43 23 Circular Secondary Clarifier Launder Covers. A certificate of unit responsibility shall be provided.

D. Manufacturer Experience

1. Equipment manufacturer shall have experience of not less than 10 installations of similar size and model of collector in the last five years. Provide a reference list, including clarifier diameter, design return flow rate, rated headloss, and user contact information.

1.03 DELIVERY, STORAGE AND HANDLING

- A. Equipment shall be shipped, handled, and stored in accordance with the manufacturer requirements.
- B. If damage occurs, immediately make all repairs and replacements necessary to the satisfaction of the Engineer at no cost to the Owner.
- C. The mechanism shall be lubricated in strict accordance with the instructions of the clarifier manufacture's field service representative. The required lubricants shall be provided by the Manufacture and installed by the Contractor when instructed by the Manufacture.

1.04 SUBMITTALS

- A. The following information shall be submitted in accordance with **Section 01 33 00**:
 1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
 2. A copy of the contract document control diagrams and process and instrumentation diagrams relating to the submitted equipment, with addendum updates that apply to the equipment in this section, marked to show specific changes necessary for the equipment proposed in the submittal. If no changes are required, the drawing or drawings shall be marked "no changes required". Failure to include copies of the relevant drawings with the submittal shall be cause for rejection of the entire submittal with no further review.
 3. Certificate of Unit Responsibility attesting that the Contractor has assigned, and that the manufacturer accepts, unit responsibility in accordance with the requirements of this Section and **Section 43 05 11-1.02 Unit Responsibility**. No other submittal material will be reviewed until the certificate has been received and found to be in conformance with these requirements.
 4. General arrangement drawings showing the entire assembly. This shall include a materials list and descriptions of all major components such as all gears, structural

members, sludge collection members, and the scum removal system (sizes, piping connections, ASTM designations where appropriate, thicknesses, and construction).

5. Rating, AGMA and ASTM designations, construction, and detailed descriptions of all gears, reducers, and drives.
6. Calculations substantiating the torque rating of the gear assembly as specified in
7. Bearing manufacturer, bearing model, and ABMA L-10 life data.
8. Motor data Section 43 05 21-Form A as required in Section 43 05 21-1.03.
9. Proposed on-site testing and start-up procedures, including sketches and calculations for torque test as specified in paragraph 3.02.
10. Shop primer and coating data for all shop-coated components per 09 90 00.
11. Applicable operation and maintenance data in accordance with Section 01 78 23.
12. Step by step instructions how to replace bearing race if it can be replaced in the field.
13. Installation Certification section 43 05 11-Form A as specified in paragraph 3.01.
14. Training Certification Section 43 05 11 – Form B as specified in paragraph 3.02 General.

B. Drive Calculations .

1. The calculations shall clearly specify the values used for the following design parameters for surface durability and strength ratings:
 - a. Number of pinions
 - b. Actual Face width
 - c. Tooth geometry factor (I and J Factors)
 - d. Load Distribution Factor
 - e. Allowable Contact Stress
 - f. Allowable Bending Stress
 - g. Pinion Pitch Diameter
 - h. Tooth Diametral Pitch
 - i. Hardness Ration Factor
 - j. Elastic Coefficient
 - k. Life Factor

C. Other Calculations:

1. All Calculations shall be stamped by a registered engineer in the State of Utah for the appropriate discipline, including structural engineer for structural elements.
2. Structural calculations shall be performed for the following conditions: Seismic loads in accordance with Section 01 73 24 “Design Requirements for nonstructural non-building structures”.
3. Calculations substantiating the limiting deflections and torques for the center cage and rake arms.
4. Calculations showing the stresses in the drive cage and sludge collection arms as specified in paragraph 2.03 C Drive Cage and paragraph 2.03 D Sludge Collector mechanism. The cage shall be cross braced for forward and reverse motion.
5. Calculations substantiating the torque rating of the gear assembly as specified.
6. Calculations substantiating the sludge collector design and configuration as specified in paragraph 1.01 E.5.

