NATOMAS MUTUAL WATER COMPANY

VOLUME 1

ELKHORN PUMPING PLANT REPLACEMENT

SPECIFICATIONS

DIVISIONS 00 THROUGH 49

BIDDING DOCUMENTS

Jacobs

REDDING, CALIFORNIA

FEBRUARY 2024

NATOMAS MUTUAL WATER COMPANY

SACRAMENTO, CALIFORNIA

BIDDING REQUIREMENTS
AND
CONTRACT DOCUMENTS

for the construction of the

ELKHORN PUMPING PLANT REPLACEMENT

VOLUME 1 OF 2

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BIDDING DOCUMENTS

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JACOBS

Redding, CA

FEBRUARY 2024

Project No. PW\JA\W8Y09802 Copy No. _____

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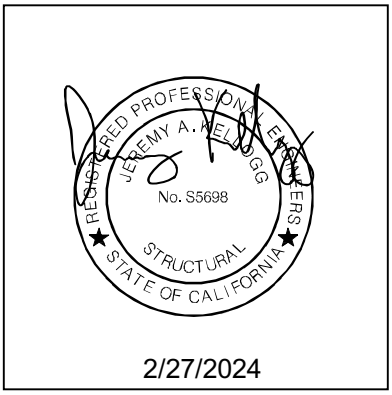

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PART 1

PROCUREMENT REQUIREMENTS

ADVERTISEMENT FOR BIDS

Sealed Bids for construction of the Elkhorn Pumping Plant Replacement, addressed to Brett Gray, General Manager, will be received at the office of the Natomas Mutual Water Company (Owner), 2601 West Elkhorn Boulevard, Rio Linda, CA 95673, until 1:00 p.m., local time, on the 15th day of April, 2024. Any Bids received after the specified time will not be considered.

Bids will then be publicly opened and read.

The Project contemplated consists of a replacement 60 cfs fish screen and pumping plant facility, located on the Sacramento River, adjacent to Garden Highway. Project components include:

- Demolition of the existing pumping plant.
- Pile supported structure with concrete deck.
- Access road from Garden Highway to the pumping plant structure.
- Log boom and deflector boom located in the Sacramento River.
- Two fish screens with integral brush cleaning system and retrieval system.
- Two 200-hp mixed-flow irrigation pumps with adjustable frequency drives.
- Two welded steel pipelines between pumps and a junction box on the river side of Garden Highway.
- Electrical, controls, and lighting.
- Miscellaneous auxiliary equipment and site improvements.

The Work will be completed in all respects on or before May 29, 2026.

Bidding Documents may be examined in Owner's office, 2601 West Elkhorn Boulevard, Rio Linda, CA 95673. An electronic copy of the Bidding Documents may be obtained upon request free of charge. A printed copy of the Bidding Documents may be obtained from the Owner's office upon payment (check or money order only) of $300. Return of the documents is not required, and amount paid for the documents is nonrefundable.

To obtain printed copy of the Bidding Documents via mail, send requests to the attention of Ms. Amanda Davis, telephone: (916) 419-5936, e-mail: ADavis@natomaswater.com at the office of the Owner. Include check or money order in the amount noted above, plus $50 for shipping.

Each Bid must be submitted on the prescribed Bid Form and accompanied by Bid security as prescribed in the Instructions to Bidders.

The Successful Bidder will be required to furnish the additional bond(s) and insurance prescribed in the Bidding Documents.

In order to Bid and perform public work, the Bidder and Subcontractors shall hold or obtain such licenses as required by State Statutes, and federal and local Laws and Regulations. Bidders and Subcontractors shall hold current public works contractor registration number issued by the Department of Industrial Relations at time of Bid. Bidders shall hold California Contractors' License, Class A at time of award. Failure to possess specified license at time of award shall render Bid nonresponsive.

Payment for the Work accomplished will be made monthly, but part of amount earned will be withheld to ensure performance under the Contract. Substitution of securities for monies withheld is permitted by Contract Documents as an option open to Successful Bidder.

For information concerning the proposed Work, contact Brad Memeo, Jacobs Engineering Group Inc., telephone: (530) 229-3430.

For an appointment to visit the Site, contact Brett Gray, Natomas Mutual Water Company, telephone: (916) 419-5936.

Attendance at a prebid conference will be a mandatory requirement of submitting a Bid for this Project. Refer to Instructions to Bidders for additional information.

Owner's right is reserved to reject all Bids or any Bid not conforming to the intent and purpose of the Bidding Documents.

Dated this 29 day of Feb, 2024.

Natomas Mutual Water Company

By _____
Brett Gray, General Manager

END OF SECTION

INSTRUCTIONS TO BIDDERS

1. DEFINED TERMS

1.1. 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:

1.1.1. *Issuing Office* – The office from which the Bidding Documents are to be issued and where the bidding procedures are to be administered.

1.1.2. *Successful Bidder* – Lowest, responsible, and responsive Bidder to whom Owner (on the basis of Owner's evaluation as hereinafter provided) makes an award.

2. COPIES OF BIDDING DOCUMENTS

2.1. Complete sets of the Bidding Documents in the number and for the deposit sum, if any, stated in the Advertisement for Bids may be obtained from the Issuing Office.

2.2. Complete sets of Bidding Documents shall be used in preparing Bids. Neither Owner nor Engineer assumes responsibility for errors or misinterpretations resulting from use of incomplete sets of Bidding Documents.

2.3. Drawings bound in the Bidding Documents are photographic reductions of original tracings. Amount of reduction is indicated by a note or scale bar on Drawing. Full-size Drawings may be obtained from Owner at cost of reproduction and handling, plus postage for mailing (if mailing is requested). Drawings will only be made available to firms listed as having complete sets of Bidding Documents. No return of full-size Drawings is required, and no refund will be made.

2.4. Owner and Engineer, in making copies of Bidding Documents made 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 or grant for any other use.

3. QUALIFICATIONS OF BIDDERS

3.1. In order to perform public work, Bidder and its Subcontractors, prior to award of Contract or as otherwise required by the jurisdiction, shall hold or obtain such licenses as required by State Statutes, and federal and local Laws and Regulations.

3.2. To demonstrate Bidder's qualifications to perform the Work, within 5 days of Owner's request, Bidder shall submit written evidence such as financial data,

previous experience, present commitments, and such other data as may be called for below:

3.2.1. Qualifications of proposed Project Manager.

3.2.2. Qualifications of proposed Superintendent.

3.2.3. Qualifications of proposed pile driver (Subcontractor or crew if proposed to be self-performed).

3.2.4. Pipe Pile Driving Plan as defined in Section 31 62 16, Steel Piles.

3.3. Refer to Paragraph 7.06 of the Supplementary Conditions for more information.

3.4. Bidder is advised to carefully review those portions of the Bid Form requiring representations and certifications.

3.5. In accordance with California Public Contract Code 6101, no Bidder shall be eligible to Bid or receive award for this Contract, who has in preceding 5 years, been convicted of violating a state or federal law respecting the employment of undocumented aliens.

3.6. In accordance with California Labor Code 1777.1 Contractor or Subcontractor that has violated the statutes regarding apprentices may not Bid on or perform work on public works projects for 1 year for the first violation and up to 3 years for the second or subsequent violations.

3.7. In accordance with Public Work Reforms (SB854), all Contractors and Subcontractors who Bid or work on a public works project must be registered and pay an annual fee to the State of California Department of Industrial Relations.

3.8. As defined in California Public Contract Code 10232, no Bidder shall be eligible to receive award for this Contract who has more than one final, unappealable finding of contempt of court by a federal court in last 2 years because of Bidder’s failure to comply with a National Labor Relations Board order.

3.9. As defined in California Public Contract Code 10162, a Bid may be rejected if Bidder or an employee of Bidder has been disqualified, removed, or otherwise prevented from Bidding on, or completing a federal, state or local project because of a violation of law or a safety regulation.

3.10. As defined in California Public Contract Code 10285.1, a Bid may be rejected if Bidder has been convicted of violating state or federal antitrust law for 3 years after conviction.

3.11. As defined in California Public Contract Code 10232, a Bid may be rejected if Bidder has more than one final unappealable finding of contempt of federal court for failure to comply with a federal court order of the National Labor Relations Board.

3.12. Bids will be accepted only from Bidders on the planholders' list maintained by Owner that attended the mandatory Prebid Conference.

4. LICENSE REQUIREMENTS

4.1. The classification of Contractor's License a Bidder shall hold to be eligible for award of the Contract for the Work is listed in the Advertisement for Bids.

5. EXAMINATION OF BIDDING DOCUMENTS, OTHER RELATED DATA, AND SITE

5.1. Subsurface and Physical Conditions:

5.1.1. The Supplementary Conditions identify:

5.1.1.1. Those reports known to Owner of explorations and tests of subsurface conditions at or contiguous to the Site.

5.1.1.2. Those drawings known to Owner of physical conditions relating to existing surface and subsurface structures at the Site (except Underground Facilities).

5.1.2. Copies of reports and drawings referenced will be made available by Owner to any Bidder on request. The "technical data" contained therein upon which Bidder is entitled to rely as provided in Paragraph 5.03 of the General Conditions has been identified and established in Paragraph 5.03 of 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. Costs associated with making available copies of reports and drawings shall be borne by Owner.

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

5.3. Hazardous Environmental Condition:

5.3.1. The Supplementary Conditions identify reports and drawings known to Owner relating to a Hazardous Environmental Condition identified at the Site.

5.3.2. Copies of reports and drawings referenced will be made available by Owner to any Bidder on request. Those reports and drawings are not part of the Contract Documents, but the "technical data" contained therein upon which Bidder is entitled to rely as provided in Paragraph 5.06 of the General Conditions has been identified and established in Paragraph 5.06 of 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. Costs associated with making available copies of reports and drawings shall be borne by Owner.

5.4. Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders with respect to 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 Paragraph 5.03 through Paragraph 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 as a result of 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.

5.5. On request, Owner will provide each Bidder access to the Site to conduct such examinations, investigations, explorations, tests, and studies as Bidder deems necessary for submission of a Bid. 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. Bidder shall comply with all applicable Laws and Regulations relative to excavation and utility locates.

5.6. Related Work at Site: Reference is made to the General Requirements for identification of the general nature of other work that is to be performed at the Site by Owner or others (such as utilities and other prime contractors) that relates to the Work contemplated by these Bidding Documents. On request Owner will provide to each Bidder for examination, access to or copies of contract documents (other than portions thereof related to price) for such other work.

5.7. Safety: Paragraph 7.12.C of the General Conditions indicates that if an Owner safety program exists, it will be noted in the Supplementary Conditions.

5.8. It is responsibility of each Bidder before submitting a Bid to:

5.8.1. Examine and carefully study the Bidding Documents, other related data identified in the Bidding Documents, and any Addenda.

5.8.2. Visit the Site to become familiar with and satisfy Bidder as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.

5.8.3. Become familiar with and satisfy Bidder as to all federal, state, and local Laws and Regulations that may affect cost, progress, and performance of the Work.

5.8.4. Carefully study all:

5.8.4.1. Reports of explorations and tests of subsurface conditions at or contiguous to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities) that have been identified in Paragraph 5.03 of the Supplementary Conditions as containing reliable “technical data”.

5.8.4.2. Reports and drawings of Hazardous Environmental Conditions, if any, at the Site that have been identified in Paragraph 5.06 of the Supplementary Conditions as containing reliable “technical data”.

5.8.5. Consider the information known to Bidder; 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:

5.8.5.1. Cost, progress, and performance of the Work.

5.8.5.2. Means, methods, techniques, sequences, and procedures of construction to be employed by Bidder, including applying any specific means, methods, techniques, sequences, and procedures of construction expressly required by the Bidding Documents.

5.8.5.3. Bidder’s safety precautions and programs.

5.8.6. Agree at the time of submitting its Bid that 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(s) Bid and within the times required, and in accordance with the other terms and conditions of the Bidding Documents.

5.8.7. 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.

5.8.8. Promptly give Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder discovers in Bidding Documents and confirm that written resolution thereof by Engineer is acceptable to Bidder.

5.8.9. Determine Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance of the Work.

5.9. 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 is premised upon performing and furnishing the Work required by Bidding Documents and applying specific means, methods, techniques, sequences, and procedures of construction that may be shown or indicated or expressly required by Bidding Documents; that Bidder has given Engineer written notice of all conflicts, errors, ambiguities, and discrepancies that Bidder has discovered in Bidding Documents and the written resolutions thereof by Engineer are acceptable to Bidder; and that Bidding Documents are generally sufficient to indicate and convey understanding of terms and conditions for performing and furnishing the Work.

6. PREBID CONFERENCE

6.1. A prebid conference will be held at 10:00 a.m. local time on March 21, 2024 at Owner’s office (2601 West Elkhorn Boulevard, Rio Linda, CA 95673). Representatives of Owner and Engineer will be present to discuss the Project. The conference will include a tour of the Site. Bidders are required to attend and participate in the conference. Bids will not be accepted from Bidders that do not have a representative at the prebid conference. Engineer will transmit to 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.

7. SITE AND OTHER AREAS

7.1. The Site is identified in the Bidding Documents. Easements for permanent structures or permanent changes in existing facilities are to be obtained and paid for by Owner, unless otherwise provided in the Bidding Documents. All additional lands and access thereto required for temporary construction facilities, construction equipment, or storage of materials and equipment to be incorporated in the Work are to be obtained and paid for by Contractor.

8. INTERPRETATIONS AND ADDENDA

8.1. 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 mailed or delivered to all parties recorded by the office issuing documents as having received the Bidding Documents. Questions received less than 10 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.

8.2. Addenda may also be issued to clarify, correct, or change the Bidding Documents as deemed advisable by Owner or Engineer.

9. BID SECURITY

9.1. Bid shall be accompanied by Bid security made payable to Owner in an amount of 10 percent of Bidder's maximum Bid price and in the form of a certified check, bank money order, or a penal Bid bond (on the attached form), issued by a surety meeting the requirements of Paragraph 6.01 of the General Conditions.

9.2. The Bid security of the Successful Bidder will be retained until 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 returned. If the Successful Bidder fails to execute and deliver the Contract Documents and furnish the required contract security within the time period specified in Article Signing of Agreement, 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. Bid security of other Bidders whom Owner believes to have a reasonable chance of receiving the award may be retained by Owner until the earlier of the 7th day after the Effective Date of the Agreement or the number of days specified for all Bids to remain subject to acceptance in Article Bids to Remain Subject to Acceptance, whereupon Bid security furnished by such Bidders will be returned.

9.3. Bid security of other Bidders whom Owner believes do not have a reasonable chance of receiving the award will be returned within 7 days after Bid opening.

10. CONTRACT TIMES

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

11. LIQUIDATED DAMAGES

11.1. Provisions for liquidated damages, if any, are set forth in the Agreement.

12. SUBSTITUTE AND "OR-EQUAL" ITEMS

12.1. The Contract, if awarded, will be on the basis of materials and equipment specified or described in the Bidding Documents without consideration of possible substitute or "or-equal" items. Whenever it is specified or described in the Bidding Documents that a substitute or "or-equal" item of material or equipment may be furnished or used by Contractor if acceptable to Engineer, application for such acceptance will not be considered by Engineer until after the Effective Date of the Agreement.

13. SUBCONTRACTORS, SUPPLIERS, AND OTHERS

13.1. In accordance with California Public Contract Code 6109, Contractor shall not employ a Subcontractor that has been debarred due to violation of a state or federal labor code as covered in LC 1777.1 or 1777.7.

13.2. Bidder shall submit with its Bid the names and business addresses of each proposed Subcontractor who will perform Work under these Bidding Documents in amounts 1/2 of 1 percent or greater of total Bid, and shall list the portion of the Work which will be done by such Subcontractor. If the Bidder fails to specify a Subcontractor for any portion of the Work to be performed under the Bidding Documents, the Bidder agrees to perform that portion of the Work itself, and further agrees that it is qualified to perform that portion of the Work. Refer to Paragraph 7.06 of the Supplementary Conditions for more information.

13.3. 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 a substitute in which case apparent Successful Bidder shall submit an acceptable 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.

13.4. 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, individuals, or entities. Declining to make requested substitutions will not 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 revocation of

such acceptance after the Effective Date of the Agreement as provided in General Conditions Paragraph 7.06.E.

13.5. Contractor shall not be required to employ any Subcontractor, Supplier, individual, or entity against whom Contractor has reasonable objection.

13.6. Contractor shall retain specific Subcontractors and Suppliers for the performance of designated parts of the Work where required by the Contract.

14. WAGE RATES

14.1. The Work under these Bidding Documents is to be paid for by public funds; therefore, minimum prevailing wage rates published by State and Federal Departments of Labor are applicable. Refer to Paragraph 7.10 of the Supplementary Conditions for more information.

14.2. Owner has obtained from the Director of the Department of Industrial Relations the prevailing rate of per diem wages for workers to be used on the Project. Copies are on file at Owner's principal office, and are available to interested persons on request. Successful Bidder agrees, upon execution of the Agreement, to post a copy at the Site.

14.3. Compliance with Federal Labor Standards and Wage Determinations:

14.3.1. The Work under these Bidding Documents is to be paid for in part by federal funds; therefore, minimum prevailing wage rates published by both the State and Federal Departments of Labor are applicable. In case of discrepancies between the two lists of wage rates, the Bidder shall pay not less than the higher rates indicated therein for the respective crafts.

14.3.2. It shall be the Bidder's responsibility to make certain that its Bid is based upon the latest available wage information.

14.3.3. The Owner does not guarantee that labor can be procured for the minimum wages listed. The rates of wages listed are minimum only, below which the Bidder cannot pay, and they do not constitute a representation that labor can be procured for the minimum listed.

15. PREPARATION OF BID

15.1. All blanks on the Bid Form shall be completed by typing or printing with 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 Bid item listed therein or the words "No Bid," "No Change," or "Not Applicable" entered.

15.2. A Bid by a corporation shall be executed in the corporate name by the president or a vice president or other corporate officer accompanied by evidence of authority to sign. The corporate seal shall be affixed and attested by the secretary or an assistant secretary. The corporate address and state of incorporation shall be shown.

15.3. A Bid by a partnership shall be executed in the partnership name and signed by a partner (whose title must appear under the signature), accompanied by evidence of authority to sign. The official address of the partnership shall be shown.

15.4. A Bid by a limited liability company shall be executed in the name of the firm by a member 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.

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

15.6. A Bid by a joint venture shall be executed by each joint venturer in the manner indicated on the Bid Form. The official address of the joint venture shall be shown.

15.7. All names shall be typed or printed in ink below the signatures.

15.8. The Bid shall contain an acknowledgement of receipt of all Addenda; the numbers of which shall be filled in on the Bid Form.

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

15.10. 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 and class, if applicable, and the DIR public works contractor registration number shall also be shown on the Bid Form.

16. BASIS OF BID; COMPARISON OF BIDS

16.1. Lump Sum:

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

16.2. Unit Price:

16.2.1. Bidders shall submit a Bid on a unit price basis for each item of Work listed in the Bid schedule.

16.2.2. The total of all estimated prices will be the sum of the products of the estimated quantity of each item and the corresponding unit price. The final quantities and Contract Price will be determined in accordance with Paragraph 13.03 of the General Conditions.

16.2.3. Discrepancies between the multiplication of units of Work and unit prices will be resolved in favor of the unit prices. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum.

17. SUBMISSION OF BID

17.1. The unbound copy of the Bid Form is to be completed and submitted with the Bid security and the documents listed in Article Attachments To This Bid, in Section 00 41 13, Bid Form.

17.2. A Bid shall be submitted no later than the date and time prescribed, and at the place indicated in the Advertisement for Bids. Enclose Bid in a plainly marked package with the Project title (and, if applicable, the designated portion of the Project for which the Bid is submitted), name and address of Bidder, and 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.”

18. MODIFICATION AND WITHDRAWAL OF BID

18.1. A Bid may be modified or 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.

18.2. 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.

19. OPENING OF BIDS

19.1. Bids will be opened at the time and place indicated in the Advertisement for Bids and unless obviously nonresponsive, 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.