7. Calculations sizing the spiral rake blade depth and sludge transport calculations.
8. Calculations demonstrating bridge deflection.
9. Bearing manufacturer, bearing model, and ABMA L10 life data. Provide calculations demonstrating the drive bearing is designed for one of the following:
 - a. Drives with renewable heat-treated alloy steel bearing races:
 - 1) Bearings shall be a minimum 1-in diameter, SAE 52100, 58 Rc. The Drive bearings shall be designed for the total rotating weight with a minimum L10 life of 20 years, or 175,000 hours, for continuous operation,
 - b. Drives with precision type bearing, non-renewable heat treated alloy steel bearing races.
 - 1) Bearings shall be a minimum 1-in diameter, SAE 52100, 58 Rc. The drive bearings shall be designed for the total rotating weight with a minimum L-10 life of 100 years, or 875,000 hours, for continuous operation.
10. Calculations sizing and locating the center column mixed liquor inlet ports.
11. Center column anchor bolt design.
12. Calculations substantiating the feedwell diameter and depth.
13. Calculations substantiating the EDI diameter, depth and opening

1.05 ENVIRONMENTAL CONDITIONS

- A. The secondary clarifiers are located outside on the TSSD premises which is gated and fenced. The secondary clarifiers are not covered or enclosed and are exposed to seasonal weather variations.
- B. In addition, design shall accommodate the following site conditions:
 1. Site work elevation: 4,496 above mean sea level.
 2. Exposure: Ultraviolet radiation of sun on drive and walkway components. Remaining components are under cover and subject to sewer gasses including hydrogen sulfide.
 3. Chemicals: Sludge may contain alum and polymer to provide chemically enhanced treatment.
 4. Ambient Temperature Range: Minimum minus 20 degrees F to 110 degrees F, maximum.
 5. Ambient Humidity Range: Minimum average of 36 percent to an average maximum of 75 percent relative humidity, including rain, snow and ice.
 6. Spray water: Contractor to coordinate with the Owner regarding availability and location and access to plant effluent secondary water.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. The Owner and Construction Manager believe the following candidate manufacturers are capable of producing equipment and/or products that will satisfy the requirements of this Section. This statement, however, shall not be construed as an endorsement of a particular manufacturer's products, nor shall it be construed that named manufacturers' standard equipment or products will comply with the requirements of this Section. Candidate manufacturers include Rebuild it Services Group, Ovivo (Eimco), Evoqua (Envirex), Walker Process, WesTech Engineering Inc., or approved equal.

2.02 MATERIALS

Component	Base Bid Material	Bid Alternate Material
Center column	ASTM A276 Type 304 Stainless Steel	ASTM A36
Steel plate	ASTM A A240 Type 304 Stainless Steel	ASTM A36
Structural steel shapes	ASTM A A276 Type 304 Stainless Steel	ASTM A36
Bridge Steel	ASTM A36	ASTM A36
Bridge Grating	ASTM B308, 6061 -T6 or 6063 -T6 extruded aluminum alloy	ASTM B308, 6061 -T6 or 6063 -T6 extruded aluminum alloy
Bridge Handrailing	ASTM B308, 6061 -T6 or 6063 -T6 extruded aluminum alloy	ASTM B308, 6061 -T6 or 6063 -T6 extruded aluminum alloy
Squeegees	Neoprene	Neoprene
Drive cage	ASTM A A276 Type 304 Stainless Steel, steel, 3/16 inch minimum	ASTM A36, steel ¼ inch minimum
Rake Arms and Spiral Blades	ASTM A A276 Type 304 Stainless Steel, steel, 3/16 inch minimum	ASTM A36, steel ¼ inch minimum
Main spur gear		
• Ductile iron	ASTM A536, 80-55-06	ASTM A536, 80-55-06
• Forged steel	AISI 4140, 4150 or 4340	AISI 4140, 4150 or 4340
Worm	Through hardened AISI 41L50 or 8620 alloy steel	Through hardened AISI 41L50 or 8620 alloy steel
Worm gear	ASTM B247, gear bronze alloy casting	ASTM B247, gear bronze alloy casting
Pinion	AISI 4140, 4142, 4150 or 4340	AISI 4140, 4142, 4150 or 4340
Main bearings	SAE 52100, Rockwell C64	SAE 52100, Rockwell C64
Submerged fastening hardware including anchor bolts	ANSI, Type 316 stainless steel	ANSI, Type 316 stainless steel
Scum wiper blades	Neoprene	Neoprene
Scum Skimmer and Trough	ASTM A A276 Type 304 Stainless Steel, steel, 3/16 inch minimum	ASTM A36, steel ¼ inch minimum
Scum wiper blades	Neoprene	Neoprene

- A. Materials specified are considered the minimum acceptable for the purposes of durability, strength, and resistance to erosion and corrosion. The Contractor may propose alternative materials for the purpose of providing greater strength or to meet required stress limitations. However, alternative materials must provide at least the same qualities as those specified for the purpose.

2.03 EQUIPMENT

A. Influent Structure:

1. The tank influent structure shall consist of the center column and the influent diffusion well. The center column shall be a hollow steel cylinder with its base flanged for fixing to the concrete floor of the tank. Its top shall also be flanged and stiffened for supporting the sludge collection mechanism, the drive mechanism, and the access bridge beams. Ports shall be provided for discharging the mixed liquor from the center column into the Energy Dissipating Inlet. The top of the ports shall extend 3 inches above the maximum water surface elevation in the center column to allow scum to exit the center column.
2. The influent diffusion well shall be designed to provide even distribution of flow into the tank and shall consist of an Energy Disipating Inlet, EDI, and an outer concentric

Feedwell . The EDland the Feedwell shall be fabricated of minimum 3/16-inch thick stainless steel plate.

3. The Energy Disipating Inlet, EDI, shall be fitted with openings with adjustable multiple hinged steel diffuser gates, 15 inches wide. The gates shall be designed to direct the flow to move in the same tangential direction to provide for energy control and flocculation of inflow solids. The gates shall be hinged to the tub with stainless steel piano hinges. Gates pivoted on their vertical centerline will not be allowed. The gates shall be spaced no more than 30 inches apart around the periphery. The adjustable feature shall be accomplished using stainless steel chain connected to the end of the gate and tethered to the distribution tub by a pin on the tub. The distribution tub shall be supported from the drive cage and shall rotate therewith. A neoprene seal shall be provided at the bottom of the tub between the rotating bottom and the stationary center column to prevent the passage of mixed liquor into the sedimentation tank at this location. The top of the ports in the influent pier and the top of the gates in the distribution tub shall be above the tank's maximum water surface elevation.
4. The Feedwell shall be stationary and shall be supported from the bridge framework. Additional supporting members shall be provided if required.

B. Drive Cage:

1. Torque shall be transmitted from the drive unit to the sludge collection arms and scum skimmers by a drive cage. The drive cage shall encompass the center column and shall be of sufficient strength to transmit and/or carry all loads and stresses associated with 200 percent of the continuous operating torque. Drive cages shall be capable of accepting the specified design loads resulting from operation in both the clockwise and counter-clockwise directions. Calculations shall be provided showing the related stresses developed in the drive cage at that torque.