20. BIDS TO REMAIN SUBJECT TO ACCEPTANCE

20.1. 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.

21. EVALUATION OF BIDS AND AWARD OF CONTRACT

21.1. Owner reserves the right to reject any or all Bids, including without limitation, nonconforming, nonresponsive, unbalanced or conditional Bids. Owner further reserves the right to reject the Bid of any Bidder whom it finds, after reasonable inquiry and evaluation, to not be responsible. Owner may also reject the Bid of any Bidder if Owner believes that it would not be in the best interest of the Project to make an award to that Bidder. Owner also reserves the right to waive all informalities not involving price, time, or changes in the Work and to negotiate contract terms with the Successful Bidder.

21.2. More than one Bid for the same Work from an individual or entity under the same or different names will not be considered. Reasonable grounds for believing that any Bidder has an interest in more than one Bid for the Work may be cause for disqualification of that Bidder and the rejection of all Bids in which that Bidder has an interest.

21.3. In evaluating Bids, Owner will consider whether or not the Bids comply with the prescribed requirements, and such alternates, unit prices, and other data, as may be requested in the Bid Form or prior to the Notice of Award.

21.4. In evaluating Bidders, Owner may consider the qualifications of Bidders and may consider the qualifications and experience of Subcontractors, Suppliers, and other individuals or entities proposed for those portions of the Work for which the identity of Subcontractors, Suppliers, and other individuals or entities must be submitted either with the Bid, or otherwise prior to issuance of the Notice of Award.

21.5. Owner may conduct such investigations as Owner deems necessary to establish responsibility, qualifications, and financial ability of Bidders, proposed Subcontractors, Suppliers, individuals, or entities proposed for those portions of the Work in accordance with the Contract Documents.

21.6. If the Contract is to be awarded, Owner will award the Contract to Bidder whose Bid is in the best interests of the Project.

22. CONTRACT SECURITY AND INSURANCE

22.1. Article 6 of the General Conditions, as may be modified by the Supplementary Conditions, sets forth Owner’s requirements as to bonds and insurance. When

Successful Bidder delivers executed Agreement to Owner, it shall be accompanied by such bonds.

23. SIGNING OF AGREEMENT

23.1. When Owner issues a Notice of Award to Successful Bidder, it shall be accompanied by the required number of unsigned counterparts of the Agreement along with the other Contract Documents that are identified in the Agreement as attached thereto. Within 15 days thereafter, Successful Bidder shall sign and deliver the required number of counterparts of the Agreement and attached documents to Owner. Within 10 days thereafter, Owner shall deliver one fully signed counterpart to Successful Bidder with a complete set of the Drawings with appropriate identification.

24. RETAINAGE

24.1. Provisions concerning retainage and Contractor's rights to deposit securities in lieu of retainage, if applicable, are set forth in the Agreement.

END OF SECTION

NOTE TO BIDDER: Use typewriter or ink for completing this Bid Form.

BID FORM
(STIPULATED PRICE BASIS)

1. BID RECIPIENT

1.1. This Bid is submitted to:

Owner: Natomas Mutual Water Company

Address: 2601 West Elkhorn Boulevard, Rio Linda, CA 95673

Project Identification: Elkhorn Pumping Plant Replacement

1.2. 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.

2. BIDDER'S ACKNOWLEDGEMENTS

2.1. 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 60 days after the Bid opening, or for such longer period of time that Bidder may agree to in writing upon request of Owner.

3. BIDDER'S REPRESENTATIONS

3.1. In submitting this Bid, Bidder represents that:

3.1.1. Bidder has examined and carefully studied the Bidding Documents, the other related data identified in the Bidding Documents, and the following Addenda, receipt of which is hereby acknowledged.

Addendum No.	**Addendum Date**

(Bidder shall insert number of each Addendum received.)

3.1.2. Bidder has visited the Site 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.

3.1.3. Bidder is familiar with and is satisfied as to all Laws and Regulations that may affect cost, progress, and performance of the Work.

3.1.4. Bidder has carefully studied: i) reports of explorations and tests of subsurface conditions at or contiguous to the Site and drawings of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities) which have been identified in Paragraph 5.03 of the Supplementary Conditions as containing reliable “technical data,”; and ii) reports and drawings of Hazardous Environmental Conditions, if any, at the Site that have been identified in Paragraph 5.06 of the Supplementary Conditions as containing reliable “technical data.”

3.1.5. Bidder has considered the information known to Bidder; 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, including applying the specific means, methods, techniques, sequences, and procedures of construction expressly required by the Bidding Documents; and (3) Bidder’s safety precautions and programs.

3.1.6. Based on information and observations referred to in paragraph above, Bidder does not consider that further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of this Bid for performance of the Work at the price(s) Bid and within the times required, and in accordance with the other terms and conditions of the Bidding Documents.

3.1.7. 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.

3.1.8. Bidder has given Engineer written notice of conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Bidding Documents, and the written resolution thereof by Engineer is acceptable to Bidder.

3.1.9. The Bidding Documents are generally sufficient to indicate and convey understanding of terms and conditions for the performance of the Work for which this Bid is submitted.

4. BIDDER'S CERTIFICATION

4.1. Bidder certifies:

4.1.1. 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;

4.1.2. Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid;

4.1.3. Bidder has not solicited or induced any individual or entity to refrain from bidding; and

4.1.4. Bidder has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract. For the purposes of this paragraph:

4.1.4.1. "corrupt practice" means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the bidding process;

4.1.4.2. "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 noncompetitive levels, or (c) to deprive Owner of the benefits of free and open competition;

4.1.4.3. "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, noncompetitive levels; and

4.1.4.4. "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.

4.1.5. Required sales and use taxes are included in the stated Bid prices for the Work unless provision is made herein for the Bidder to separately itemize the estimated amount of sales tax or if Instructions to Bidders state Owner is tax exempt.

4.1.6. In accordance with California Public Contract Code 6101 Bidder has not been convicted of violating a state or federal law respecting the employment of undocumented aliens in preceding 5 years.

4.1.7. In accordance with California Labor Code 1777.1, neither Bidder nor its Subcontractors have violated the statutes regarding apprentices for 1 year for the first violation and up to 3 years for the second or subsequent violations.

4.1.8. In accordance with Public Works Reforms (SB854), all Bidders who Bid or work on a public works project must be registered with the State of California Department of Industrial Relations.

4.1.9. In accordance with California Public Contract Code 10162, neither Bidder nor any employee with a proprietary interest in Bidder, has ever been disqualified, removed, or otherwise prevented from bidding on or completing a federal, state or local government project because of a violation of law or a safety regulation.

4.1.10. In accordance with California Public Contract Code 10232, Bidder has no more than one final, unappealable finding of contempt of court by a federal court in last 2 years because of Bidder's failure to comply with a National Labor Relations Board order.

4.1.11. In accordance with California Public Contract Code 10285.1, Bidder has not been convicted of violating state or federal antitrust law within the last 3 years.

5. BASIS OF BIDS

5.1. Bidder shall complete the Work in accordance with the Contract Documents for the following price(s):

5.2. Lump Sum Bid Price:

Item No.	Item Description	Lump Sum Bid Price
1.	Mobilization.	$
2.	Demolition.	$
3.	Mechanically cleaned wedgewire fish screens described in Section 35 79 19, Mechanically Cleaned Wedgewire Fish Screens.	$

Item No.	Item Description	Lump Sum Bid Price
4.	Excepting only work covered in Bid Items 1 through 3 above and Unit Price Bid Items below, all Work required to be provided under the Contract Documents.	$
Lump Sum Bid Price (Total of Above)		$

5.3. Unit Price Bid Schedule:

5.3.1. Unit prices have been computed in accordance with Paragraph 13.03.C of the General Conditions.

5.3.2. Bidder acknowledges that estimated quantities are not guaranteed, and are solely for the purpose of comparison of Bids, and final payment for all unit price Bid items will be based on actual quantities, determined as provided in the Contract Documents.

Unit Price Bid Schedule					
Item No.	**Description**	**Estimated Quantity**	**Unit**	**Bid Unit Price**	**Extended Bid Unit Price**
1.	24-inch steel pipe pile material and installation of additional length required when tip elevation necessary to achieve capacity is deeper than estimated pile tip elevation for required ultimate driving resistance indicated.	40	LF	$	$
Total of Extended Bid Unit Prices					$

5.4. Base Bid Summary:

5.4.1. Lump Sum Bid Price: $_____

5.4.2. Total Extended Unit Bid Prices: $_____

5.4.3. Base Bid (Total of Above): $_____

6. TIME OF COMPLETION

6.1. Bidder agrees the Work, and any Milestones specified in Section 01 31 13, Project Coordination, will be substantially complete and will be completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions on or before the dates, or within the number of calendar days, indicated in the Agreement.

6.2. Bidder accepts the provisions of the Agreement as to liquidated damages in the event of failure to complete the Work, and any specified Milestones, within the Contract Times.

7. ATTACHMENTS TO THIS BID

7.1. The following documents are submitted with and made a condition of this Bid:

7.1.1. Required Bid security in the form of Bid bond.

7.1.2. List of Project References.

7.1.3. List of Proposed Subcontractors.

7.1.4. Noncollusion Affidavit.

7.1.5. Nondiscrimination Clause.

7.1.6. Drug-Free Workplace Certification.

7.1.7. Certification Regarding Lobbying.

7.1.8. Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion.

8. DEFINED TERMS

8.1. 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.

9. BID SUBMITTAL

9.1. This Bid submitted by:

If Bidder is:

An Individual

Name (typed or printed): _____

By (signature): _____

Doing business as: _____

A Partnership

Partnership Name: _____ (SEAL)

By: _____
(Signature of general partner – attach evidence of authority to sign)

Name *(typed or printed)*: _____

A Corporation

Corporation Name: _____ (SEAL)

State of Incorporation: _____

Type (General Business, Professional, Service, Limited Liability): ____

By: _____
(Signature – attach evidence of authority to sign)

Name (typed or printed): _____

Title: _____ (CORPORATE SEAL)

Attest: _____
(Signature of Corporate Secretary)

Date of Qualification to do business in California is:
_____.

A Joint Venture

Joint Venturer Name: _____ (SEAL)

By: _____
(Signature of joint venture partner – attach evidence of authority to sign)

Name (typed or printed): _____

Title: _____

(Each joint venturer must sign. The manner of signing for each individual, partnership, and corporation that is a party to the joint venture should be in the manner indicated above.)

Bidder's Business Address: _____

_____

Phone No.:_____ FAX No.: _____

E-mail: _____

SUBMITTED on _____, 20_____

California Contractor's License No.: _____

Contractor's License Class (where applicable): _____

California DIR Public Works Contractor Registration No.: _____

Bidder certifies that it is a California company as defined in Public Contract Code 6107.

_____ Yes _____ No

Bidder's principal place of business is in California:

_____ Yes (resident) _____ No (nonresident)

END OF SECTION

PROJECT REFERENCES

Provide two (2) to three (3) references to recently completed or substantially complete contracts with requirements similar to those described within this solicitation. Use attachments as necessary.

CLIENT NAME **CONTACT NAME, TELEPHONE NO.** **PROJECT DESCRIPTION**	**CONTRACT NO.** **CONTRACT DATE**	**START DATE** **END DATE** **CONTRACT VALUE**	**ANY PERFORMANCE PROBLEMS?** (Technical/ Quality, Schedule or Cost related) (Y/N) *Explain in attachment*	**CONTRACT TERMINATED?** (Y/N) *Explain in attachment*
		$		
		$		
		$		

NAME AND ADDRESS OF OFFEROR	**NAME OF SIGNER**	**TITLE OF SIGNER**
	OFFEROR'S SIGNATURE	**DATE SIGNED**

References checked by: Date(s) checked:

LIST OF PROPOSED SUBCONTRACTORS

List below each Subcontractor who meets the conditions described in Section 00 21 13, Instructions to Bidders. For each Subcontractor, list Subcontractor's name, address, license number, DIR public works contractor registration number, and a description of the type or kind of work the Subcontractor will perform.

	SUBCONTRACTOR NAMES AND ADDRESS	**KIND OF WORK**	**LICENSE NO. & DIR NO.**
1.			
2.			
3.			
4.			
5.			
6.			

NONCOLLUSION AFFIDAVIT
(TO BE EXECUTED BY BIDDER AND SUBMITTED WITH BID)

STATE OF CALIFORNIA
}
COUNTY OF _____}

_____, being first duly sworn, deposes and

says that he or she is _____ of _____ the party making the foregoing Bid that the Bid is not made in the interest of, or on behalf of, any undisclosed person, partnership, company, association, organization, or corporation; that the Bid is genuine and not collusive or sham; that the Bidder has not directly or indirectly induced or solicited any other Bidder to put in a false or sham bid, and has not directly or indirectly colluded, conspired, connived, or agreed with any Bidder or anyone else to put in a sham bid, or that anyone shall refrain from bidding; that the Bidder has not in any manner, directly or indirectly, sought by agreement, communication, or conference with anyone to fix the Bid price of the Bidder or any other Bidder, or to fix any overhead, profit, or cost element of the Bid price, or of that of any other Bidder, or to secure any advantage against the public body awarding the Contract of anyone interested in the proposed Contract; that all statements contained in the Bid are true; and, further, that the Bidder has not, directly or indirectly, submitted his or her Bid price or any breakdown thereof, or the contents thereof, or divulged information or data relative thereto, or paid, and will not pay, any fee to any corporation, partnership, company association, organization, Bid depository, or to any member or agent thereof to effectuate a collusive or sham Bid.

_____
Name of Contractor

_____
Bidder (Affiant)

Subscribed and sworn to before me this _____ day of _____ , 20 _____

My commission expires: _____

_____ Notary Public

END OF SECTION

NONDISCRIMINATION CLAUSE

During the performance of this Agreement, Contractor and its Subcontractors shall not unlawfully discriminate, harass, or allow harassment against any employee or applicant for employment because of race, religion, color, national origin, ancestry, physical, disability (including HIV and AIDS), mental disability, medical condition, marital status, age (over 40), denial of family care leave, or sex. Contractors and Subcontractors shall ensure that the evaluation and treatment of their employees and applicants for employment are free of such discrimination and harassment. Contractors and Subcontractors shall comply with the provisions of the Fair Employment and Housing Act (Government Code Section 12900 et seq.) and the applicable regulations promulgated thereunder (California Administrative Code, Title 2, Section 7285.0 et seq.). The applicable regulations of the Fair Employment and Housing Commission implementing Government Code, Section 12900, set forth in Chapter 5 of Division 4 of Title 2 of the California Administrative Code are incorporated into this Contract by reference and made a part hereof as if set forth in full. Contractor and its Subcontractor shall give written notice of their obligations under this clause to labor organizations with which they have a collective bargaining or other Agreement.

Contractor shall include the nondiscrimination and compliance provisions of this clause in all subcontracts to perform work under the Agreement.

The undersigned certifies that the Contractor will comply with the above requirements:

Contractor or
Subcontractor Name: _____

Certified by:

Name: _____ Title: _____

Signature: _____ Date: _____

END OF SECTION

DRUG-FREE WORKPLACE CERTIFICATION

Contractor Name: _____

The Contractor or applicant named above hereby certifies compliance with Government Code Section 8355 in matters relating to providing a drug-free workplace. The above named Contractor or applicant will:

1. Publish a statement notifying employees that unlawful manufacture, distribution, dispensation, possession, or use of a controlled substance is prohibited and specifying action to be taken against employees for violations, as required by Government Code Section 8355(a).

2. Establish a Drug-Free Awareness Program as required by Government Code Section 8355(b), to inform employees about all of the following:

   (a) The dangers of drug abuse in the workplace.

   (b) The person's or organization's policy of maintaining a drug-free workplace.

   (c) Any available counseling, rehabilitation, and employee assistance programs, and

   (d) Penalties that may be imposed upon employees for the drug abuse violations.

3. Provide as required by Government Code Section 8355(c), that every employee who works on the Project:

   (a) Will receive a copy of the company's drug-free policy statement, and

   (b) Will agree to abide by the terms of the company's statement as a condition of employment on the Project.

CERTIFICATION

I, the official named below, hereby swear that I am duly authorized legally to bind the Contractor or loan recipient to the above described certification. I am fully aware that this certification, executed on the date and in the County below, is made under penalty of perjury under the laws of the State of California.

OFFICIAL'S NAME: (print): _____

DATE EXECUTED: _____ EXECUTED IN COUNTY OF: _____

CONTRACTOR/APPLICANT SIGNATURE: _____

TITLE: _____

END OF SECTION

CERTIFICATION REGARDING LOBBYING

The undersigned _____ certifies, to the best of his or her knowledge and belief, that:

1. No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any persons for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding to any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

2. If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

3. The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly.

   This certification is a material representation of fact upon which reliance is placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by 31, U.S.C. 1352 (as amended by the Lobbying Disclosure Act of 1995). Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

[Note: Pursuant to 31 U.S.C. 1352(c)(1)-(2)(A), any person who makes a prohibited expenditure or fails to file or amend a required certification or disclosure form shall be subject to a civil penalty of not less than $10,000 for each such expenditure or failure.]

The Contractor, _____, certifies or affirms the truthfulness and accuracy of each statement of its certification and disclosure, if any. In addition, the Contractor understands and agrees that the provisions of 31 U.S.C. Section A 3801 *et seq.*, apply to this certification and disclosure, if any.

_____ _____

Date Signature of Contractor's Authorized Official

_____

Name and Title of Contractors Authorized Official

Subscribed and sworn to before me this ___ day of _____, 20__, in the State of _____; and the County of _____.

Notary Public

_____

My Appointment Expires _____

CERTIFICATION REGARDING DEBARMENT, SUSPENSION,

INELIGIBILITY and VOLUNTARY EXCLUSION

LOWER TIER COVERED TRANSACTION

(1) The prospective lower tier participant (Bidder/Contractor) certifies, by submission of this bid or proposal, that neither it nor its principals is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in this transaction by any Federal department or agency.

(2) Where the prospective lower tier participant (Bidder/Contractor) is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

(3) The lower tier participant (Bidder/Contractor), _____, certifies or affirms the truthfulness and accuracy of this statement of its certification and disclosure, if any.

SIGNATURE
_____

TITLE
_____

COMPANY
_____

DATE
_____

State of _____

County of _____

Subscribed and sworn to before me this ____ day of _____, 20__.

Notary Public
_____

My Appointment Expires _____

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):

Natomas Mutual Water Company
2601 West Elkhorn Boulevard
Rio Linda, CA 95673

BID

Bid Due Date:
Project (Brief Description Including Location): Elkhorn Pumping Plant Replacement, Sacramento County, California.

BOND

Bond Number:
Date (Not later than Bid due date):

Penal sum _____ _____
(Words) (Figures)

Surety and Bidder, intending to be legally bound hereby, subject to the terms printed on the reverse side hereof, do each cause this Bid Bond to be duly executed on its behalf by its authorized officer, agent, or representative.

BIDDER	SURETY
_____(Seal)	_____(Seal)
Bidder's Name and Corporate Seal	Surety's Name and Corporate Seal
By: _____	By: _____
Signature and Title	Signature and Title (Attach Power of Attorney)
Attest: _____	Attest: _____
Signature and Title	Signature and Title

Note: Above addresses are to be used for giving required notice.

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 Surety's liability.

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 by 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 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 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.

END OF SECTION

PART 2

CONTRACTING REQUIREMENTS

AGREEMENT

THIS AGREEMENT is by and between Natomas Mutual Water Company (Owner) and

_____ (Contractor).

Owner and Contractor, in consideration of the mutual covenants set forth herein, agree as follows:

1. WORK

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

1.1.1. A replacement 60 cfs fish screen and pumping plant facility, located on the Sacramento River, adjacent to Garden Highway. Project components include:

1.1.1.1. Demolition of the existing pumping plant.

1.1.1.2. Pile supported structure with concrete deck.

1.1.1.3. Access road from Garden Highway to the pumping plant structure.

1.1.1.4. Log boom and deflector boom located in the Sacramento River.

1.1.1.5. Two fish screens with integral brush cleaning system and retrieval system.

1.1.1.6. Two 200-hp mixed-flow irrigation pumps with adjustable frequency drives.

1.1.1.7. Two welded steel pipelines between pumps and a junction box on the river side of Garden Highway.

1.1.1.8. Electrical, controls, and lighting.

1.1.1.9. Miscellaneous auxiliary equipment and site improvements.

2. ENGINEER

2.1. The Project has been designed by Jacobs Engineering Group Inc. (Engineer), who is to act as Owner's representative, assume 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.

3. CONTRACT TIMES

3.1. Time of the Essence: 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.

3.2. Dates for Substantial Completion and Final Payment:

3.2.1. The Work shall be substantially completed on or before April 24, 2026, and completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions on or before May 29, 2026.

3.3. Milestone 1:

3.3.1. The Work necessary to achieve the Milestone(s), as identified in Section 01 31 13, Project Coordination, shall be substantially completed no later than October 1, 2024.

3.4. Liquidated Damages:

3.4.1. Contractor and Owner recognize that time is of the essence of this Agreement and that Owner will suffer financial loss if the Work is not completed within the times specified in Paragraph Contract Times above, plus any extensions thereof allowed in accordance with Article 11 of the General Conditions. The parties also recognize the delays, expense, and difficulties involved in proving in a legal or arbitration 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) Contractor shall pay Owner ten thousand dollars ($10,000) for each day that expires after the time specified herein for Substantial Completion until the Work is substantially complete.

3.4.2. Contractor and Owner also recognize that time is of the essence of this Agreement's specified Milestone(s) and that Owner will suffer financial loss if the Work necessary to complete the Milestone(s) is not completed within the times specified in Paragraph Contract Times above, plus any extensions thereof allowed in accordance with Article 11 of the General Conditions. The

parties also recognize the delays, expense, and difficulties involved in proving in a legal or arbitration proceeding the actual loss suffered by Owner if the Milestone 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) Contractor shall pay Owner five thousand dollars ($5,000) for each day that expires after the time specified herein for completion of the Milestone until Work necessary to complete the Milestone is substantially complete.

3.4.3. After Substantial Completion, if Contractor neglects, refuses, or fails to complete remaining Work within the Contract Time or any proper extension thereof granted by Owner, Contractor shall pay Owner two thousand five hundred dollars ($2,500) for each day that expires after the time specified herein for completion and readiness for final payment until the Work is completed and ready for final payment.

4. CONTRACT PRICE

4.1. For all Work, at the prices stated in Contractor's Bid, attached hereto as an exhibit.

5. PAYMENT PROCEDURES

5.1. Submittal and Processing of Payments: 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.

5.2. Progress Payments and Retainage: Owner will make progress payments on account of the Contract Price on the basis of Contractor's Application for Payment on the date of each month as established in the preconstruction conference during performance of the Work as provided herein. All such payments will be measured by the Schedule of Values established as provided in Paragraph 2.05 of 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 in the General Requirements.

5.2.1. 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 Engineer may determine or Owner may withhold, including but not limited to liquidated damages, in accordance with Paragraph 15.01 of the General Conditions:

5.2.1.1. Ninety-five percent (95%) of Work completed (with the balance being retainage); and

5.2.1.2. Ninety-five percent (95%) of cost of materials and equipment stored onsite not incorporated in the Work (with the balance being retainage).

5.2.2. Contractor may elect to substitute securities of equivalent value in accordance with requirements and procedures of Sections 22300 or 10263 of the California Public Contract Code.

5.3. Final Payment:

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

6. INTEREST

6.1. Monies not paid when due as provided in Article 15 of the General Conditions shall bear interest at the rate of ten percent (10%) per annum.

7. CONTRACTOR'S REPRESENTATIONS

7.1. In order to induce Owner to enter into this Agreement, Contractor makes the following representations:

7.1.1. Contractor has examined and carefully studied the Contract Documents and the other related data identified in the Bidding Documents.

7.1.2. Contractor has visited the Site 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.

7.1.3. Contractor is familiar with and is satisfied as to all federal, state, and local Laws and Regulations that may affect cost, progress, and performance of the Work.

7.1.4. Contractor has carefully studied: (1) reports of explorations and tests of subsurface conditions at or contiguous to the Site and drawings of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities) if any, which have been identified in Paragraph 5.03 of the Supplementary Conditions as containing reliable "technical data", and (2) reports and drawings of Hazardous Environmental Conditions, if any, at the Site which have been identified in Paragraph 5.06 of the Supplementary Conditions as containing reliable "technical data."

7.1.5. Contractor has considered the information known to Contractor; 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 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, including any specific means, methods, techniques, sequences, and procedures of construction expressly required by the Contract Documents; and 3) Contractor's safety precautions and programs.

7.1.6. Based on the information and observations referred to above, Contractor does not consider that any 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 Documents.

7.1.7. 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.

7.1.8. Contractor has given Engineer written notice of conflicts, errors, ambiguities, or discrepancies that Contractor has discovered in the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.

7.1.9. The Contract Documents are generally sufficient to indicate and convey understanding of terms and conditions for performance and furnishing of the Work.

8. CONTRACT DOCUMENTS

8.1. Contents:

8.1.1. The Contract Documents that are attached to this Agreement (except as expressly noted otherwise) consist of the following:

8.1.1.1. This Agreement (pages 1 to 8, inclusive).

8.1.1.2. Performance bond (pages 1 to 4, inclusive).

8.1.1.3. Payment bond (pages 1 to 4, inclusive).

8.1.1.4. General Conditions (pages 1 to 52, inclusive).

8.1.1.5. Supplementary Conditions (pages 1 to 17, inclusive).

8.1.1.6. Specifications as listed in the table of contents of the Project Manual.

8.1.1.7. Drawings consisting of 66 sheets with each sheet bearing the following general title: Elkhorn Pumping Plant Replacement.

8.1.1.8. Addenda (numbers _____ to _____, inclusive).

8.1.2. Exhibits to this Agreement (enumerated as follows):

8.1.2.1. Contractor's Bid (pages ____ to ____, inclusive).

8.1.3. The following which may be delivered or issued on or after the Effective Date of the Agreement and are not attached hereto:

8.1.3.1. Notice to Proceed (pages ____ to ____, inclusive).

8.1.3.2. Work Change Directives.

8.1.3.3. Change Order(s).

8.2. There are no Contract Documents other than those listed above in this Article.

8.3. The Contract Documents may only be amended, modified, or supplemented as provided in Paragraph 11.01 of the General Conditions.

9. MISCELLANEOUS

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

9.2. Successors and Assigns: Owner and Contractor each binds itself, its partners, successors, assigns, and legal representatives to the other party hereto, its partners, successors, assigns, and legal representatives in respect to all covenants, agreements, and obligations contained in the Contract Documents.

9.3. Severability: Any provision or part of the Contract Documents held to be void or unenforceable under any Law or Regulation shall be deemed stricken, and remaining provisions shall continue to be valid and binding upon Owner and Contractor, who agree 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.

9.4. Assignment of Contract:

9.4.1. No assignment by a party hereto of any rights under or interests in the Contract shall be binding on another party hereto without the written consent of the party sought to be bound; and, specifically but without limitation, monies that may become due and monies that are due may not be assigned without such consent (except to the extent that the effect of this restriction may be limited by law), and unless specifically stated to the contrary in any written consent to an assignment, no assignment shall release or discharge the assignor from any duty or responsibility under the Contract Documents.

9.5. Contractor's Certifications:

9.5.1. 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:

9.5.1.1. "corrupt practice" means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the bidding process or in Contract execution;

9.5.1.2. "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 Price at artificial noncompetitive levels, or (c) to deprive Owner of the benefits of free and open competition;

9.5.1.3. "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, noncompetitive levels; and

9.5.1.4. "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.

IN WITNESS WHEREOF, Owner and Contractor have signed this Agreement in triplicate. One counterpart each has been delivered to Owner, Contractor, and Engineer. All portions of the Contract Documents have been signed or identified by Owner and Contractor or on their behalf.

This Agreement will be effective on _____, 20__ (which is the Effective Date of the Agreement).

OWNER: Natomas Mutual Water Company_____

_____

By: _____

Title: _____

[CORPORATE SEAL]

Attest: _____

Title: _____

Address for giving notices:

2601 West Elkhorn Boulevard

Rio Linda, CA 95673

(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.)

CONTRACTOR: _____

_____

By: _____

Title: _____

[CORPORATE SEAL]

Attest: _____

Title: _____

Address for giving notices:

_____

_____

License No. _____
(Where applicable)

Agent for service or process: _____

_____

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

END OF SECTION

PERFORMANCE BOND FORM

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

CONTRACTOR
(Name and Address):

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

OWNER (Name and Address):

Natomas Mutual Water Company
2601 West Elkhorn Boulevard
Rio Linda, CA 95673

CONTRACT

Date:
Amount:
Description (Name and Location):

BOND

Bond Number:
Date (Not earlier than Contract Date):
Amount:
Modifications to this Bond Form:

Surety and Contractor, intending to be legally bound hereby, subject to the terms printed on the reverse side hereof, do each cause this Performance Bond to be duly executed on its behalf by its authorized officer, agent, or representative.

CONTRACTOR AS PRINCIPAL

Company:

Signature: _____(Seal)
Name and Title

SURETY

_____(Seal)
Surety's Name and Corporate Seal

By: _____
Signature and Title

(Attach Power of Attorney)

(Space is provided below for signatures of additional parties, if required.)

Attest: _____
Signature and Title

CONTRACTOR AS PRINCIPAL

Company:

Signature: _____(Seal)
Name and Title

SURETY

_____(Seal)
Surety's Name and Corporate Seal

By: _____
Signature and Title

(Attach Power of Attorney)

Attest: _____
Signature and Title

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

2. If Contractor performs the Contract, Surety and Contractor have no obligation under this Bond, except to participate in conferences as provided in Paragraph 3.1.

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

3.1. Owner has notified Contractor and Surety, at the addresses described in Paragraph 10 below, that Owner is considering declaring a Contractor Default and has requested and attempted to arrange a conference with Contractor and Surety to be held not later than 15 days after receipt of such notice to discuss methods of performing the Contract. If Owner, Contractor and Surety agree, Contractor shall be allowed a reasonable time to perform the Contract, but such an agreement shall not waive Owner's right, if any, subsequently to declare a Contractor Default; and

3.2. Owner has declared a Contractor Default and formally terminated Contractor's right to complete the Contract. Such Contractor Default shall not be declared earlier than 20 days after Contractor and Surety have received notice as provided in Paragraph 3.1; and

3.3. Owner has agreed to pay the Balance of the Contract Price to:

1. Surety in accordance with the terms of the Contract;

2. Another contractor selected pursuant to Paragraph 4.3 to perform the Contract.

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

4.1. Arrange for Contractor, with consent of Owner, to perform and complete the Contract; or

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

4.3. Obtain bids or negotiated proposals from qualified contractors acceptable to Owner for a contract for performance and completion of the Contract, arrange for a contract to be prepared for execution by Owner and Contractor selected with Owner's concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Contract, and pay to Owner the amount of damages as described in Paragraph 6 in excess of the Balance of the Contract Price incurred by Owner resulting from Contractor Default; or

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

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

2. Deny liability in whole or in part and notify Owner citing reasons therefor.

5. If Surety does not proceed as provided in Paragraph 4 with reasonable promptness, Surety shall be deemed to be in default on this Bond 15 days after receipt of an additional written notice from Owner to Surety demanding that Surety perform its obligations under this Bond, and Owner shall be entitled to enforce any remedy available to Owner. If Surety proceeds as provided in Paragraph 4.4, and Owner refuses the payment tendered or Surety has denied liability, in whole or in part, without further notice Owner shall be entitled to enforce any remedy available to Owner.

6. After Owner has terminated Contractor's right to complete the Contract, and if Surety elects to act under Paragraph 4.1, 4.2, or 4.3 above, then the responsibilities of Surety to Owner shall not be greater than those of Contractor under the Contract, and the responsibilities of Owner to Surety shall not be greater than those of Owner under the Contract. To a limit of the amount of this Bond, but subject to

commitment by Owner of the Balance of the Contract Price to mitigation of costs and damages on the Contract, Surety is obligated without duplication for:

6.1. The responsibilities of Contractor for correction of defective Work and completion of the Contract;

6.2. Additional legal, design professional, and delay costs resulting from Contractor's Default, and resulting from the actions or failure to act of Surety under Paragraph 4; and

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

7. Surety shall not be liable to Owner or others for obligations of Contractor that are unrelated to the 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 Owner or its heirs, executors, administrators, or successors.

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

9. 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 Contractor Default or within two years after Contractor ceased working or within two years after 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 period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

10. Notice to Surety, Owner, or Contractor shall be mailed or delivered to the address shown on the signature page.

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

12. Definitions.

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

12.2. Contract: The agreement between Owner and Contractor identified on the signature page, including all Contract Documents and changes thereto.

12.3. Contractor Default: Failure of Contractor, which has neither been remedied nor waived, to perform or otherwise to comply with the terms of the Contract.

12.4. Owner Default: Failure of Owner, which has neither been remedied nor waived, to pay Contractor as required by the Contract or to perform and complete or comply with the other terms thereof.

FOR INFORMATION ONLY – Name, Address and Telephone
Surety Agency or Broker
Owner's Representative (engineer or other party)

END OF SECTION

PAYMENT BOND FORM

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

CONTRACTOR
(Name and Address):

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

OWNER (Name and Address):

Natomas Mutual Water Company
2601 West Elkhorn Boulevard
Rio Linda, CA 95673

CONTRACT

Date:
Amount:
Description (Name and Location):

BOND

Bond Number:
Date (Not earlier than Contract Date):
Amount:
Modifications to this Bond Form:

Surety and Contractor, intending to be legally bound hereby, subject to the terms printed on the reverse side hereof, do each cause this Payment Bond to be duly executed on its behalf by its authorized officer, agent, or representative.

CONTRACTOR AS PRINCIPAL

Company:

Signature: _____(Seal)
Name and Title

SURETY

_____(Seal)
Surety's Name and Corporate Seal

By: _____
Signature and Title

(Attach Power of Attorney)

(Space is provided below for signatures of additional parties, if required.)

Attest: _____
Signature and Title

CONTRACTOR AS PRINCIPAL

Company:

Signature: _____(Seal)
Name and Title

SURETY

_____(Seal)
Surety's Name and Corporate Seal

By: _____
Signature and Title

(Attach Power of Attorney)

Attest: _____
Signature and Title

1. Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to Owner to pay for labor, materials, and equipment furnished by Claimants for use in the performance of the Contract, which is incorporated herein by reference.

2. With respect to Owner, this obligation shall be null and void if Contractor:

2.1. Promptly makes payment, directly or indirectly, for all sums due Claimants, and

2.2. Defends, indemnifies, and holds harmless Owner from all claims, demands, liens, or suits alleging non-payment by Contractor by any person or entity who furnished labor, materials, or equipment for use in the performance of the Contract, provided Owner has promptly notified Contractor and Surety (at the addresses described in Paragraph 12) of any claims, demands, liens, or suits and tendered defense of such claims, demands, liens, or suits to Contractor and Surety, and provided there is no Owner Default.

3. With respect to Claimants, this obligation shall be null and void if Contractor promptly makes payment, directly or indirectly, for all sums due.

4. Surety shall have no obligation to Claimants under this Bond until:

4.1. Claimants who are employed by or have a direct contract with Contractor have given notice to Surety (at the addresses described in Paragraph 12) and sent a copy, or notice thereof, to Owner, stating that a claim is being made under this Bond and, with substantial accuracy, the amount of the claim.

4.2. Claimants who do not have a direct contract with Contractor:

1. Have furnished written notice to Contractor and sent a copy, or notice thereof, to Owner, within 90 days after having last performed labor or last furnished materials or equipment included in the claim stating, with substantial accuracy, the amount of the claim and the name of the party to whom the materials or equipment were furnished or supplied, or for whom the labor was done or performed; and

2. Have either received a rejection in whole or in part from Contractor, or not received within 30 days of furnishing the above notice any communication from Contractor by which Contractor had indicated the claim will be paid directly or indirectly; and

3. Not having been paid within the above 30 days, have sent a written notice to Surety and sent a copy, or notice thereof, to Owner, stating that a claim is being made under this Bond and enclosing a copy of the previous written notice furnished to Contractor.

5. If a notice by a Claimant required by Paragraph 4 is provided by Owner to Contractor or to Surety, that is sufficient compliance.

6. Reserved.

7. Surety's total obligation shall not exceed the amount of this Bond, and the amount of this Bond shall be credited for any payments made in good faith by Surety.

8. Amounts owed by Owner to Contractor under the Contract shall be used for the performance of the Contract and to satisfy claims, if any, under any performance bond. By Contractor furnishing and Owner accepting this Bond, they agree that all funds earned by Contractor in the performance of the Contract are dedicated to satisfy obligations of Contractor and Surety under this Bond, subject to Owner's priority to use the funds for the completion of the Work.

9. Surety shall not be liable to Owner, Claimants, or others for obligations of Contractor that are unrelated to the Contract. Owner shall not be liable for payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligations to make payments to, give notices on behalf of, or otherwise have obligations to Claimants under this Bond.

10. Surety hereby waives notice of any change, including changes of time, to the Contract or to

related Subcontracts, purchase orders and other obligations.

11. No suit or action shall be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the location in which the Work or part of the Work is located or after the expiration of one year from the date (1) on which the Claimant gave the notice required by Paragraph 4.1 or Paragraph 4.2.3, 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.

12. Notice to Surety, Owner, or Contractor shall be mailed or delivered to the addresses shown on the signature page. Actual receipt of notice by Surety, Owner, or Contractor, however accomplished, shall be sufficient compliance as of the date received at the address shown on the signature page.

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

14. Upon request of any person or entity appearing to be a potential beneficiary of this Bond, Contractor shall promptly furnish a copy of this Bond or shall permit a copy to be made.

15. Definitions:

15.1. Claimant: An individual or entity having a direct contract with Contractor, or with a first-tier subcontractor of Contractor, to furnish labor, materials, or equipment for use in the performance of the Contract. The intent of this Bond shall be to include without limitation in the terms “labor, materials or equipment” that part of water, gas, power, light, heat, oil, gasoline, telephone service, or rental equipment used in the Contract, architectural and engineering services required for performance of the Work of Contractor and 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.

15.2. Contract: The agreement between Owner and Contractor identified on the signature page, including all Contract Documents and changes thereto.

15.3. Owner Default: Failure of Owner, which has neither been remedied nor waived, to pay Contractor as required by the Contract or to perform and complete or comply with the other terms thereof.

FOR INFORMATION ONLY – Name, Address and Telephone
Surety Agency or Broker:
Owner’s Representative (engineer or other party):

END OF SECTION

STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

Prepared by

Issued and Published Jointly by

These General Conditions have been prepared for use with the Agreement Between Owner and Contractor for Construction Contract (EJCDC® C-520, Stipulated Sum, or C-525, Cost-Plus, 2013 Editions). Their provisions are interrelated and a change in one may necessitate a change in the other.

National Society of Professional Engineers
1420 King Street, Alexandria, VA 22314-2794
(703) 684-2882
www.nspe.org

American Council of Engineering Companies
1015 15th Street N.W., Washington, DC 20005
(202) 347-7474
www.acec.org

American Society of Civil Engineers
1801 Alexander Bell Drive, Reston, VA 20191-4400
(800) 548-2723
www.asce.org

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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 considered 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, expediters, 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.

SUPPLEMENTARY CONDITIONS

These Supplementary Conditions amend or supplement the Standard General Conditions of the Construction Contract as indicated below. 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.