C. Sludge Collector Mechanism:

1. The sludge collector shall consist of two fabricated stainless steel truss type rake arms located parallel to the tank bottom. The stainless steel rakearms shall be complete with a spiral blade and squeegees designed to sweep the entire tank bottom clean every one half revolution. The squeegees shall be adequately braced to the stainless steel spiral blades and shall extend to the bottom of the tank. The mechanism shall collect the sludge from the tank bottom and carry to the sludge hopper to the opening of the sludge withdrawal conduit. The complete sludge collection mechanism shall be capable of handling the return sludge as specified in paragraph 1.01 Operating Conditions.
2. The stainless steelspiral rake blades shall be supported from the drive cage by stainless steel truss arms to hold the spiral blades in alignment in a vertical and horizontal plane. The spiral blades shall be a minimum of 8-inches at the outer perimeter and 20-inches at the center. Spiral blades shall be designed with a logarithmic spiral curve with a constant 30-degree angle of attack. The rake arms shall be designed to withstand 200 percent of the continuous operating torque developed from uniform loads applied to all arms. In addition, each arm shall be designed to withstand a point load applied at its extreme end that produces cutout torque. Uniform loads and the point loading shall be applied separately. Calculations shall be provided showing the related stresses developed in the sludge collection arms under both conditions. Turnbuckles, guy cables and similar arrangements will not be allowed for support of the collector arms. The truss arms shall be of box or

triangle truss construction, fabricated from rolled structural stainless steel angles or sections having a minimum thickness of 3/16 inch.

D. Drive Mechanism:

1. General:

- a. The drive assembly shall include an electric gear motor, worm gear and worm gear reducer, pinion gear, turntable type main spur gear, drive base, shear pin hub coupling, steel roller drive chain, and torque overload protection system. The spur gear set shall be designed in accordance with AGMA 2001-B. The worm gears shall be designed in accordance with AGMA 6034-A for a service factor of 1.25 applied to the continuous operating torque.

- 1) The drive mechanism shall be mounted on the influent column with the top of the spur gear housing capable of supporting the total access bridge load by means of equally loaded, removable bridge supports. The gear motor drive shall be provided with output sprockets and chain to allow operation of the collector mechanism at 66, 80 and 100 percent of the speed specified in **paragraph 1.01 Operating Conditions**. Drive mechanism components shall be designed for the rated torque specified in **paragraph 1.01 Performance and Design Requirements**. Calculations shall be provided that substantiate the torque rating (including momentary peak torque) of the gear assembly. Numerical values shall be shown for all terms used in the AGMA rating equations.

2. Gear Motor:

- a. The drive motor shall be 1,800 rpm conforming to **Section 43 05 21**. The motor shall be designed for continuous duty, Class II applications in accordance with AGMA 6019-E. The motor shall be Type 2 as specified in **Section 43 05 21**. Motor bearings shall be rated for a minimum L-10 life of 100,000 hours.

- 1) Power transmission between the gear motor and a special, single-reduction worm gear reducer shall be made through a roller chain and sprocket drive assembly. The chain drive shall be enclosed by a removable chain guard, constructed of a minimum 14-gage hot-dip galvanized steel and conform to OSHA requirements.

3. Worm Gear:

- a. The special worm assembly shall consist of a through hardened and ground alloy steel worm and a centrifugally cast bronze worm gear. The worm gear assembly shall be self-contained and enclosed in a cast iron gear case and provided complete with oil fill, level, and drain fittings and a sight gage. The drain shall be at the lowest point of the oil reservoir and shall be accessible.
- 1) The worm gear torque capacity shall be determined according to AGMA 6034-A for service factor of 1.25 applied to the continuous operating torque.

4. Pinion Gear:

- a. The pinion and pinion shaft which drive the internal spur gear shall be made from heat treated forged alloy steel and designed in accordance with AGMA 6010-E. The pinion shall be rigidly supported by bearings located above and below the pinion gear. Overhung pinions shall not be acceptable.

5. Spur Gear Assembly:

- a. The spur gear shall be AGMA Quality 5 and shall be designed and rated in accordance with AGMA 2001-B. If the spur gear is of a split gear design, the two

halves shall be provided with precision mating surfaces with self-registering and indexed fits.