SC-1.01. Renumber Paragraph 1.01.A.38 to 1.01.A.38.a, and add the following new paragraphs:

> 1.01.A.38.b. *Specialist*—The term Specialist refers to a person, partnership, firm, or corporation of established reputation (or if newly organized, whose personnel have previously established a reputation in the same field), which is regularly engaged in, and which maintains a regular force of workers skilled in either (as applicable) manufacturing or fabricating items required by the Contract Documents, or otherwise performing Work required by the Contract Documents. Where the Specifications require the installation by a Specialist, that term shall also be deemed to mean either the manufacturer of the item, a person, partnership, firm, or corporation licensed by the manufacturer, or a person, partnership, firm, or corporation who will perform the Work under the manufacturer's direct supervision.
>
> 1.01.A.38.c. *Standard Specifications*—Wherever in these Contract Documents reference is made to the Standard Specifications, said reference shall be understood as referring to the technical portions only of the California Department of Transportation (Caltrans), Standard Specifications, 2018 which applicable parts are incorporated herein and made a part of these Documents by specific reference thereto. If requirements contained in the Standard Specifications are modified by or are in conflict with supplemental information in these Contract Documents, the requirements of these Contract Documents shall prevail.

SC-1.01. Add the following language at the end of Paragraph 1.01.A.40:

> Substantial Completion is further defined as (i) that degree of completion of the Project's operating facilities or systems sufficient to provide Owner the full time, uninterrupted, and continuous beneficial operation of the Work; and (ii) required functional, performance and acceptance, or startup testing has been successfully

demonstrated for components, devices, equipment, and instrumentation and control to the satisfaction of Engineer in accordance with the requirements of the Specifications.

SC-2.02. Delete Paragraph 2.02.A. in its entirety and insert the following new paragraph in its place:

2.02.A. Owner shall furnish to Contractor four copies of conformed Contract Documents incorporating and integrating all Addenda and any amendments negotiated prior to the Effective Date of the Contract (including one fully executed counterpart of the Agreement) and one copy in electronic portable document format (PDF). Additional printed copies of the conformed Contract Documents will be furnished upon request at the cost of reproduction.

SC-3.01. Add the following new paragraph immediately after Paragraph 3.01.E:

3.01.F. Sections of Division 01, General Requirements, govern the execution of the Work of all sections of the Specifications.

SC-4.01. Delete the third sentence of Paragraph 4.01.A in its entirety.

SC-5.02. Add the following language to the end of Paragraph 5.02.A.1:

Contractor shall not enter upon nor use property not under Owner control until appropriate easements have been executed and a copy is on file at the Site.

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

5.03.C. The following reports of explorations and tests of subsurface conditions at or adjacent to the Site are known to Owner:

5.03.C.1. Report dated February 2024 prepared by Jacobs Engineering Group Inc., 2525 Airpark Drive, Redding, CA, 96001 entitled Geotechnical Data Report – Elkhorn Pumping Plant Replacement consisting of 96 pages. The Technical Data contained in such report upon whose accuracy Contractor may rely are soil borings, cone penetrometer test soundings, and test results.

5.03.D. 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:

5.03.D.1. Drawing dated February 25, 2010 prepared by PSOMAS, 1075 Creekside Ridge Drive, Suite 200, Roseville, CA, 95678, entitled Elkhorn Pumping Plant SREL-2 Detail Survey consisting of 1 sheet numbered 1 to 1, inclusive. None of the contents of such drawings is Technical Data on whose accuracy Contractor may rely.

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

5.03.F. Information regarding historic and current river conditions near the Site can be found at https://waterdata.usgs.gov (Site identification number: 11425500).

SC-5.06. Delete Paragraph 5.06.A and Paragraph 5.06.B in their entirety and insert the following in their place:

5.06.A. No reports or drawings related to Hazardous Environmental Conditions are known to Owner.

5.06.B. Existing pipe, equipment, structural components, and piles to be demolished may contain incidental amounts of potentially hazardous coatings and materials, and are within the scope of the Work for which Contractor shall be responsible.

SC-6.01. Delete Paragraph 6.01.A in its entirety and insert the following in its place:

SC-6.01.A. Contractor shall furnish separate performance and payment bonds executed by admitted surety insurer and subject to approval of Owner. Performance bond shall be in amount not less than 100 percent of the Contract amount and payment bond in amount not less than 100 percent as security for the faithful performance and payment of all Contractor's obligations under the Contract Documents. These bonds shall adhere to, at a minimum, the provisions included in the bond forms as made a part of the Contract, and shall remain in effect at least until one year after the date when final payment becomes due, except as provided otherwise by Laws or Regulations or by the Contract Documents.

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

6.03.A.5. 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:

6.03.A.5.a. Workers' Compensation and related coverages under Paragraph 6.03.A.1 and Paragraph 6.03.A.3 of the General Conditions:

6.03.A.5.a.1. State: Statutory.

6.03.A.5.a.2. Applicable Federal (e.g., Longshoreman's): Statutory.

6.03.A.5.a.3. Employer's Liability: $1,000,000 per accident.

6.03.A.5.a.4. Workers Compensation Policy shall contain a United States Longshoreman's and Harbor Workers Act endorsement and, when appropriate, a Maritime Employer's Liability (Jones Act) endorsement with a minimum amount of $1,000,000.

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

6.03.C.9. Contractor's General Liability under Paragraph 6.03.B. and Paragraph 6.03.C of the General Conditions:

6.03.C.9.a. General Aggregate	$2,000,000
6.03.C.9.b. Products - Completed Operations Aggregate	$2,000,000
6.03.C.9.c. Personal and Advertising Injury (per person/Organization)	$1,000,000
6.0.3.C.9.d. Each Occurrence (Bodily Injury and Property Damage)	$1,000,000
6.0.3.C.9.e. Fire Damages (any one fire)	$100,000
6.0.3.C.9.f. Medical Expenses (any one person)	$10,000

6.03.C.9.e. Property Damage liability insurance will provide Explosion, Collapse, and Underground coverages where applicable.

SC-6.03. Add the following new paragraph immediately following Paragraph 6.03.D:

6.03.D.1. Contractor's Automobile Liability

6.03.D.1.a. Bodily Injury:

Each Person	$1,000,000
Each Accident	$2,000,000

6.03.D.1.b. Property Damage:

Each Accident	$1,000,000
6.03.D.1.a. Combined Single Limit of	$1,000,000

SC-6.03. Add the following new paragraph immediately following Paragraph 6.03.E:

6.03.E.1. Excess or Umbrella Liability:

a) General Aggregate	$10,000,000
b) Each Occurrence	$10,000,000

SC-6.03. Add the following new paragraph immediately following Paragraph 6.03.F:

6.03.F.1. Pollution Liability:

a) Each Occurrence	$1,000,000
b) General Aggregate	$2,000,000

☐ If box is checked, Contractor is not required to provide Contractor's Pollution Liability insurance under this Contract.

SC-6.03. Add the following language at the end of Paragraph 6.03.G:

SC-6.03.G. Contractor shall cause the Sacramento Area Flood Control Agency, a joint powers authority formed pursuant to the laws of the State of California ("SAFCA") as well as SAFCA's officers, agents and employees, to be named as additional insureds (in addition to, and not in lieu of, all of those other individuals or entities required to be added, identified or named as additional insureds under this Paragraph 6.03.G., in the Supplementary Conditions or in any of the other Contract Documents) to each insurance policy required to be obtained by Contractor under any of the Contract Documents, including, without limitation of the foregoing, as additional insureds to Contractor's commercial general liability, automobile liability, umbrella or excess, pollution liability, and builder's risk policies of insurance.

6.03.G.1. Include the following parties or entities as additional insured:

6.03.G.1.a. Natomas Mutual Water Company, its trustees, officers, employees, and volunteers at 2601 West Elkhorn, Rio Linda, CA 95673,

6.03.G.1.b. Jacobs Engineering Group, Inc. at 2525 Airpark Drive, Redding, CA 96001.

6.03.G.1.c. The State of California, its officers, agents, employees, and servants.

SC-6.03. Add the following new paragraph immediately following Paragraph 6.03.H:

6.03.H.1 Contractor's Professional Liability:

a) Each Claim	$1,000,000
b) Annual Aggregate	$2,000,000

6.03.K. Provide the following additional types of insurance:

6.03.K.1. Where Contractor's operations involve the use of owned or non-owned watercraft, provide coverage for bodily injury and property damage arising out of ownership, maintenance, use, or entrustment as follows:

a) General Aggregate	$1,000,000
b) Each Occurrence (Bodily Injury and Property Damage)	$1,000,000

SC-6.03.K.2., Add the following new article:

6.03.K.2 Provide coverage for business interruption arising out of Contractor's failure to achieve Substantial Completion by the time specified.

a) Each Claim	$1,000,000

SC-6.05. Insert the following paragraph after 6.05.A.1:

6.05.A.1.a. In addition to the individuals and entities specified in Paragraph 6.05.A.1, include as insureds, the following:

6.05.A.1.a.1) Jacobs Engineering Group, Inc.

6.05.A.1.a.2) The State of California, its officers, agents, employees, and servants.

6.05.A.2.a. In addition to the above listed perils, the property insurance shall include flood, landslide, mudslide, mechanical or electrical breakdown/failure, loss of occupancy or business interruption cost, and damage to electrical apparatus from electrical current.

6.05.A.2.b. be maintained in effect until Substantial Completion is made unless otherwise agreed to in writing by Owner, Contractor, and Engineer with 30 days written notice to each other loss payee to whom a certificate of insurance has been issued; and

6.05.A.2.c. Comply with the requirements of Paragraph 6.05.A of the General Conditions.

SC-6.05. Add the following new paragraph immediately after Paragraph 6.05.A.13:

6.05.A.14. Exclude coverage for damages which have been solely caused by “acts of God”, in excess of 5 percent of the Contract Price, as such acts are defined in Section 7105 of the California Public Contract Code.

SC-6.05. Add the following language as Paragraph 6.05.A.15:

6.05.A.15. Property insurance furnished under this Contract shall have deductibles no greater than $10,000 for direct physical loss in any one occurrence for sublimits except for earthquake, which shall have a maximum deductible of $50,000.

SC-6.06. Add the following new paragraph at the end of Paragraph 6.06.A:

6.06.A. None of the above waivers shall extend to the rights of the builders risk insurer for losses and damages arising out of the rendering or the failure to render any professional services against the Engineer or its consultants, or their officers, directors, members, partners, employees, agents, consultants, or subcontractors.

SC-7.02. Add the following new paragraph immediately after Paragraph 7.02.B:

7.02.B.1. Eight hours’ labor constitutes a legal day’s work or 40 hours per week. Hours worked beyond a legal day’s work shall be paid at not less than 1.5 times the rate of pay. Contractor or Subcontractor that violates laws regarding a legal day’s work shall be penalized in accordance with LC 1813.

SC-7.02. Add the following language to the end of Paragraph 7.02.B:

7.02.B.1. Contractor and Subcontractor regular working hours consist of 8 working hours within an 11-hour period between 7:00 a.m. and 6:00 p.m., excluding Saturdays, Sundays and holidays. Overtime work is work in excess of 40 hours per week. Holidays include Memorial Day, July 4th, Labor Day, Thanksgiving, the Day after Thanksgiving, and the period from December 25th through January 1st.

SC-7.02. Add the following new paragraph immediately after Paragraph 7.02.B:

7.02.C. Contractor shall be responsible for the cost of any overtime pay or other expense incurred by the Owner for Engineer’s services (including those of the Resident Project Representative, if any), Owner’s representative, and construction observation services, occasioned by the performance of Work on Saturday, Sunday, any legal holiday, or as overtime on any regular work day. If Contractor is responsible but does not pay, or if the parties are unable to agree as to the amount

owed, then Owner may impose a reasonable set-off against payments due under Article 15.

SC-7.05. Add the following language at the end of Paragraph 7.05.D:

Reimbursement rates for Engineer or their officers, directors, members, partners, employees, agents, and other consultants and subcontractors for evaluation of proposed substitutes shall be on the basis established in Paragraph 15.01.E. of these Supplementary Conditions.

SC-7.06. Add the following language at the end of Paragraph 7.06.A:

Contractor shall perform a minimum of 60 percent of the onsite labor with its own employees.

SC-7.08. Add the following new paragraphs immediately after Paragraph 7.08.A:

7.08.B. Owner has obtained and paid for construction permits and licenses as described in Section 01 45 00, Permits.

7.08.C. Contractor shall examine the permits and conform to the requirements contained therein, including the purchase of additional bonds or insurance as specified therein, and such requirements are hereby made a part of these Contract Documents as fully and completely as though the same were set forth herein. Failure to examine the permit(s) will not relieve Contractor from compliance with the requirements stated therein. Within 30 days after the date of signing the Agreement, Contractor shall confer with an agent of the permitting agency so that insurance requirements and similar matters can be arranged prior to the time set for that portion of the Work.

7.08.D. Contractor shall obtain all permits for the Work that are not obtained by Owner. A partial listing of permits to be obtained by Contractor is included in Section 01 45 00, Permits. Said list is intended to describe the known overall project permits required to be obtained by Contractor for the Work, but does not include many permits which Contractor may be required to obtain to support execution of the Work and the means and methods selected to accomplish the Work. No guarantee is made that the listing of permits to be obtained by Contractor as presented in Section 01 45 00, Permits, is comprehensive or complete. Failure to list permits that must be obtained by Contractor does not relieve Contractor from the obligation to obtain and comply with all permits required for the Work that are not identified as obtained by Owner. The cost of obtaining all permits and complying with permit requirements and conditions is Contractor’s sole responsibility and shall be included in the Bid Price for the Work. No additional compensation or Contract Time will be provided for obtaining all permits and complying with all permit conditions as described herein.

7.08.E. Provide copies of all permits obtained by Contractor to Owner. Requirements and provisions of permits obtained by Contractor are hereby made a part of these Contract Documents as fully and completely as though the same were set forth herein.

SC-7.10. Add the following new paragraph(s) immediately after Paragraph 7.10.C:

7.10.D. While not intended to be inclusive of all Laws or Regulations for which Contractor may be responsible under Paragraph 7.10, the following Laws or Regulations are included as mandated by statute or for the convenience of Contractor:

7.10.D.1. Prevailing Wages: In accordance with the provisions of Section 1770 et. seq. of the California Labor Code, the general prevailing wage rates applicable to the Work have been determined by Director of Industrial Relations, State of California. Such determination is on file at the office of Owner, and a copy will be made available to any interested party on request. Prior to starting any Work on the Project, Contractor shall obtain copy of wage determination from Owner and post it on the Site.

7.10.D.2. Payroll Records: Section 1776 of the Labor Code enumerates certain requirements concerning Contractor's and Subcontractors' payroll records. This section stipulates that responsibility for compliance shall be fixed upon Contractor. Payroll records shall be maintained, be available for inspection and copies furnished in accordance with Section 1776, and in the event of noncompliance with the requirements, Contractor is subject to the penalties as described in Section 1776.

7.10.D.3. Apprentices: Contractor's attention is directed to Sections 1777.5 of the Labor Code concerning employment of apprentices by Contractor and its Subcontractors. Contractor shall comply with requirements of these sections and will be solely responsible for performing all Work under the Contract in compliance with Section 1777.5.

7.10.D.4. Debarred Subcontractor: Contractor shall not employ a Subcontractor that has been debarred due to violation of a state or federal labor code as covered in California Labor Code 1777.1 or 1777.7.

7.10.D.5. Family Support: In accordance with California Public Contract Code 7110 regarding children and family support obligations, Contractor shall be compliant with employee earnings and in providing name of employees to the New Hire Registry maintained by the Employment Development Department.

7.10.D.6. Pollution Control: In accordance with California Public Contract Code 10231, Contractor shall comply with air pollution control rules,

regulations, ordinances, and statutes which apply to work performed pursuant to the Contract.

SC-7.12. Add the following new paragraph(s) immediately following Paragraph 7.12.G:

7.12.H. Trench Safety: Pursuant to California Labor Code 6705:

7.12.H.1. When the Work involves excavation of trenches 5 feet or more in depth, Contractor shall prepare, submit, and receive from Owner acceptance of, a detailed trench excavation plan showing design of shoring, bracing, sloping, or other provisions to be made for worker protection from the hazards of caving ground during excavation.

7.12.H.2. If such plan varies from shoring system standards established by Construction Safety Orders, plan shall be prepared by registered civil or structural engineer in the State of California. Nothing herein shall be deemed to allow use of shoring, sloping, or protective system less effective than that required by Construction Safety Orders.

SC-7.18.D., Add the following new article:

SC-7.18.D. 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 the Sacramento Area Flood Control Agency, a joint powers authority formed pursuant to the laws of the State of California ("SAFCA") its governing board officers, agents and employees from and against any and all claims, costs, losses, liabilities and damages (including but not limited to all fees, expenses 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, liability 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. The limitations of liability and other terms set forth under Paragraphs 7.18.B and 7.18.C shall apply with equal force and effect with respect to Contractor's indemnification obligations under this Section 7.18.D as they do with respect to Contractor's obligations under Paragraph 7.18.A. Additionally, Contractor's indemnification obligations under 7.18.A and 7.18.D, respectively, shall not be limited by the types and amounts of insurance or

self-insurance maintained by SAFCA, Owner, Contractor, any Subcontractor, any Supplier, Engineer, any additional insured, or any other person or entity.

SC-10.03. Add the following new paragraphs immediately after Paragraph 10.03.A:

10.03.B. Resident Project Representative (RPR) will be furnished by Engineer. The responsibilities, authority, and limitations of the RPR are limited to those of Engineer in accordance with Paragraph 10.08 and as set forth elsewhere in the Contract Documents and are further limited and described below.

10.03.C. Responsibilities and Authority:

10.03.C.1. Schedules: Review and monitor Progress Schedule, Schedule of Submittals, and Schedule of Values prepared by Contractor and consult with Engineer concerning acceptability.

10.03.C.2. Conferences and Meetings: Conduct or attend meetings with Contractor, such as preconstruction conferences, progress meetings, Work conferences and other Project related meetings.

10.03.C.3. Liaison: (i) Serve as Engineer's liaison with Contractor, working principally through Contractor's authorized representative, and assist in understanding the intent of the Contract Documents; (ii) assist Engineer in serving as Owner's liaison with Contractor when Contractor's operations affect Owner's onsite operations; (iii) assist in obtaining from Owner additional details or information when required for proper execution of the Work.

10.03.C.4. Interpretation of Contract Documents: Inform Engineer when clarifications and interpretations of the Contract Documents are needed and transmit to Contractor clarifications and interpretations as issued by Engineer.

10.03.C.5. Submittals: Receive submittals that are furnished at the Site by Contractor, and notify Engineer of availability for examination. Advise Engineer and Contractor of the commencement of any Work or arrival of materials and equipment at Site, when recognized, requiring a Shop Drawing or Sample if the submittal has not been approved by Engineer.

10.03.C.6. Modifications: Consider and evaluate Contractor's suggestions for modifications in Drawings or Specifications and provide recommendations to Engineer; transmit to Contractor, in writing decisions as issued by Engineer.

10.03.C.7. Review of Work and Rejection of Defective Work: (i) Conduct onsite observations of the Work in progress to assist Engineer in determining if the Work is, in general, proceeding in accordance with the Contract

Documents; (ii) inform Engineer and Contractor whenever RPR believes that any Work is defective; (iii) advise Engineer whenever RPR believes that any Work will not produce a completed Project that conforms generally to the Contract Documents or will imperil the integrity of the design concept of the completed Project as a functioning whole as indicated in the Contract Documents, or has been damaged or does not meet the requirements of any inspection test, or approval required to be made; and advise Engineer of that part of the Work in progress that RPR believes should be corrected or rejected or uncovered for observation, or requires special testing, inspection, or approval.

10.03.C.8. Inspections, Tests, and System Startups: (i) Verify tests, equipment and systems startups and operating and maintenance training are conducted in the presence of appropriate personnel, and that Contractor maintains adequate records thereof; (ii) observe, record, and report to Engineer appropriate details relative to the test procedures and system startups; and (iii) accompany visiting inspectors representing public or other agencies having jurisdiction over the Project, record the results of these inspections, and report to Engineer.

10.03.C.9. Records: (i) Maintain records for use in preparing Project documentation; (ii) keep a diary or log book recording pertinent Site conditions, activities, decisions and events; (iii) record names, addresses, fax numbers, e-mail addresses, web site locations, and telephone numbers of Contractors, Subcontractors, and major Suppliers of materials and equipment.

10.03.C.10. Reports: (i) Furnish Engineer periodic reports of progress of the Work and of Contractor’s compliance with the Progress Schedule and Schedule of Submittals; (ii) immediately notify Engineer of the occurrence of Site accidents, emergencies, acts of God endangering the Work, damage to property by fire or other causes, or the discovery of any Hazardous Environmental Condition; and (iii) assist Engineer in drafting proposed Change Orders, Work Change Directives, and Field Orders; obtain backup material from Contractor as appropriate.

10.03.C.11. Payment Requests: Review Applications for Payment with Contractor for compliance with the established procedure for their submission and forward with recommendations to Engineer, noting particularly the relationship of the payment requested to the Schedule of Values, Work completed, and materials and equipment delivered at the Site but not incorporated in the Work.

10.03.C.12. Certificates, Operation and Maintenance Manuals: During the course of the Work, verify materials and equipment certificates and operation

and maintenance manuals and other data required by Specifications to be assembled and furnished by Contractor are applicable to the items actually installed and in accordance with the Contract Documents, and have these documents been delivered to Engineer for review and forwarding to Owner prior to payment for that part of the Work.

10.03.C.13. Completion: (i) Participate in a Substantial Completion inspection; assist in determination of Substantial Completion and the preparation of lists of items to be completed or corrected; (ii) Participate in a final inspection in the company of Engineer, Owner, and Contractor and prepare a final list of items to be completed and deficiencies to be remedied; and (iii) observe whether items on final list have been completed or corrected, and make recommendations to Engineer concerning acceptance.

10.03.D. Limitations of Authority: Resident Project Representative will not:

10.03.D.1. have authority to authorize a deviation from Contract Documents or substitution of materials or equipment, unless authorized by Engineer; or

10.03.D.2. exceed the limitations of Engineer’s authority as set forth in Contract Documents; or

10.03.D.3. undertake any of the responsibilities of Contractor, Subcontractors, Suppliers, or Contractor’s authorized representative; or

10.03.D.4. advise on, issue directions relative to, or assume control over an aspect of the means, methods, techniques, sequences, or procedures of Contractor’s work unless such advice or directions are specifically required by the Contract Documents; or

10.03.D.5. advise on, issue directions regarding, or assume control over safety practices, precautions, and programs in connection with the activities or operations of Owner or Contractor; or

10.03.D.6. participate in specialized field or laboratory tests or inspections conducted offsite by others, except as specifically authorized by Engineer; or

10.03.D.7. accept Shop Drawings or Samples from anyone other than Contractor; or

10.03.D.8. authorize Owner to occupy the Project in whole or in part.

SC-10.08. Add the following new paragraph immediately after Paragraph 10.08.E:

10.08.F. Contractors, Subcontractors, Suppliers, and others on the Project, or their sureties, shall maintain no direct action against Engineer, its officers, employees, affiliated corporations, and subcontractors, for any Claim arising out of, in connection with, or resulting from the engineering services performed. Only the Owner will be the beneficiary of any undertaking by Engineer.

Article 12.01.F. Delete the last sentence in Paragraph 12.01.F in its entirety and add the following in its place:

SC-12.01.F. A denial of a Claim (whether in whole or in part) shall be final and binding unless: (i) within 30 days of the denial the party aggrieved by the denial sends written notice to the other party of its election to proceed with submitting the denial to dispute resolution pursuant to Article 17 (as amended by SC-17.01 and SC-17.02, as applicable); and (ii) the party aggrieved by the denial files the claim, or demand for arbitration (as applicable) in accordance with the terms of and within the time frames provided by SC-17.01 and SC- 17.02, as applicable.

SC-13.01. Delete Paragraph 13.01.B.5.c in its entirety and insert the following in its place:

13.01.B.5.c. Construction Equipment and Machinery:

13.01.B.5.c.(1) Rentals of construction equipment and machinery, and the parts thereof 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. 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.

13.01.B.5.c.(2) Costs for equipment and machinery owned by Contractor will be paid at a rate shown for such equipment in the current Caltrans Labor Surcharge and Equipment Rental Rate Book. An hourly rate will be computed by dividing the monthly rates by 176. These computed rates will include all operating costs. Costs will include the time the equipment or machinery is in use on the changed Work and the costs of transportation, loading, unloading, assembly, dismantling, and removal when directly attributable to the changed Work. The cost of such equipment or machinery, or parts thereof, shall cease to accrue when the use thereof is no longer necessary for the changed Work. Equipment or machinery with a value of less than $1,000 will be considered small tools.

SC-13.03. Add the following language after Paragraph 13.03.E.3:

13.03.E.4. The unit price of an item of Unit Price Work shall be subject to re-evaluation and adjustment under the following conditions:

13.03.E.4.a. if the Bid price of a particular item of Unit Price Work amounts to 5 percent or more of the Contract Price and the variation in the quantity of that particular item of Unit Price Work performed by Contractor differs by more than 15 percent from the estimated quantity of such item indicated in the Agreement; and

13.03.E.4.b. if there is no corresponding adjustment with respect to any other item of Work; and

13.03.E.4.c. if Contractor believes that Contractor has incurred additional expense as a result thereof or if Owner believes the quantity variation entitles Owner to an adjustment in the unit price, either Owner or Contractor may make a Claim for an adjustment in the Contract Price in accordance with Article 10 if the parties are unable to agree as to the effect of any such variation in the quantity of Unit Price Work performed.

SC-14.02. Delete Paragraph 14.02.B in its entirety and insert the following in its place:

14.02.B. Contractor shall retain an independent testing laboratory or testing agency and shall be responsible for arranging and shall pay for specified tests, inspections, and approvals required for Owner’s and Engineer’s acceptance of the Work at the Site except:

14.02.B.1. costs incurred in connection with tests or inspections pursuant to Paragraph 14.02.C shall be paid for as provided in said paragraph; and

14.02.B.2. as otherwise specifically provided in the Contract Documents.

SC-14.02. Add the following language at the end of Paragraph 14.02.D:

Tests required by Contract Documents to be performed by Contractor that require test certificates be submitted to Owner or Engineer for acceptance shall be made by an independent testing laboratory or agency licensed or certified in accordance with Laws and Regulations and applicable state and local statutes. In the event state license or certification is not required, testing laboratories or agencies shall meet the following applicable requirements:

14.02.D.6. Basic requirements of ASTM E329, “Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection” as applicable.

14.02.D.7. Calibrate testing equipment at reasonable intervals by devices of accuracy, traceable to the National Institute of Standards and Technology or accepted values of natural physical constants.

SC-15.01. Delete Paragraph 15.01.D.1 in its entirety and insert the following in its place:

15.01.D.1. Contractor acknowledges that the Project will be paid out of grant funds from agencies of the State of California and the Federal Bureau of Reclamation. Upon approval of each Application for Payment by Engineer, Owner will promptly submit the approved Application for Payment to the funding agencies. Funds are expected to be disbursed within 45 to 60 days of the submittal of the Application for Payment to the funding agencies, but it may take as long as 90 days. Recognizing that the timely disbursement of grant funding is outside the control of Owner once it is submitted to the funding agencies, Contractor waives any rights it may have under California Civil Code §3260.1 relating to progress payments.

SC-15.06. Delete Paragraph 15.06.D in its entirety and insert the following in its place:

15.06.D. *Payment Becomes Due*: Sixty days after presentation to Owner of the final Application for Payment and accompanying documentation, the amount recommended by Engineer less any sum Owner is entitled to set off against Engineer's recommendation, including but not limited to liquidated damages, will become due and, will be paid by Owner to Contractor.

15.06.D.1. In accordance with California Public Contract Code 7107, if payment of retainage is not made within time period specified, improperly withheld amount shall bear interest at the rate of 2 percent per month.

SC-17.01. Delete Article 17.01 in its entirety and insert the following in its place:

17.01.A. Section 20104 of the California Public Contract Code shall apply to all public works claims of $375,000 or less which arise between Contractor and Owner. Claims shall be filed in writing on or before date of final payment and include documents to substantiate Claim. Procedures to be followed by parties filing Claim are set forth in Section 20104.2 and Section 20104.4 of the California Public Contract Code.

SC-17.02. Add the following new paragraph immediately after Paragraph 17.01.

SC-17.02 Arbitration

SC-17.02.A. All matters subject to final resolution under this Article will be decided by arbitration in accordance with the rules of American Arbitration Association, subject to the conditions and limitations of this paragraph. This agreement to arbitrate and any other agreement or consent to arbitrate entered

into will be specifically enforceable under the prevailing law of any court having jurisdiction.

SC-17.02.B. The demand for arbitration will be filed in writing with the other party to the Contract and with the selected arbitrator or arbitration provider, and a copy will be sent to Engineer for information. The demand for arbitration will be made within the specific time required in this Article, or if no specified time is applicable within a reasonable time after the matter in question has arisen, and in no event shall any such demand be made after the date when institution of legal or equitable proceedings based on such matter in question would be barred by the applicable statute of limitations. The demand for arbitration should include specific reference to Paragraph SC-17.02.D below.

SC-17.02.C. No arbitration arising out of or relating to the Contract shall include by consolidation, joinder, or in any other manner any other individual or entity (including Engineer, and Engineer's consultants and the officers, directors, partners, agents, employees or consultants of any of them) who is not a party to this Contract unless:

SC-17.02.C.1. the inclusion of such other individual or entity is necessary if complete relief is to be afforded among those who are already parties to the arbitration; and

SC-17.02.C.2. such other individual or entity is substantially involved in a question of law or fact which is common to those who are already parties to the arbitration and which will arise in such proceedings.

SC-17.02.D. The award rendered by the arbitrator(s) shall be consistent with the agreement of the parties, in writing, and include a concise breakdown of the award, and a written explanation of the award specifically citing the Contract provisions deemed applicable and relied on in making the award.

SC-17.02.E. The award will be final. Judgment may be entered upon it in any court having jurisdiction thereof, and it will not be subject to modification or appeal, subject to provisions of the Laws and Regulations relating to vacating or modifying an arbitral award.

SC-17.02.F. The fees and expenses of the arbitrators and any arbitration service shall be shared equally by Owner and Contractor.

17.02.F. The fees and expenses of the arbitrators and any arbitration service shall be shared equally by Owner and Contractor.

END OF SECTION

PART 3

SPECIFICATIONS

SECTION 01 11 00
SUMMARY OF WORK

PART 1 GENERAL

1.01 WORK COVERED BY CONTRACT DOCUMENTS

A. The completed Work will provide Owner with the following:

1. A replacement 60 cfs fish screen and pumping plant facility, located on the Sacramento River, adjacent to Garden Highway. Project components include:
   a. Demolition of the existing pumping plant.
   b. Pile supported structure with concrete deck.
   c. Access road from Garden Highway to the pumping plant structure.
   d. Log boom and deflector boom located in the Sacramento River.
   e. Two fish screens with integral brush cleaning system and retrieval system.
   f. Two 200-hp mixed-flow irrigation pumps with adjustable frequency drives.
   g. Two welded steel pipelines between pumps and a junction box on the river side of Garden Highway.
   h. Electrical, controls, and lighting.
   i. Miscellaneous auxiliary equipment and site improvements.

1.02 WORK NOT COVERED BY CONTRACT DOCUMENTS

A. Replacement of pumping plant discharge pipelines through Garden Highway and the Sacramento River Levee.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 26 00
CONTRACT MODIFICATION PROCEDURES

PART 1 GENERAL

1.01 PROPOSAL REQUESTS

A. Owner may, in anticipation of ordering an addition, deletion, or revision to the Work, request Contractor to prepare a detailed proposal of cost and times to perform contemplated change.

B. Proposal request will include reference number for tracking purposes and detailed description of and reason for proposed change, and such additional information as appropriate and as may be required for Contractor to accurately estimate cost and time impact on Project.

C. Proposal request is for information only; Contractor is neither authorized to execute proposed change nor to stop Work in progress as result of such request.

D. Contractor's written proposal shall:

1. Be transmitted to Engineer promptly, but not later than 14 days after Contractor's receipt of Owner's written request.
2. Remain firm for a maximum period of 45 days after receipt by Engineer.
3. Detail proposed cost of the Work as defined in Article 11 of the General Conditions.
4. Include proposed adjustment of Contract Time associated with the proposed change. Note that a description of the anticipated change to critical path activities must accompany a request for adjustment of Contract Time.

E. Owner's request for proposal or Contractor's failure to submit such proposal within the required time period will not justify a Claim for an adjustment in Contract Price or Contract Times (or Milestones).

1.02 CLAIMS

A. Include, at a minimum:

1. Specific references including (i) Drawing numbers, (ii) Specification section and article/paragraph number, and (iii) Submittal type, Submittal

number, date reviewed, Engineer's comment, as applicable, with appropriate attachments.

2. Stipulated facts and pertinent documents, including photographs and statements.
3. Interpretations relied upon.
4. Description of (i) nature and extent of Claim, (ii) who or what caused the situation, (iii) impact to the Work and work of others, and (iv) discussion of claimant's justification for requesting a change to price or times or both.
5. Estimated adjustment in price claimant believes it is entitled to with full documentation and justification.
6. Requested Change in Contract Times: Include at least (i) Progress Schedule documentation showing logic diagram for request, (ii) documentation that float times available for Work have been used, and (iii) revised activity logic with durations including sub-network logic revisions, duration changes, and other interrelated schedule impacts, as appropriate.
7. Documentation as may be necessary as set forth below for Work Change Directive, and as Engineer may otherwise require.

1.03 WORK CHANGE DIRECTIVES

A. Procedures:

1. Engineer will:
   a. Initiate, including a description of the Work involved and any attachments.
   b. Affix signature, demonstrating Engineer's recommendation.
   c. Obtain authorization from Owner.
   d. Transmit to Contractor.
2. Upon completion of Work covered by the Work Change Directive or when final Contract Times and Contract Price are determined, Contractor shall submit documentation for inclusion in a Change Order.
3. Contractor's documentation shall include but not be limited to:
   a. Appropriately detailed records of Work performed to enable determination of value of the Work.
   b. Full information required to substantiate resulting change in Contract Times and Contract Price for Work. On request of Engineer, provide additional data necessary to support documentation.
   c. Support data for Work performed on a unit price or Cost of the Work basis with additional information such as:
      1) Dates Work was performed, and by whom.
      2) Time records, wage rates paid, and equipment rental rates.

3) Invoices and receipts for materials, equipment, and subcontracts, all similarly documented.

B. Effective Date of Work Change Directive: Date of signature by Owner, unless otherwise indicated thereon.

1.04 CHANGE ORDERS

A. Procedure:

1. Engineer will prepare proposed Change Order and transmit such with Engineer's written recommendation and request to Contractor for signature.
2. Contractor shall, upon receipt, either: (i) promptly sign, and return to Engineer for Owner's signature, or (ii) return unsigned with written justification for not executing Change Order.
3. Engineer will, upon receipt of Contractor signed copy, promptly forward Engineer's written recommendation and partially executed copy for Owner's signature, or if Contractor fails to execute the Change Order, Engineer will promptly so notify Owner and transmit Contractor's justification to Owner.
4. Upon receipt of Contractor-executed Change Order, Owner will promptly either:
   a. Execute Change Order and return to Engineer; or
   b. Return to Engineer unsigned copy with written justification for not executing Change Order.
5. Upon receipt of Owner-executed Change Order, Engineer will transmit executed Change Order to Contractor, or if Owner fails to execute the Change Order, Engineer will promptly so notify Contractor and transmit Owner's justification to Contractor.
6. Upon receipt of Owner-executed Change Order, Contractor shall:
   a. Perform Work covered by Change Order.
   b. Revise Schedule of Values to adjust Contract Price and submit with next Application for Payment.
   c. Revise Progress Schedule to reflect changes in Contract Times, if any, and to adjust times for other items of Work affected by change.
   d. Enter changes in Project record documents after completion of change related Work.

B. In signing a Change Order, Owner and Contractor acknowledge and agree that:

1. Stipulated compensation (Contract Price or Contract Times, or both) set forth includes payment for (i) the Cost of the Work covered by the Change Order, (ii) Contractor's fee for overhead and profit, (iii) interruption of Progress Schedule, (iv) delay and impact, including cumulative impact, on other Work under the Contract Documents, and (v) extended overheads.
2. Change Order constitutes full mutual accord and satisfaction for the change to the Work.
3. Unless otherwise stated in the Change Order, all requirements of the original Contract Documents apply to the Work covered by the Change Order.

1.05 COST OF THE WORK

A. In determining the supplemental costs allowed in Paragraph 13.01.B.5 of the General Conditions for rental equipment and machinery, the following will apply.

B. Rental of construction equipment and machinery and the parts thereof having a replacement value in excess of $1,000, whether owned by Contractor or rented or leased from others, shall meet the following requirements:

1. Full costs for leased equipment shall not exceed rates listed in the Caltrans Labor Surcharge and Equipment Rental Rate Book (Rate Book). The most recent published edition in effect at commencement of actual equipment use shall be used.
2. Rates shall apply to equipment in good working condition. Equipment not in good condition, or larger than required, may be rejected by Engineer or accepted at reduced rates.
3. Leased Equipment:
   a. For equipment leased or rented in arm's length transactions from outside vendors, maximum rates shall be determined by the following actual usage/Payment Category:
      1) Less than 8 hours: Hourly rate.
      2) 8 or more hours but less than 7 days: Daily rate.
      3) 7 or more days but less than 30 days: Weekly rate.
      4) 30 days or more: Monthly rate.
4. Arm's length rental and lease transactions are those in which the firm involved in the rental or lease of equipment is not associated with, owned by, have common management, directorship, facilities and/or stockholders with the firm renting the equipment.

5. Financial arrangements associated with rental and lease transactions that provide Contractor remuneration or discounts not visible to the Owner must be disclosed and integrated with charged rates.
6. Leased Equipment in Use: Actual equipment use time documented by Engineer shall be the basis that equipment was on and utilized at the Project Site. In addition to the leasing rate above, equipment operational costs shall be paid at the estimated hourly operating cost rate set forth in the Rate Book if not already included in the lease rate. Hours of operation shall be based upon actual equipment usage to the nearest quarter hour, as recorded by Engineer.
7. Leased Equipment, When Idle (Standby): Idle or standby equipment is equipment onsite or in transit to and from the Work Site and necessary to perform the Work under the modification, but not in actual use. Idle equipment time, as documented by Engineer, shall be paid at the leasing rate determined above, excluding operational costs.
8. Owned and Other Equipment in Use: Equipment rates for owned equipment or equipment provided in other than arm's length transaction shall not exceed the single shift total hourly costs rate developed in accordance with the Rate Book and as modified herein for multiple shifts. This total hourly rate will be paid for each hour the equipment actually performs work. Hours of operation shall be based upon actual equipment usage as recorded by Engineer. This rate shall represent payment in full for Contractor's direct costs.
9. Owned and Other Equipment, When Idle (Standby): Equipment necessary to be onsite to perform the Work on single shift operations, but not utilized, shall be paid for at the ownership hourly expense rate developed in accordance with the Rate Book, provided its presence and necessity onsite has been documented by Engineer. Payment for idle time of portions of a normal workday, in conjunction with original contract Work, will not be allowed. In no event shall idle time claimed in a day for a particular piece of equipment exceed the normal Work or shift schedule established for the Project. It is agreed that this rate shall represent payment in full for Contractor's direct costs. When Engineer determines that the equipment is not needed to continuously remain at the Work Site, payment will be limited to actual hours in use.
10. Owned and Other Equipment, Multiple Shifts: For multiple shift operations, the Rate Book single shift total hourly costs rate shall apply to the operating equipment during the first shift. For subsequent shifts, up to two in a 24-hour day, operating rate shall be the sum of the total hourly Rate Book operating cost and 60 percent of the Rate Book ownership and overhaul expense. Payment for idle or standby time for second and third shifts shall be 20 percent of the Rate Book ownership and overhaul expense.