- 1) The spur gear housing shall be made of cast iron. A felt or neoprene seal and dust shield shall be included with each spur gear housing in two locations; a lower seal located between the stationary drive base and main gear and an upper seal located between the main gear and stationary drive cover. The spur gear housing shall be designed to allow submergence of the gear face in the oil bath sufficient to provide complete lubrication of the gear assembly. When the main spur gear is manufactured from forged steel, a minimum 75 percent of the gear face shall be submerged in oil. The gear case shall be complete with an oil fill and drain components. Drain piping shall tap the lowest point in the oil reservoir for removal of oil and condensate, shall be valved, and shall be conveniently accessible. An extension operator shall be provided for operation of the drain valve from the walkway level above. A dipstick extending from the walkway level to the bottom of the drain shall be provided to indicate oil level and the presence of condensate.
- 2) The drive assembly shall be firmly mounted to a cast iron turntable base with a minimum wall thickness of 1/2 inch. The drive base shall be mounted on the center column and be provided with a positive leveling feature. The drive base shall be suitable for supporting the entire load of the drive mechanism and access bridge. To permit inspection and maintenance of components in the interior of the drive unit housing, each assembly shall have an access opening of not less than inches in diameter. Cover plate with lifting eyes securely attached shall be provided for the opening. The base shall be formed to provide a sump with a valved drain and sight glass not less than 1-5/16 inches deep to allow for the collection and disposal of condensate. The sump shall be designed to trap condensate before it comes in contact with bearing housings.

6. Main Bearing:

- a. The entire sludge collector mechanism shall be suspended from the turntable which in turn shall be supported on a ball bearing assembly that uses hardened carbon corrected, vacuum degassed alloy steel bearing balls. The bearing balls shall run in an oil bath on replaceable carbon corrected, high carbon steel liners hardened to 38-46 Rockwell C as specified in ASTM E18 and placed in annular raceways in the gear and turntable base. A cross-contact or four-point angle contact bearing arrangement is prohibited.

7. Torque Overload Protection:

- a. The drive mechanism for the sludge collector shall be provided with an overload protection device and an overload alarm system. The overload protection device shall be designed to measure thrust of the worm gear shaft and be provided with an indicator showing the load on the mechanism. The indicator shall be visible from the access bridge, shall read in ft-lbs torque or percent continuous operating torque and shall cover the range of torques specified up to 200 percent of the continuous operating torque. The torque overload protection system shall be fully functional in both forward and reverse rotation of the mechanism.
 - 1) The overload device shall include two switches, the first to activate a remote alarm, and the second to shut down the unit. The overload device shall be enclosed in a watertight cast iron or aluminum housing. The switches shall be NEMA 4X DPDT, rated at 10 amps and 250 volts AC. The device shall be

factory calibrated to activate the alarm switch such that its contacts open when the torque load on the mechanism reaches 110 percent of the continuous operating torque and activate the cutout switch (normally closed) at 120 percent of the continuous operating torque.

- 2) A backup shear pin shall be provided in a shear pin hub mounted on the output shaft of the gear motors. The shear pin shall be selected to break when the load on the mechanism achieves 140 percent of the continuous operating torque specified. A NEMA 4X limit switch shall be provided to activate when the shear pin breaks. The shear pin device shall be capable of protecting the collector mechanism regardless of the direction of collector rotation.

8. Condensate Removal:

- a. Each drive unit shall include an automatic condensate removal system, which shall include a 1-inch stainless steel ball valve with vertical stem and 1-inch stainless steel piping. The pipe arrangement shall be designed to provide constant removal of condensate from the main gear housing. A minimum of 6-inch clearance shall be provided below the low point drain to allow for easy access by plant personnel.