11. When necessary to obtain owned equipment from sources beyond the Project limits, the actual cost to transfer equipment to the Site and return it to its original location will be allowed as an additional item of expense. Move-in and move-out allowances will not be made for equipment brought to the Project if the equipment is also used on original Contract or related Work.
12. If the move-out destination is not to the original location, payment for move-out will not exceed payment for move-in.
13. If move is made by common carrier, the allowance will be the amount paid for the freight. If equipment is hauled with Contractor's own forces, rental will be allowed for the hauling unit plus the hauling unit operator's wage. If equipment is transferred under its own power, the rental will be 75 percent of the appropriate total hourly costs for the equipment, without attachments, plus the equipment operator's wage.
14. Charges for time utilized in servicing equipment to ready it for use prior to moving and similar charges will not be allowed.
15. When a breakdown occurs on any piece of owned equipment, payment shall cease for that equipment and any other owned equipment idled by the breakdown.
16. If any part of the Work is shut down by Owner, standby time will be paid during nonoperating hours if diversion of equipment to other Work is not practicable. Engineer reserves the right to cease standby time payment when an extended shutdown is anticipated.
17. If a rate has not been established in the Rate Book for owned equipment, Contractor may:
    a. If approved by Engineer, use the rate of the most similar model found, considering such characteristics as manufacturer, capacity, horsepower, age, and fuel type, or
    b. Request Equipment Watch to furnish a written response for a rate on the equipment, which shall be presented to Engineer for approval; or
    c. Request Engineer to establish a rate.

1.06 FIELD ORDER

A. Engineer will issue Field Orders and transmit to Contractor.

B. Effective date of the Field Order shall be the date of signature by Engineer, unless otherwise indicated thereon.

C. Contractor shall acknowledge receipt by signing and returning one copy to Engineer.

D. Field Orders will be incorporated into subsequent Change Orders, as a no-cost change to the Contract.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 29 00
PAYMENT PROCEDURES

PART 1 GENERAL

1.01 SUBMITTALS

A. Informational Submittals:

1. Schedule of Values: Submit on Contractor's standard form.
2. Schedule of Estimated Progress Payments:
   a. Submit with initially acceptable Schedule of Values.
   b. Submit adjustments thereto with Application for Payment.
3. Application for Payment.
4. Final Application for Payment.

1.02 SCHEDULE OF VALUES

A. Prepare a separate Schedule of Values for each schedule of the Work under the Agreement.

B. Upon request of Engineer, provide documentation to support the accuracy of the Schedule of Values.

C. Unit Price Work: Reflect unit price quantity and price breakdown from conformed Bid Form.

D. Lump Sum Work:

1. Lump sum items in the Contract are to be divided into smaller unit prices to allow more accurate determination of the percentage of the item that has been completed.
2. List bonds and insurance premiums, mobilization, demobilization, preliminary and detailed progress schedule preparation, equipment testing, facility startup, and contract closeout separately.
   a. Mobilization includes, at minimum, items identified in Section 01 50 00, Temporary Facilities and Controls.
   b. Include item(s) for monthly progress schedule update.
3. Break down by Divisions 02 through 49 with appropriate subdivision of each specification for each Project facility.
4. Separate product costs and installation costs.
5. Provide prices for items such that no individual item exceeds $10,000.00. An exception may be made for equipment packages that cannot be subdivided into units or subassemblies.

6. For equipment or systems that exceed $50,000, the costs reported for startup activation shall not be less than 10 percent of the total item cost.

E. An unbalanced or front-end loaded schedule will not be acceptable.

F. Summation of the complete Schedule of Values representing all the Work shall equal the Contract Price.

G. Submit Schedule of Values in a spreadsheet format compatible with latest version of Microsoft Excel.

1.03 SCHEDULE OF ESTIMATED PROGRESS PAYMENTS

A. Show estimated payment requests throughout Contract Times aggregating initial Contract Price.

B. Base estimated progress payments on initially acceptable progress schedule. Adjust to reflect subsequent adjustments in progress schedule and Contract Price as reflected by modifications to the Contract Documents.

1.04 APPLICATION FOR PAYMENT

A. Transmittal Summary Form: Attach one Summary Form with each detailed Application for Payment for each schedule and include Request for Payment of Materials and Equipment on Hand as applicable. Execute certification by authorized officer of Contractor.

B. Use detailed Application for Payment Form suitable to Engineer.

C. Provide separate form for each schedule as applicable.

D. Include accepted Schedule of Values for each schedule or portion of lump sum Work and the unit price breakdown for the Work to be paid on a unit priced basis.

E. Include separate line item for each Change Order and Work Change Directive executed prior to date of submission. Provide further breakdown of such as requested by Engineer.

F. Preparation:

1. Round values to nearest dollar.
2. Submit Application for Payment, including a Transmittal Summary Form and detailed Application for Payment Form(s) for each schedule as applicable, a listing of materials on hand for each schedule as applicable, and such supporting data as may be requested by Engineer.

1.05 MEASUREMENT—GENERAL

A. Weighing, measuring, and metering devices used to measure quantity of materials for Work shall be suitable for purpose intended and conform to tolerances and specifications as specified in National Institute of Standards and Technology, Handbook 44.

B. Whenever pay quantities of material are determined by weight, weigh material on scales furnished by Contractor and certified accurate by state agency responsible. Obtain weight or load slip from weigher and deliver to Owner's representative at point of delivery of material.

C. Vehicles used to haul material being paid for by weight shall be weighed empty daily and at such additional times as required by Engineer. Each vehicle shall bear a plainly legible identification mark.

D. Haul materials that are specified for measurement by the cubic yard measured in the vehicle in transport vehicles of such type and size that actual contents may be readily and accurately determined. Unless all vehicles are of uniform capacity, each vehicle must bear a plainly legible identification mark indicating its water level capacity. Load vehicles to at least their water level capacity. Loads hauled in vehicles not meeting above requirements or loads of a quantity less than the capacity of the vehicle, measured after being leveled off as above provided, will be subject to rejection, and no compensation will be allowed for such material.

E. Where measurement of quantities depends on elevation of existing ground, elevations obtained during construction will be compared with those shown on Drawings. Variations of 1 foot or less will be ignored, and profiles shown on Drawings will be used for determining quantities.

F. Units of measure shown on Bid Form shall be as follows, unless specified otherwise.

Item	Method of Measurement
LF	Linear Foot – Measured by Engineer

1.06 PAYMENT

A. Payment for all Lump Sum Work shown or specified in Contract Documents is included in the Contract Price. Payment will be based on a percentage complete basis for each line item of the accepted Schedule of Values.

B. Payment for Lump Sum Work covers all Work specified or shown within the limits or Specification sections as follows:

1. All Work shown on Drawings and in Specification, with exception of unit price items.

C. Payment for unit price items covers all the labor, materials, and services necessary to furnish and install the following items.

Item	Description
Steel Piles	24-inch steel pipe pile material and installation of additional length required when tip elevation necessary to achieve capacity is deeper than estimated pile tip elevation for required ultimate driving resistance indicated.

1.07 NONPAYMENT FOR REJECTED OR UNUSED PRODUCTS

A. Payment will not be made for following:

1. Loading, hauling, and disposing of rejected material.
2. Quantities of material wasted or disposed of in manner not called for under Contract Documents.
3. Rejected loads of material, including material rejected after it has been placed by reason of failure of Contractor to conform to provisions of Contract Documents.
4. Material not unloaded from transporting vehicle.
5. Defective Work not accepted by Owner.
6. Material remaining on hand after completion of Work.

1.08 PARTIAL PAYMENT FOR STORED MATERIALS AND EQUIPMENT

A. Partial Payment: No partial payments will be made for materials and equipment delivered or stored unless Shop Drawings and preliminary operation and maintenance data is acceptable to Engineer.

B. Final Payment: Will be made only for products incorporated in Work; remaining products, for which partial payments have been made, shall revert to Contractor unless otherwise agreed, and partial payments made for those items will be deducted from final payment.

1.09 PARTIAL PAYMENT FOR UNDELIVERED, PROJECT-SPECIFIC MANUFACTURED OR FABRICATED EQUIPMENT

A. Notwithstanding above provisions, partial payments for undelivered (not yet delivered to Site or not stored in the vicinity of Site) products specifically manufactured for this Project, excluding off the shelf or catalog items, will be made for products listed below when all following conditions exist:

1. Partial payment request is supported by written acknowledgment from Suppliers that invoice requirements have been met.
2. Equipment is adequately insured, maintained, stored, and protected by appropriate security measures.
3. Each equipment item is clearly marked and segregated from other items to permit inventory and accountability.
4. Authorization has been provided for access to storage Site for Engineer and Owner.
5. Equipment meets applicable Specifications of these Contract Documents.

B. Applicable Items:

Specification Section	Specific Product
35 79 19	Mechanically Cleaned Wedgewire Fish Screen
44 42 56.23	Mixed Flow Irrigation Pumps

C. Payment of 15 percent of manufacturer's quoted price for undelivered, Project-specific manufactured equipment will be made following Shop Drawing approval. Thereafter, monthly payments will be made based on progress of fabrication as determined by Engineer, but in no case will total of payments prior to delivery exceed 75 percent of manufacturer's quoted price.

D. Failure of Contractor to continue compliance with above requirements shall give cause for Owner to withhold payments made for such equipment from future partial payments.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 30 00
ENVIRONMENTAL COMPLIANCE

PART 1 GENERAL

1.01 DEFINITIONS

A. Cultural Resources: Consist of man-made, pre-historic, or historic items including human remains found on both the ground surface and subsurface. Cultural resources are defined as at least 50 years old.

B. Floodway: Portions of work area regulated by State of California, Department of Water Resources, Central Valley Flood Protection Board. Floodway is defined as the entire area between and including the Sacramento River and the Sacramento levee. Levees are defined to extend, on the land side, to a point 15 feet beyond the land side toe of the fill for the new Sacramento River levee.

C. In-River: That portion of the Work west of the Garden Highway below elevation 20 shall be considered in-river for the purposes of environmental compliance.

D. Protected Trees: Unless shown otherwise, all trees at the Site are protected and hereby designated to remain in place during construction.

E. ROW or Work Area Restoration: Original contours and grade restored, except where otherwise required by the Contract Documents.

F. Staging Area: That area used by the Contractors where construction-related activities will occur, including long-term and short-term equipment storage and maintenance, materials storage (both temporary and long term), parking, office space, etc.

G. Topsoil: The uppermost soil horizon that supports vegetation – varies by location and contour.

H. Tree Drip Line: Outside perimeter of tree branch spread.

I. Waterways: Any drainage conveyance including, but not limited to, streams, creeks, rivers, ditches, culverts, channels, and sloughs.

J. Wetlands: Land areas of high soil moisture including, but not limited to seeps, springs, pools, and ponds.

K. Work Area: The Site, including those lands, within the limits shown on Drawings, for use by the Contractor to conduct the Work.

1.02 GENERAL

A. Perform Work in conformance with the environmental mitigation measures in this section and other provisions of the Contract Documents. Conduct all operations in such a way as to minimize environmental impacts and comply with all laws, regulations, permits, plans, and agreements applicable to the Project. Conduct operations such as to:

1. Minimize the removal and disturbance of natural vegetation, except as required for new surfaces required by the Contract Documents.
2. Prevent erosion and loss of soil from the Project Work area.
3. Remove, maintain, and replace topsoil for revegetation.
4. Minimize physical and chemical degradation of aquatic habitats through sediment deposition and runoff of contaminants.
5. Minimize the impact of construction on the community and sensitive resources.

B. Confine construction activities and equipment to the designated work area. Install temporary orange fencing, or chain link fencing around the designated work area and any additional work areas obtained by the Contractor that are outside the areas shown on Drawings. Keep construction equipment and personnel out of restricted or limited portions of the work area. Remove all temporary fencing in individual portions of the work area as soon as the Site is restored.

C. For Contractor operations outside the work area designated on Drawings, submit documentation demonstrating permission to utilize said lands and demonstrating compliance with requirements of federal, state, and local regulatory agencies.

D. All Contractor supervisors and foremen are required to attend a 2 hour environmental training program conducted by Engineer to review Project environmental requirements and commitments, and to discuss protection of specific sensitive resources to be encountered along the Project route. All nonsupervisory Contractor personnel will be required to attend an environmental briefing (approximately 30 minutes in length) conducted by Engineer. Contractor is responsible for ensuring that all workers requiring training are identified to the Engineer.

E. Refer to Section 01 45 00, Permits, for specific permitting requirements.

1.03 SUBMITTALS

A. Informational Submittals:

1. Develop the Plans and provide the information required below, and provide the Plans to Engineer for review and acceptance in accordance with Section 01 33 00, Submittal Procedures.
   a. Dust Suppression Plan.
   b. Storm Water Pollution Prevention Plan (SWPPP). Including site-specific Erosion Control Programs for all areas. Guidelines for erosion control implementation appear in the SWPPP requirements and shall be included as part of the SWPPP.
   c. Water quality monitoring reports.
   d. Hazardous Materials Management Plan (HMMP).

B. These Plans must be accepted by the Engineer by dates indicated, if applicable, and prior to the beginning of any ground disturbing activity, and Contractor must maintain practices and mitigation devices and materials prescribed by the Plans throughout the duration of construction.

C. All Plans (draft and final) shall be submitted in fully bookmarked PDF format in accordance with Section 01 33 00, Submittal Procedures.

1.04 OWNER PREPARED OR OBTAINED DOCUMENTS

A. Refer to Section 01 45 00, Permits, for information regarding Owner-obtained and Contractor-obtained permits and associated documents.

B. Owner has applied for Army Corps of Engineers 404/10 and Central Valley Flood Protection Board permits. These permits will be made available once obtained.

C. The Owner will submit an electronic Notice of Intent (NOI) to discharge to the RWQCB for construction-related discharge. Submission of NOI by Owner will not relieve Contractor of any SWPPP management, responsibilities, or liability. Contractor shall be responsible for any stormwater or NPDES related fines or penalties.

1.05 QUALITY CONTROL AND ACCOUNTABILITY

A. Many of the requirements contained in this section are based on conditions attached to environmental permits and agreements obtained by Owner. Violation of these conditions can result in monetary fines, requirements for restoration of or compensation for damage, or stoppage of Work. Fines imposed upon Owner resulting from Contractor noncompliance with

environmental requirements included in the Contract Documents shall be paid by Contractor.

B. Contractor shall be held fully responsible for any damage resulting from Contractor operations to natural vegetation, wildlife, cultural resources, waters of the United States, water quality, and any other environmental resources located either:

1. Outside the work areas permitted in the Contract Documents; or
2. Inside the work areas but clearly specified, or marked on Drawings, or marked in the field to indicate that avoidance of that resource is required.

C. Contractor shall assume full responsibility for all costs associated with restoration, revegetation, and monitoring to ensure successful restoration and for all other measures necessary to repair or compensate for any such damage incurred.

D. Owner may require that Contractor remove construction personnel that cause flagrant and/or repeated violations of the mitigation specifications. Engineer will monitor Contractor compliance with the environmental mitigation specifications and will record noncompliance events. Copies of noncompliance forms will be given to Contractor within 24 hours. Owner may require remedial actions of Contractor including, but not limited to, additional training of Contractor personnel.

E. Whenever a noncompliance occurs, submit to Engineer, memoranda and other documentation describing actions taken to mitigate damage and return to compliance with environmental mitigation measures, as required. Contractor memoranda and other documentation shall specify the environmental mitigation addressed, how compliance was met or regained, what problems were encountered, and any remedial actions taken and those planned to prevent further occurrences.

F. Environmental inspectors provided by Owner represent Owner and have the authority to enforce the environmental requirements of all relevant Project documents and can halt any noncompliant activities that may pose an immediate or imminent threat to biological, water, air, or cultural resources.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 NOISE CONTROLS

A. Provide appropriate and applicable noise control in accordance with Section 01 50 00, Temporary Facilities and Controls.

3.02 TRAFFIC CONTROLS

A. Meet all applicable safety requirements, reduce construction traffic to the extent feasible, prepare and comply with Traffic Control Plans, and obtain any required permits or approvals in accordance with Section 01 45 00, Permits, and Section 01 50 00, Temporary Facilities and Controls.

3.03 ACCESS CONTROLS

A. Vehicle Access:

1. Restrict Project-related vehicle traffic to established roads, Project access roads, designated haul routes, and the Work area.
2. Access points across non-work areas are prohibited.
3. No construction vehicles, equipment, or materials will be stored at any time within wetland boundaries.
4. After work area restoration and topsoil replacement, access within the work area, except along existing roads replaced within the work area, shall be restricted to repair and revegetation crews that have received prior approval from the Engineer.

B. Work Areas: All work areas that are used by Contractor shall be fenced prior to construction. Fencing shall be as specified and shall be maintained in good working condition by Contractor.

C. Parking: Vehicle parking shall be restricted to approved work areas and as otherwise indicated. Vehicle parking is to be limited in vegetated areas.

D. Conditions of Right-of-Way or similar temporary use Agreements for private properties shall be adhered to by Contractor.

3.04 CLEARING, GRUBBING, AND TOPSOILING

A. General: Do not disturb trees and other vegetation (including root systems and drip lines), unless within the footprint of the completed facility or specifically noted to be removed.

1. Conduct clearing and grubbing operations only within the limits of the work area. No filling, excavating, trenching, or stockpiling of materials shall be permitted in specified restricted areas or within the drip line of the protected vegetation within the work area, except as indicated in the Contract Documents and approved by Owner. To prevent soil compaction within the protected area, no equipment or materials storage shall occur within these areas, except as approved by Owner.
2. Remove all topsoil to 12-inch depth (or lesser depth directed by the Engineer) in all vegetated areas that will be restored to their original surfacing. Stockpile topsoil in protected portion of the work area for restoration to the same area after the area is no longer needed to conduct the Work. Fence stockpiled topsoil to prevent inadvertent removal during the Work. Treat surface of stockpiles topsoil with a biodegradable, non-toxic, soil binder to prevent wind erosion. Protect stockpiled topsoil from water erosion.
3. Clearing shall result in an irregular edge, rather than a straight edge. Fell trees so that they fall away from facilities and vegetation not designated for removal. Cut stumps not designated for grubbing flush with ground surface. Cut off shrubs, brush, weeds, and grasses to within 2 inches of ground surface.
4. Remove trees, snags, stumps, shrubs, brush, limbs, and other vegetative growth to the minimum extent necessary to allow construction.

3.05 DUST CONTROL

A. Comply with SMAQMD Fugitive Dust Control Plan requirements in accordance with Section 01 45 00, Permits.

B. Dust Control: Prepare and submit a Dust Suppression Plan in accordance with this and Section 01 33 00, Submittal Procedures. The plan shall be accepted by the Engineer prior to any work on the Site. The elements of this plan shall be designed to prevent dust in visible amounts from leaving the worksite, including dust from mud deposited on paved roads by all work-related vehicles. Contractor shall be responsible in all respects for dust cleanup and repair of and/or compensation for any damage resulting from any dust originating from Contractor operations. The dust abatement measures

described in the accepted plan shall be continued until Contractor is relieved of further responsibility by Engineer.

1. The following minimum measures shall be followed and incorporated into the Dust Suppression Plan:
    a. Storage yards, access roads, staging areas, and the work area shall be kept damp enough to prevent visible dust from leaving the Site.
    b. Haul trucks traveling off the Site shall be covered or hauled materials shall be wetted down. Haul trucks traveling on the Site shall be covered, as necessary, to prevent visible dust from leaving the Site.
    c. All onsite and offsite access roads shall be stabilized using water or chemical stabilizer/suppressant.
    d. Grading activities shall be altered or shall cease when wind speeds exceeds 30 mph.
    e. Dust control techniques, such as soil binders, shall be used to minimize dust generation from stockpiles. Water or chemical stabilizers/suppressants shall be used after material is added or removed from the surface of stockpiles.
    f. When water is used for dust control, watering shall be conducted at least twice during the morning and twice during the afternoon. Conduct watering more frequently if dust suppression is not effective at the frequency indicated.
    g. Vehicle speeds in the work area and on all unpaved access roads shall be no greater than 15 mph, except where approved by Engineer.
    h. Control all land clearing, grubbing, scraping, excavation, land leveling, grading, cut, fill, and demolition activities using water or by presoaking to control dust emissions.
    i. After clearing, topsoil removal, grading, earth moving, or excavation is completed, the entire area of disturbed soil shall be treated immediately by watering, spreading of soil binders, or use of other dust and erosion control measures to prevent wind pick-up of dust until the area is restored or otherwise developed so that dust generation will not occur. Apply organic mulches or other effective soil cover to disturbed areas that are not scheduled to be re-disturbed for at least 10 days. Replacement of topsoil, drill seeding and hydroseeding shall be completed as soon as feasible.
    j. Topsoil shall be respread and vegetation shall be replanted in disturbed areas as soon as possible.
    k. Water shall not be taken from local aquatic habitats or drainages for dust control (e.g., Sacramento River). Water from existing water supply systems or treated (reclaimed) wastewater is

acceptable for dust control when appropriate arrangements are made. All such arrangements must be made by Contractor and approved by Engineer.

l. Mud deposited on paved roads as a result of Contractor vehicles or equipment traffic shall be cleaned up immediately using shovels and brooms, or with a mechanical street sweeper. Contractor shall install wash stations or other measures, as necessary, to prevent mud from being carried onto public roadways.

2. Designate a person or persons to monitor the dust control program and to work with Engineer to order increased watering, as necessary, to prevent transport of dust offsite and to implement dust control methods and those for mud and track-out control on pavement. Their responsibilities shall include updating the provisions of the plan as needed to provide effective dust suppression. Their duties shall also include holiday and weekend periods when work may not be in progress. The name and telephone number of such persons shall be provided to Engineer.

3. Engineer's review and acceptance of the Dust Suppression Plan will be for general conformance with the intent of this section. Contractor shall be solely responsible for the application and effectiveness for all materials, workmanship, procedures, actions and other provisions included in the plan. It is the Contractor's sole responsibility to identify, develop, and implement applicable management practices, update the plan as required, and monitor and comply with all provisions as required to prevent dust and wind erosion, and protect air quality for all aspects of the Work.

3.06 OPEN PIPES, CULVERTS, OR SIMILAR STRUCTURES

A. Open pipes, culverts, or similar structures stored or installed anywhere in the work area shall be inspected for sensitive animals before the pipe is moved, buried, capped, or otherwise used, except as directed by Engineer. All in-place pipeline segments shall be capped daily until buried to prevent entry of animals.

3.07 STAGING AREAS AND SPOILS DISPOSAL SITES

A. All staging and spoils stockpiling shall take place within the work areas indicated on Drawings. Excess soil or demolition debris disposal shall be as specified.

B. Provide topsoil removal, maintenance, and replacement.

3.08 EROSION CONTROL AND STORM WATER POLLUTION PREVENTION PLAN

A. Prepare Storm Water Pollution Prevention Plan (SWPPP) documents in full conformance with these Contract Documents and all aspects of State Water Resources Control Board National Pollutant Discharge Elimination System (NPDES) General Permit for Storm Water Discharges Associated with Construction Activity Water Quality Order 2009-0009-DWQ (General Permit).

B. Contractor's SWPPP shall be prepared by a qualified SWPPP Developer who participates in applicable training.

C. Contractor's SWPPP shall be submitted to Engineer in full conformance with Section 01 33 00, Submittal Procedures, and shall be accepted by Engineer before onset of any construction activities. Engineer's review and acceptance will be for general conformance with the requirements of the SWPPP in accordance with the General Permit. Contractor shall be solely responsible for the application and effectiveness for all materials, workmanship, procedures, actions and other provisions included in the SWPPP. It is the Contractor's sole responsibility to identify, develop, and implement applicable management practices, update the plan as required, and monitor and comply with all provisions as required to control erosion and protect water quality for all aspects of the Work.

D. Contractor shall carry out the provisions of the accepted SWPPP. Contractor's activities shall comply with the conditions in the General Permit, which require preparation of a SWPPP, calculating of Work risk level, potential adherence to Numeric Action levels and Numeric Effluent limitations, potential effluent monitoring and reporting, potential receiving water monitoring and reporting, implementation of minimum BMP requirements and site monitoring to ensure that effects on water quality are minimized, that water quality objectives identified in the RWQCB Basin Plan are met, and beneficial uses are not impacted.

E. In addition to the content requirements of the General Permit and the contents required to comply with these Contract Documents, the content of the SWPPP shall include the following measures:

1. Authorizations and Prohibitions: The General Permit authorizes the discharge of stormwater associated with construction activities only as outlined in the SWPPP. The permit also authorizes certain non-stormwater discharges (i.e., trench dewatering of stormwater, hydrostatic testing) necessary for construction only as outlined in the

SWPPP. The General Permit explicitly prohibits all other discharges, including water containing contaminants, water that may adversely affect water quality, dewatering of irrigation ponds, canals of pre-existing settlement basins, or direct discharges into waterways of any kind.

2. Erosion Control: Provide, inspect and maintain erosion and sediment controls in accordance with the SWPPP and other requirements of the Contract Documents.
3. Hazardous Materials Storage and Waste Disposal: The SWPPP shall incorporate the HMMP by reference.
4. Non-Stormwater Management, Dewatering: Conduct all dewatering operations in accordance with local, state, and federal laws, regulations, and other requirements. Notify Owner of all anticipated dewatering operations in advance, with a minimum of 3 days' notice.
5. The SWPPP shall include a site map, description of proposed construction activities, demonstration of compliance with relevant local ordinances and regulations, and overview of the BMPs that will be implemented to effectively minimize or eliminate the discharge of contaminated stormwater runoff from the Project Site to the BAT/BCT standard, including soil erosion and discharge of other construction-related pollutants that could contaminate nearby water resources.

F. Monitoring, Maintenance, Inspection, and Repair: Keep the accepted SWPPP at Contractor's construction yard with all of its referenced plans, attachments, supplements, and amendments. Designate a responsible person that shall be familiar with the plan and its requirements. Keep the SWPPP current and amended as needed. Maintain in proper functional condition all features, BMPs, components, and related field requirements of the SWPPP at all times. Contractor shall conduct, on a regular and continuous schedule – at a minimum adhering to the type and frequency specified in the General Permit, any necessary monitoring and reporting set forth in the SWPPP or on a case-by-case basis to ensure that BMPs are correctly implemented and effective in controlling the discharge of stormwater-related pollutants and that performance standards are met at all times.

G. Sampling and Water Quality: Comply with sampling requirements specified in the General Permit, the SWPPP, and prohibitions regarding water quality. Generally, water that violates the water quality standards as described in the Water Quality Control Plan, RWQCB - Central Valley Region, shall not be discharged. Notify Engineer's Environmental Monitor when any water that is suspected to be contaminated is encountered. Contractor shall conduct necessary sampling to confirm water being discharged meets water quality objectives as conditioned in the General Permit, these Contract Documents,

and the 401 Water Quality Certification for the Project in accordance with Section 01 45 00, Permits.

H. Contractor's operations and actions shall not result in discharges that exceed water quality objectives/thresholds for turbidity, temperature, and hydrocarbons (fuels) or any other pollutant as established by the Central Valley RWQCB pertaining to specific water bodies into which they are intending to or may discharge.

I. Contractor shall control and manage the drainage on the entire work area and the disposal of such drainage from commencement of Work until final contract completion. Silt, eroded materials, construction debris, concrete or washings thereof, petroleum or paint products or other hazardous substances, shall not be introduced, or placed where they may be washed by rainfall or runoff, into any water course, stream, lake, reservoir, or storm drain system.

J. As part of this process, Contractor shall implement multiple erosion, sediment, and pollutant control BMPs in areas that have the potential to drain to surface waters. These BMPs shall be selected to achieve maximum pollutant and sediment removal and will represent the best available technology that is economically achievable.

K. Contractor shall use standard containment and handling protocols to ensure hazardous materials are not released.

L. The methods to protect water quality during construction that must be included in the SWPPP shall include, or at a minimum be consistent with, the following guidelines:

1. Cover or apply non-toxic soil stabilizers to inactive construction areas (previously graded areas inactive for 10 days or more) that could contribute sediment to waterways.
2. Enclose and cover exposed stockpiles of dirt or other loose, granular construction materials that could contribute sediment or other pollutants to waterways.
3. Control and contain soil and filter runoff from disturbed areas. This may be done by using berms, silt fencing, straw wattles, plastic sheeting or geofabric, silt/sediment traps and catch basins, silt fencing, sand bag dikes, temporary vegetation or other groundcover, or other means necessary to prevent the escape of sediment from the disturbed area.
4. Ensure that no earth or organic material shall be deposited or placed where it may be directly or indirectly carried into a stream, marsh, slough, lagoon, or body of standing water.

5. Prohibit the following types of materials from being rinsed or washed into the streets, shoulder areas, gutters, or any noncontained areas: Concrete; solvents and adhesives; thinners; paints; fuels; sawdust; dirt; gasoline; asphalt and concrete saw slurry; and heavily chlorinated water.
6. Ensure dewatering activities are conducted according to the provisions of the SWPPP. No dewatered materials shall be placed in local water bodies or in storm drains leading to such bodies without implementation of proper construction water quality control measures.
7. Ensure drainage facilities in downstream offsite areas are protected from sediment using BMPs that are effective and acceptable to Engineer and the Central Valley RWQCB.
8. Water draining from the Work area, whether from rainfall or introduced by the Contractor, shall cause no erosion of earth, whether disturbed or not disturbed, or of excavated or dredged earth stored on site, or of material imported for fill or other purposes. No soil or other material shall be discharged from the work area in a quantity that will have an adverse effect on the receiving waters.

M. To provide effective and continuous control of water pollution, it may be necessary for Contractor to perform the Work in small or multiple units, on an out of phase schedule, and with modified construction procedures. Contractor shall coordinate water pollution control work with all other work done on the Contract.

N. Where Contractor’s operations may cause water pollution, the following steps shall be taken:

1. Confine earthwork operations to the dry season, whenever possible. If earthwork needs to be scheduled for the wet season, ensure that additional erosion and sediment transport control measures are implemented prior to the onset of the first major storm of the season or prior to the start of the rainy season, whichever occurs first. Schedule so that erosion control features will be installed concurrently with or immediately following grading and/or excavation operations.
2. Temporary swales shall be constructed to divert runoff. Discharge runoff into small drainages at frequent intervals to avoid buildup of large potentially erosive flows.
3. Keep disturbed areas to the minimum necessary for construction. Stabilize disturbed areas as quickly as possible. Prevent runoff from flowing over disturbed areas or unprotected slopes during construction. Direct flows over vegetated areas prior to discharge into public storm drainage systems.
4. Protect interior and downgradient stormwater inlets with sediment control at all times.

5. Trap sediment before it leaves the Site, using such techniques as silt fence, earth dike, temporary drains and swales, straw fiber roll barrier, sediment traps and basins, and check dams. Sediment traps shall be installed so that the amount of sediment in runoff meets all regulatory requirements. Remove and dispose of all Project construction-generated siltation that occurs in offsite retention pond(s) or channels.
6. Water treatment facilities such as, but not limited to, sediment ponds, skimmers, settling tanks, settling basins, and traps shall be consistent with the accepted SWPPP and located within the Project area to collect and treat contaminated runoff from construction activities.
7. Erosion control measures that are implemented on all graded slopes and grading activities shall utilize a seed mix composed of species approved by the Engineer.

O. Final selection, implementation, updating, and monitoring of BMPs shall be the responsibility of Contractor and will be subject to review by Engineer and should be consistent with the measures described above. Engineer will verify that Owner has filed the NOI and that the SWPPP is completed before allowing construction to begin. Contractor shall notify Engineer immediately if a noncompliance action, issue, or event occurs.

P. Contractor shall electronically file the Notice of Termination (NOT) and supporting documentation once final stabilization conditions are attained.

3.09 WATER QUALITY PROTECTION MONITORING AND REPORTING

A. Contractor shall, at a minimum, perform the following monitoring and reporting activities:

1. Dewatering Discharge Monitoring:
   a. Effluent monitoring will be required for any outfall that emits wastewater directly to surface waters for the following:
      1) Total suspended solids, settleable solids, flow, temperature, pH, 20 degrees C BOD_5.
2. Receiving water monitoring will be required for the following:
   a. Turbidity, temperature, pH, electrical conductivity, dissolved oxygen both upstream and downstream from the point of discharge.
3. Contractor shall submit a report of all monitoring results monthly during all dewatering and in-water construction activities.
4. Monitoring shall occur for turbidity and settleable material immediately upstream and 300 feet downstream every 4 hours for the duration of the work day for any work that results in the deposition of soil materials or the creation of a visible plume in surface waters.

3.10 HAZARDOUS MATERIALS MANAGEMENT

A. Hazardous materials management described herein applies to materials used by Contractor during performance of the Work. These provisions do not apply to any known or unknown existing hazardous materials that may be encountered within the Work area.

B. Contractor shall develop and implement a Hazardous Materials Management Plan (HMMP) for the Work. The HMMP shall be prepared by a Certified Industrial Hygienist, or Professional Engineer.

C. The HMMP shall be submitted for acceptance by the Engineer in full compliance with Section 01 33 00, Submittal Procedures. Engineer's review and acceptance will be for general conformance with the intent of this section. Contractor shall be solely responsible for the application and effectiveness for all materials, workmanship, procedures, actions and other provisions included in the HMMP. It is the Contractor's sole responsibility to identify, develop, and implement applicable management practices, to update the provisions of the plan as needed, and to monitor and comply with all provisions as required to control hazardous materials and to protect worker safety and to protect against discharges and contamination of land, flora, fauna, air, and water for all aspects of the Work.

D. The HMMP shall be designed to minimize the potential for, and effects from, spills of hazardous, toxic, or petroleum substances during all construction activities. The HMMP shall include procedures that shall be used during the Work to prevent spills; control measures that will be installed at applicable locations within the work area to prevent oil from entering navigable waters or adjoining shorelines; and countermeasures to be used to contain, clean up, and mitigate the effects of a spill. The HMMP shall be completed and accepted by the Engineer before any construction activities begin. Implementation of measures included in the HMMP shall comply with all applicable county, state and federal regulations.

E. Hazardous Materials Management Plan (HMMP) shall conform, at a minimum, with the guidelines that follow:

1. The HMMP shall specify procedures for documenting inventories of hazardous materials, storage, and handling. Detailed site maps shall be prepared showing storage areas. All materials shall be stored and handled according to county, state (CCR Title 22, Division 4.5, Chapter 12, Chapter 13, Chapter 15) and federal regulations.
    a. Fuel storage areas shall be clearly shown on site maps, segregated from other hazardous materials and hazardous waste storage, sized

for 110 percent secondary containment plus precipitation from a 25-year storm event (fuels storage greater than 660 gallons requires an additional Storage Statement filed with the Central Valley RWQCB), properly labeled, and properly maintained. Protect fueling areas with berms and dikes to prevent run on, runoff, and to contain spills. Temporary containment facility should be impervious to the materials stored therein for a minimum contact time of 72 hours. Persons handling fuel storage shall be properly trained to do so (40-hour hazardous waste training, HAZWOPER).

b. Contractor's yard shall be signed with the proper placards. All other hazardous and controlled materials shall be stored in a separate, covered area with 110 percent secondary containment as shown on the site map. All materials stored shall be labeled as to its contents, and inspected for integrity. MSDS sheets shall be retained and filed onsite at the time of material delivery to the Site. No hazardous or controlled materials shall be stored outside of the secondary containment area.

c. The HMMP shall specify proper treatment and disposal of contaminated materials and wastes, excavation, and transportation procedures for spills that contact natural soils and regulatory compliance and documentation procedures. Temporary storage (no more than 90 cubic yards) of hazardous wastes shall be in accordance with county, state, and federal regulations. Hazardous wastes shall be stored in a separate, covered area with 110 percent secondary containment. Containers shall be properly labeled with accumulation dates and inspected for integrity. All wastes shall be removed prior to the 90-day storage limit. No hazardous wastes shall be stored outside of the secondary containment area.

d. The HMMP shall specify methods for preventing raw cement, concrete or concrete washings, asphalt, paint or other coating material, oil or other petroleum products, or any other substances that could be hazardous to aquatic life from contaminating the soil or entering watercourses.

2. The HMMP shall specify methods for preventing spills and for containing and cleaning up any spills that occur (for example, use of absorbent pads under vehicles during maintenance, cleanup after hydraulic hose breaks, etc.). No storage of hazardous material shall be allowed in the work area west of Garden Highway nor within 100 feet of the Sacramento River or any tributary thereto, unless an approved secondary containment system is in place. All spills shall be cleaned up immediately. Hazardous material storage anywhere within the work area is limited to those materials necessary to support the active efforts of the Contractor. Quantities shall be limited to that required to support 5 or

fewer work days. All vehicles on the work area shall be equipped to contain and cleanup small spills from leaking equipment, refueling, and other common types of common spills. Engineer will be notified immediately of all spills that occur on the work area, and the method of cleanup.

3. The HMMP shall specify methods for containment, storage, and refueling near streams, rivers, and channels. Storage and use of hazardous materials in or near streams, rivers, and channels shall be consistent with California Department of Fish and Wildlife regulations and other state and federal laws. Servicing and refueling of mobile equipment or pumps is permitted within the work area or at staging areas, but is prohibited within 100 feet of a sensitive resource, streambed, river, or channel. For stationary equipment, such as pumps or generators, that must be located within 100 feet of a streambed, river, or channel, Contractor shall place the equipment on a plastic liner within a berm sized to contain (110 percent minimum) the maximum potential fuel spill plus precipitation from a 25-year storm event.
4. The HMMP shall specify notification procedures and emergency contacts for major spills (greater than 25 gallons) or any spills that occur adjacent to, or into, streams, rivers, or channels. Contractor shall notify Engineer immediately of any major spills of pollutants, hazardous materials or lubricants, or any spills that occur adjacent to, or into, streams, rivers, or channels. Contractor shall also notify immediately the Owner's General Manager and the Office of Emergency Services at 1-800-852-7550 in the event of a spill.
5. The HMMP shall be updated as needed to meet the requirements of this section if, during the course of the Work, deficiencies are identified.

3.11 COLLECTION AND HARASSMENT OF SPECIES

A. Contractor shall comply with applicable federal and state laws that provide protection to plants and animals.

B. Do not intentionally "take" (meaning harm, harass, pursue, hunt, shoot, wound, trap, kill, capture, or collect) any species that are listed as threatened, endangered, or special status. Protection extends to animals, dead or alive, and all their body parts. The exceptions are those incidentally taken during normal clearing of the work area in conformance with the above acts and all permits or agreements obtained for this Project under these acts. Do not intentionally "take" any other species of plant or wildlife at or around the construction site. This includes all fish, snakes, lizards, frogs, turtles, birds, and mammals.

C. In the event that any threatened or endangered species, or other special status wildlife, are found in or near the Project where they could be affected by

construction activities, Contractor shall immediately halt construction and notify Engineer and Owner and proceed with construction only after Owner's Biologist has removed these species. Immediately report to Engineer any animals that are harmed or killed during construction.

D. Work stoppages of more than 8 hours that are required as a result of the actions described in this section will be considered delays beyond the Contractor's control. Work stoppages less than 8 hours will be considered incidental and will not be grounds for an increase in Contract Times or for additional compensation.

E. Contractor shall provide Owner a minimum of 14 days' advance notice of construction activities within work area, or construction activities within new areas prior to start to allow for coordination of biological surveys.

F. Pre-construction surveys will be conducted by Owner prior to all construction activities to determine whether any active Swainson's hawk nests are located within 0.5 mile of construction activities.