E. Scum Removal System:

1. The mechanism shall be provided with components to remove surface scum from the annular space between the feedwell and the scum baffle. All surface scum in the outer annular space shall be moved to a second, outer scum trough for removal from the secondary clarifier by gravity flow.
2. Two skimming arms located 180 degrees apart shall be provided for both the inner and the outer annular spaces. The arms shall collect and remove surface scum from the entire surface of both annular spaces. Skimming arms shall be designed to be easily removable under adverse weather conditions. Removal shall be achieved by accessing the skimming arms from the walkway or a special platform provided for that purpose. A manual system, including hoisting points, if necessary, shall be provided. Flexible wipers shall be located at the ends of the skimming arms to assure continuous contact with both sides of the feedwell and with the scum baffle adjacent to the outboard effluent weir.
3. Stationary antirotation arms shall be suspended at the water line to prevent the surface scum from rotating. They shall act in conjunction with the rotating skimming arms to "wedge" the surface scum outward toward the scum troughs. The antirotation and skimming arms shall be offset and angled with respect to tank radii as required to optimize the wedging effect. Provisions shall be incorporated into the design of the antirotation and skimming arms to permit adjustment of their position with respect to penetration into the liquid within the tank.
4. A hinged assembly forming a pocket to trap the scum shall be located at the outer end of the skimming arms. The assembly shall transport the trapped scum up the scum trough beach, deposit it in the trough, and then be lowered back to the liquid surface by return guides.
5. Scum troughs shall be provided as shown for the inner and outer annular spaces. They shall include a box fabricated from 3/16 inch minimum stainless steel plate, a beach, skimmer assembly return guides and a connection for the scum piping specified.

F. Walkway and Operating Platform:

1. Half diameter access bridges shall be provided as shown for the sludge collector mechanism and shall consist of structural steel beams and truss sections interlaced as required for rigidity. All walkway surfaces shall be at the same elevation. The access bridges shall be supported on the main spur gear housing which in turn shall be supported by the center column support structure. Clearance of 24 inches shall be provided around the drive. The bridges shall span from tank wall to the center of the tank, as shown. The bridges shall include new 1-1/2" aluminum 3 rail mechanical handrail system. The bridges shall include a 36-inch wide serrated aluminum grating walkway complete with 3/16-inch by 4-inch high toe plates. Removable sections of 1-1/4" rectangular aluminum serrated bar grating (non-slip) shall be provided to cover all wells or depressed areas in the walkway and access platform to provide a single plane for all walking surfaces. The operating platform shall include a similarly constructed an 8'x7'-4" walkway encircling the exposed portion of the drive unit with the specified aluminum grating. Grating shall be as specified in **Section 05 53 10** and on the drawings.
2. Structural steel beam sections shall be provided to support the scum spray system. The walkway and operating platform shall be provided with handrailing conforming to the requirements of **Section 05 52 00**.

G. Finishing Requirements:

1. All fabricated steel or ferrous metal shall be fully prepared with shop- or field-applied prime and final coats in accordance with the requirements of **Section 09 90 00**. Preparation of steel and ferrous surfaces shall comply with requirements specified in **Section 05 10 00** and **Section 09 90 00**. Provide touch up paint to repair any damage to the coating system in the field. Paint systems shall be as follows:
 - a. Base Bid
 - 1) Bridge – System **EU-1**
 - b. Bid Alternate
 - 1) Submerged equipment – **E-9**
 - 2) Bridge – System **EU-1**
2. Test areas of any shop-applied prime coats shall be selected by the Construction Manager for removal to verify compliance. Spark testing shall be conducted following application of the final finish coat.

H. Weirs and Baffles (Base Bid):

1. Weirs and baffles shall be constructed of 304 Stainless Steel.
2. The baffles shall consist of curved sections of 3/16-inch thick by 24-inch deep plate attached to the tank wall by stainless steel brackets, Type 316 stainless steel anchor bolts and hex nuts, to enable 1-inch vertical and sufficient radial adjustment to keep baffles round and always in contact with the scum skimmer.
3. The weirs shall consist of 3/16-inch thick by 10-inch deep plate sections with 3-inch 90 degree V-notches at intervals shown on the drawings. The weir sections shall be curved and fastened to the tank wall with washers, clamps, Type 316 stainless steel anchor bolts and hex nuts to allow vertical adjustment. See Contract Drawings for minimum requirements.

2.04 DISSIMILAR METALS

- A. Isolate all dissimilar metals or connectors to prevent direct contact and electrical conductivity.
 - 1. Use insulating washer and Teflon sleeves at bolted connections.

2.05 SPARE PARTS

- A. Spare parts shall be provided as follows:
 - 1. 1 set - all bearings and bearing seal rings for drive unit, except the main turntable bearing
 - 2. 1 set - all gaskets for drive unit
 - 3. 1 set - spur gear seal and replaceable bearing races
 - 4. 1 set - shear pins
 - 5. 1 set - any special tools required to assemble, disassemble, or maintain the equipment
- B. Spare parts shall be tagged and stored in accordance with Section 43 05 11-2.12.

2.06 PRODUCT DATA

- A. The following information shall be provided in accordance with Section 01 33 00:
 - 1. Calculations sizing and locating the center column mixed liquor inlet ports.
 - 2. Calculations showing stresses in the drive cage and sludge collection arms as specified in paragraph 2.03 Drive Cage and paragraph 2.03 Sludge Collector Mechanism.
 - 3. Shop primer and coating data for all shop-coated components.
 - 4. Applicable operation and maintenance data in accordance with Section 01 78 23.
 - 5. Motor data as specified in Section 43 05 21-2.05.
 - 6. Installation Certification Section 43 05 11-Form A as specified in paragraph 3.01.
 - 7. Training Certification Section 43 05 11-Form B as specified in paragraph 3.02 General.

PART 3 EXECUTION

3.01 INSTALLATION, FIELD TESTING, AND START-UP

- A. General:
 - 1. Equipment furnished under this section shall be installed, checked, and adjusted as recommended by the manufacturer. The installation shall be certified on Form 43 05 11-A as specified in Section 01 99 90.
- B. Floor Clearance:
 - 1. The mechanism shall be leveled to a clearance tolerance of not less than 0.25-inch nor more than 0.5 inches between the collector squeegee and the finished floor surface.

3.02 FIELD TESTING AND START-UP

A. General:

1. In addition to the installation and acceptance tests specified in other portions of the project manual, the equipment furnished under this section shall be subject to the following field performance tests. All performance tests shall be performed under the on-site supervision of personnel trained by the manufacturer. All equipment and instrumentation necessary to complete the testing procedures outlined below shall be provided by the Contractor. Performance testing shall include operating, seals, and torque load testing. Failure to complete the testing program, as outlined in the following paragraphs, shall be sufficient cause for rejection. In addition, a factory representative shall start up the equipment and train plant personnel in operating and maintenance procedures for not less than 8 hours. Training shall be certified on Form 43 05 11-B as specified in Section 01 99 90.

B. Operating Tests:

1. Each secondary sedimentation tank shall be filled with secondary water to its operating level and the mechanism shall be operated continuously at its maximum speed for a period of not less than 48 hours. Scum sprays system shall be operated in automatic mode throughout the test. At no time during the operating test shall the equipment fail on torque overload or exhibit indications of binding or uneven operation. The Contractor shall record torque values as registered on the drive mechanism torque indicator and motor amperage (all three phases) at 3-hour intervals.
2. If the mechanism should fail on torque overload or, in the opinion of the Construction Manager, the mechanism should exhibit indications of binding or improper adjustment, the Contractor shall immediately halt the tests and remedy the problem. After completion of necessary repairs or adjustments, the tests shall be repeated. Failure to successfully complete the test in six attempts shall be considered sufficient cause for rejection.

C. Torque Test:

1. The Contractor shall load test the entire collector mechanism by anchoring collector arms individually. Each arm of the collector mechanism shall be tested individually by using a single attachment point at the end of the arm to achieve a point load condition during the test. In successive tests, the Contractor shall demonstrate the sludge collection mechanism's (including drive unit, cage, gears and structures) capability to withstand all loads and stresses associated with the cut-out torque. Prior to initiating the test, the Contractor shall furnish the Construction Manager with sketches and calculations illustrating the test procedure and demonstrating how the specified torque will be applied to satisfy this requirement.

END OF SECTION

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