1. If breeding Swainson's hawks (i.e., those exhibiting nest building or nesting behavior) are identified, no new disturbances (e.g., heavy equipment operation associated with construction) shall occur within 0.5 mile of an active nest during the nesting season or until a qualified biologist has determined that the young have fledged or that the nest is no longer occupied.
2. The 0.5-mile nondisturbance distance may be modified on a case-by-case basis, with CDFW approval, if a qualified biological monitor determines, through repeated observations, that the activity is not disruptive to the breeding pair. Any such nests will be monitored on a daily basis to determine whether construction activities are likely to impact nesting birds. Where disturbance to a Swainson's hawk nest cannot be avoided, such disturbance shall be temporarily avoided (i.e., defer construction activities until later in the nesting cycle, such as after July 15th, when the adults are less likely to abandon the nest).
3. If it is determined by the biological monitor that a nesting pair appears to be adversely affected by construction activities (based on behavioral observations), Work at this location will stop until the young have fledged or until the biologist determines that certain activities may proceed.

G. Preconstruction surveys will be conducted by Owner prior to all construction activities to determine the location of potential giant garter snake habitat. Such habitat will be designated by Owner.

1. All Work within potential giant garter snake habitat, including activities within aquatic habitat and activities within 200 feet of supporting upland habitat, shall occur between May 1 and October 1 of any year, with exceptions made to extend this window during periods of warm or temperate conditions, subject to the discretion of regulatory agencies and the monitoring biologist.
2. Any dewatered habitat will remain dry for at least 15 consecutive days after April 15 and prior to excavating or filling of dewatered habitat.
3. All construction personnel shall participate in an USFWS-approved worker environmental awareness training program provided by the Engineer. Under the guidelines of this program, workers shall be informed about the presence of giant garter snakes and habitat associated with the species and that unlawful take of the animal or destruction of its habitat is a violation of the ESA. Prior to construction activities, a qualified biologist approved by the USFWS shall instruct construction personnel about: (1) the life history of the giant garter snake; (2) the importance of irrigation canals, marshes/wetlands, and seasonally flooded areas, such as rice fields, to the species; and (3) the terms and conditions of the biological opinion. Colored photographs of the giant garter snake will be handed out during the training session and shall be posted on the Job Site. Contractor shall demonstrate to Engineer, in writing, that all personnel on the Project Site have received this awareness training before allowing those persons to work on the Site.
4. No more than 24 hours prior to the commencement of certain construction activities (i.e., clearing, grading, excavation, etc.) in giant garter snake habitat, a pre-construction survey shall be undertaken by a qualified biologist. Contractor shall notify Engineer of all ground disturbing activities on previously undisturbed areas at least 5 working days in advance to allow these pre-construction surveys to be conducted. Failure to properly notify the Engineer as indicated will be grounds to restrict the Contractor from conducting these activities until such surveys can be completed.
5. The monitoring biologist shall be available thereafter on an on-call basis. If a snake is encountered during construction activities, the biologist shall have the authority to halt work until appropriate corrective measures have been implemented or it is determined that the snake shall not be harmed. Giant garter snakes encountered during construction activities shall be allowed to move away from construction activities on their own. Capture and relocation of trapped or injured

individuals can only be attempted by personnel or individuals with current USFWS recovery permits pursuant to Section 10(a)1(A) of the ESA.

6. Tightly woven fiber netting or similar material shall not be used for erosion control and other purposes to prevent the entanglement of giant garter snakes. No monofilament or jute netting shall be used for erosion control or other purposes within the work area.
7. Access routes, staging areas, and other ground-disturbing activities shall be limited to the minimum necessary, and will be clearly demarcated. Heavy equipment will be confined to established roadways and disturbed areas, and will observe a 15 mile-per-hours speed limit except on established roads and highways.
8. Exclusionary fencing shall be installed between snake habitat and construction areas to deter and minimize the possibility of snakes entering the work areas. Silt fencing will provide adequate snake exclusion provided that it completely encloses the work area.

H. Contractor shall comply with applicable measures identified in the Biological Opinions of the U.S. Fish and Wildlife Service and NMFS. The applicable portions of those measures are as follows:

1. Utilize best practices to minimize water quality degradation during excavation and placement of riprap. Place riprap in the Sacramento River in low flow periods during October.
2. In-river construction activities will be limited to the period from July 1 through November 1, unless indicated otherwise.
3. The disruption of any streambed at, and adjacent to, the construction site, will be minimized by limiting the areas actually required to be cleared, graded, and recontoured.
4. Pile Driving:
    a. All pile driving shall occur during daylight hours only.
    b. Vibrate piles into place to the extent possible.
    c. Pile Driving Plan shall be developed and submitted to the Engineer for review and approval prior to any pile driving activities.
    d. Contractor shall procure or manufacture a bubble curtain device capable of creating a continuous vertical stream of air bubbles along the face of the pile to dissipate and minimize underwater sound pressure and noise levels during pile installation. Such bubble curtain may be made of metal or PVC and shall be continuously fed by air compressor on land to create the bubble curtain during pile driving activities. Contractor shall retain the services of an approved hydroacoustic monitoring firm.

Contractor shall develop an acceptable monitoring plan and perform hydroacoustic monitoring during pile driving.

5. A preconstruction survey of suitable habitat for burrowing owls will be conducted by Owner within 30 days prior to the onset of construction. If an individual owl or breeding pair is found during this survey, construction around the active burrow shall be restricted during the nesting season (approximately February through August) and CDFW will be notified as to the location of the occurrence.

3.12 PROTECTION OF CULTURAL ARTIFACTS AND PALEONTOLOGICAL RESOURCES

A. During construction, if archaeological resources are discovered, Work shall be suspended in the immediate vicinity pending site investigations by a qualified archaeologist to assess the materials and determine their significance.

B. Work stoppages of more than 4 hours that are required as a result of the actions described in this section will be considered delays beyond the Contractor's control. Work stoppages less than 4 hours will be considered incidental and will not be grounds for an increase in Contract Times or for additional compensation.

C. General: Should finds of an archaeological or paleontological nature be made within the limits of the Site, immediately notify Owner and Engineer and proceed in accordance with the General Conditions. Continue the Work in other areas without interruption.

D. Archaeological Finds: Evidence of human occupation or use of an area within the contract limits prior to the Year 1840. Evidence may consist of skeletons, stone, or other utensils, or evidence of habitations or structures.

E. Paleontological Finds: Evidence of prehistoric plant or animal life, such as skeletons, bones, fossils, or casts and other indications such as pictographs.

F. Owner may order the Work stopped in other areas if, in Owner's opinion, the find is more extensive than may appear from uncovered material.

G. Protection of Finds:

1. Cover, fence, or otherwise protect finds until notice to resume the Work is given.
2. Cover finds with plastic film held in place by earth, rocks, or other weights placed outside the find. Should additional backfilling be necessary for safety or to prevent caving, place backfill material loosely over the plastic film.

3. Sheet or shore as necessary to protect excavations underway. Place temporary fence to prevent unauthorized access.
4. Dewater finds made below water table as necessary to protect construction Work underway. Divert groundwater or surface runoff away from find by ditching or other acceptable means.

H. Removal of Finds:

1. All finds are property of Owner. Do not remove or disturb finds without Owner's written authorization.
2. Should Owner elect to have a find removed, provide equipment, labor, and material to permit safe removal of find without damage. Provide transportation for delivery to individuals, institutions, or other places as Owner may find desirable, expedient, or required by law.

3.13 CLEANUP

A. Cleanup the work area and all temporary use areas promptly after construction is complete. This includes removal of stakes, lath, flagging, barrels, cans, drums, temporary fencing, accidental spills, hazardous materials, contaminated soils, and any other trash, debris, refuse, or wastes generated by or during construction activities.

B. Remove all temporary erosion control and water diversion structures that are no longer needed.

3.14 SURFACE RESTORATION

A. Contour the work area, staging areas, and other temporary construction sites to the original topography, except where otherwise required herein, as described in the SWPPP, shown on Drawings, or as directed by Engineer, in a timely manner. Include in the Project schedule submitted to Engineer, the restoration and cleanup schedule for each portion of the work area.

B. Loosen surface soils (top 2 to 4 inches) heavily compacted during construction using a cultivator or similar device. No cultivation shall occur under oak trees.

C. Replace stockpiled topsoil on the surface of the excavation. With replacement of topsoil, rock and natural plant debris shall be replaced in areas where such material was originally found to the degree practical.

D. Contouring to natural grade shall be done without disruption of adjacent undisturbed areas. Sediment collected in any sediment traps shall be removed and deposited at a site where it will not erode back into a water course.

E. Water bars, coconut-fiber matting without plastic netting mesh, seeding, and any other temporary or permanent erosion control structures shall be installed as required and covered with topsoil where appropriate.

F. Seeding shall be a drilled or hyrdoseeded mix approved by the Engineer. Contractor shall select a seed mix normally used in the immediate Project area for restoration of disturbed areas.

G. Notify Owner a minimum of 7 days in advance of completing restoration in any given area (i.e., topsoil replacement and installation of permanent erosion control or landscaping).

END OF SECTION

SECTION 01 31 13
PROJECT COORDINATION

PART 1 GENERAL

1.01 SUBMITTALS

A. Informational:

1. Statement of Qualification (SOQ) for land surveyor or civil engineer.
2. Photographs:
   a. Digital Images: Submit one copy of DVD disc containing images within 5 days of being taken. Each image is to have a minimum file size of 1.4 Mb (1,400 Kb) so viewed resolution is high quality. The production of larger file sizes with higher resolution is encouraged.

1.02 RELATED WORK AT SITE

A. General:

1. Other work that is either directly or indirectly related to scheduled performance of the Work under these Contract Documents, listed henceforth, is anticipated to be performed at Site by others.
2. Coordinate the Work of these Contract Documents with work of others as specified in General Conditions.
3. Include sequencing constraints specified herein as a part of Progress Schedule.

B. Power:

1. Agency and Contact Person: Sacramento Municipal Utility District (SMUD), Brian Angeja, telephone: (916) 732-5814, e-mail: bangeja@SMUD.org.
2. SMUD Notification No. 32309824.
3. Work to be performed by SMUD:
   a. Removal of existing transformer and associated power pole.
   b. Transformer supplying main electrical service to the facility.
   c. Metering facilities, except as indicated.
   d. Work to be performed by SMUD should be complete prior to October 31, 2025.
4. Work to be performed by Contractor:
   a. Coordinate Contractor’s Work with SMUD.
   b. Incoming power, trench, backfill, and duct system.

c. Transformer site preparation and pad.
d. As indicated.
e. Perform Work in accordance with SMUD requirements and codes.

5. Owner will be responsible for payment of direct charges of SMUD.

1.03 UTILITY NOTIFICATION AND COORDINATION

A. Coordinate the Work with various utilities within Project limits. Notify applicable utilities prior to commencing Work, if damage occurs, or if conflicts or emergencies arise during the Work.

1. SMUD, Electricity Company:
   a. Contact Person: Brian Angeja.
   b. Telephone: (916) 732-5814.
2. AT&T:
   a. Contact Person: Ed Sayers.
   b. Telephone: (916) 484-2447.

1.04 PROJECT MILESTONES

A. General: Include the Milestones specified herein as a part of the Progress Schedule required under Section 01 32 00, Construction Progress Documentation.

B. Project Milestones: Generally described in the Agreement Form. Following is a detailed description of each:

1. Milestone 1: Completion of all in-water Work within the Sacramento River including demolition, pipe pile installation, installation of circular shoring for pump suction can, and excavation within circular shoring.

1.05 WORK SEQUENCING/CONSTRAINTS

A. Include the following work sequences in the Progress Schedule:

1. No in-water Work shall be conducted within the Sacramento River between the dates of October 2 and July 14, unless specific permission has been granted in writing by the California Department of Fish and Wildlife (CDFW).
2. No Work shall be conducted within the floodway between the dates of November 1 and April 15 (flood season) unless specific permission has been granted in writing by the Central Valley Flood Protection Board (CVFPB).
3. No excavations, backfill, or other Work shall be conducted within the prism of the existing levee between the dates of November 1 and

April 15 (flood season), unless specific permission has been granted in writing by the CVFPB. Contractor shall not assume that such permission will be granted and no additional Contract Times or compensation will be provided due to failure of the CVFPB to provide such special permission.

4. The Elkhorn Pumping Plant may be taken completely out of service from April 1, 2024 through April 24, 2026. No temporary pumping is required during this period.

1.06 FACILITY OPERATIONS

A. Continuous operation of Owner's facilities is of critical importance. Schedule and conduct activities to enable existing facilities to operate continuously, unless otherwise specified.

B. Perform Work continuously during critical connections and changeovers, and as required to prevent interruption of Owner's operations.

C. When necessary, plan, design, and provide various temporary services, utilities, connections, temporary piping and heating, access, and similar items to maintain continuous operations of Owner's facility.

D. Do not close lines, open or close valves, or take other action which would affect the operation of existing systems, except as specifically required by the Contract Documents and after authorization by Owner and Engineer. Such authorization will be considered within 48 hours after receipt of Contractor's written request.

E. Do not proceed with Work affecting a facility's operation without obtaining Owner's and Engineer's advance approval of the need for and duration of such Work.

F. Relocation of Existing Facilities:

1. During construction, it is expected that minor relocations of Work will be necessary.
2. Provide complete relocation of existing structures and Underground Facilities, including piping, utilities, equipment, structures, electrical conduit wiring, electrical duct bank, and other necessary items.
3. Use only new materials for relocated facility. Match materials of existing facility, unless otherwise shown or specified.
4. Perform relocations to minimize downtime of existing facilities.
5. Install new portions of existing facilities in their relocated position prior to removal of existing facilities, unless otherwise accepted by Engineer.

1.07 ADJACENT FACILITIES AND PROPERTIES

A. Examination:

1. After Effective Date of the Agreement and before Work at Site is started, Contractor, Engineer, and affected property owners and utility owners shall make a thorough examination of pre-existing conditions including existing buildings, structures, and other improvements in vicinity of Work, as applicable, which could be damaged by construction operations.
2. Periodic reexamination shall be jointly performed to include, but not limited to, cracks in structures, settlement, leakage, and similar conditions.

B. Documentation:

1. Record and submit documentation of observations made on examination inspections in accordance with Article Construction Photographs.
2. Such documentation shall be used as indisputable evidence in ascertaining whether and to what extent damage occurred as a result of Contractor's operations, and is for the protection of adjacent property owners, Contractor, and Owner.

1.08 CONSTRUCTION PHOTOGRAPHS

A. General:

1. Photographically document all phases of the Project including preconstruction, construction progress, and post-construction.
2. Engineer shall have right to select subject matter and vantage point from which photographs are to be taken.
3. Digital Images: No post-session electronic editing of images is allowed. Stored image shall be actual image as captured without cropping or other edits.

B. Preconstruction and Post-Construction:

1. After Effective Date of the Agreement and before Work at Site is started, and again upon issuance of Substantial Completion, take a minimum of 48 photographs of Site and property adjacent to perimeter of Site.
2. Particular emphasis shall be directed to structures both inside and outside the Site.
3. Format: Digital, minimum resolution of 1680 pixels by 2240 pixels and 24-bit, millions of color.

C. Construction Progress Photos:

1. Photographically demonstrate progress of construction, showing every aspect of Site and adjacent properties as well as interior and exterior of new or impacted structures.
2. Monthly: Take 48 photographs using digital, minimum resolution of 1680 pixels by 2240 pixels and 24-bit, millions of color.

D. Documentation:

1. Digital Images:
   a. Electronic image shall have date taken embedded into image.
   b. Archive using a commercially available photo management system that provides listing of photographs including date, keyword description, and direction of photograph.
   c. Label each disk with Project and Owner's name, and month and year images were produced.

1.09 REFERENCE POINTS AND SURVEYS

A. Owner's Responsibilities:

1. Identify bench marks convenient to Work.
2. Establish horizontal reference points or coordinate system with bench marks and reference points for Contractor's use as necessary to lay out Work.

B. Location and elevation of bench marks are shown on Drawings.

C. Contractor's Responsibilities:

1. Provide additional survey and layout required to layout the Work.
2. Check and establish exact location of existing facilities prior to construction of new facilities and any connections thereto.
3. In event of discrepancy in data or staking provided by Owner, request clarification before proceeding with Work.
4. Retain professional land surveyor or civil engineer registered in state of Project who shall perform or supervise engineering surveying necessary for additional construction staking and layout.
5. Maintain complete accurate log of survey work as it progresses as a Record Document.
6. On request of Engineer, submit documentation.
7. Provide competent employee(s), tools, stakes, and other equipment and materials as Engineer may require to:
   a. Establish control points, lines, and easement boundaries.

b. Check layout, survey, and measurement work performed by others.
c. Measure quantities for payment purposes.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 SALVAGE OF MATERIALS

A. Salvage materials for Owner's use where shown.

1. Remove material with extreme care so as not to damage for future use.
2. Promptly remove salvaged materials from Work area.
3. Store materials where instructed by Owner offsite at 2601 West Elkhorn Boulevard, Rio Linda, CA 95673.

B. Meet with Engineer prior to starting to dismantle equipment or piping designated to be salvaged. Engineer will indicate locations where equipment is to be disconnected.

C. Provide new or repair damaged equipment or material specified or indicated to be salvaged. Clean and protect equipment from dust, dirt, natural elements, and store as directed.

3.02 CUTTING, FITTING, AND PATCHING

A. Cut, fit, adjust, or patch Work and work of others, including excavation and backfill as required, to make Work complete.

B. Obtain prior written authorization of Engineer before commencing Work to cut or otherwise alter:

1. Structural or reinforcing steel, structural column or beam, elevated slab, trusses, or other structural member.
2. Weather-resistant or moisture-resistant elements.
3. Efficiency, maintenance, or safety of element.
4. Work of others.

C. Refinish surfaces to provide an even finish.

1. Refinish continuous surfaces to nearest intersection.
2. Refinish entire assemblies.

3. Finish restored surfaces to such planes, shapes, and textures that no transition between existing work and the Work is evident in finished surfaces.

D. Restore existing work, Underground Facilities, and surfaces that are to remain in completed Work including concrete-embedded piping, conduit, and other utilities as specified and as shown on Drawings.

E. Make restorations with new materials and appropriate methods as specified for new Work of similar nature; if not specified, use recommended practice of manufacturer or appropriate trade association.

F. Fit Work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces and fill voids.

G. Remove specimens of installed Work for testing when requested by Engineer.

END OF SECTION

SECTION 01 31 19
PROJECT MEETINGS

PART 1 GENERAL

1.01 GENERAL

A. Engineer will schedule physical arrangements for meetings throughout progress of the Work, prepare meeting agenda with regular participant input and distribute with written notice of each meeting, preside at meetings, record minutes to include significant proceedings and decisions, and reproduce and distribute copies of minutes within 7 days after each meeting to participants and parties affected by meeting decisions.

1.02 PRECONSTRUCTION CONFERENCE

A. Contractor shall be prepared to discuss the following subjects, as a minimum:

1. Required schedules.
2. Status of Bonds and insurance.
3. Sequencing of critical path work items.
4. Progress payment procedures.
5. Project changes and clarification procedures.
6. Use of Site, access, office and storage areas, security and temporary facilities.
7. Major product delivery and priorities.
8. Contractor’s safety plan and representative.

B. Attendees will include:

1. Owner’s representatives.
2. Contractor’s office representative.
3. Contractor’s resident superintendent.
4. Contractor’s quality control representative.
5. Subcontractors’ representatives whom Contractor may desire or Engineer may request to attend.
6. Engineer’s representatives.
7. Others as appropriate.

1.03 PRELIMINARY SCHEDULES REVIEW MEETING

A. As set forth in General Conditions and Section 01 32 00, Construction Progress Documentation.

1.04 PROGRESS MEETINGS

A. Engineer will schedule regular progress meetings at Site, conducted weekly to review the Work progress, Progress Schedule, 3 week look-ahead schedule, Schedule of Submittals, Application for Payment, contract modifications, and other matters needing discussion and resolution.

B. Attendees will include:

1. Owner's representative(s), as appropriate.
2. Contractor, Subcontractors, and Suppliers, as appropriate.
3. Engineer's representative(s).
4. Others as appropriate.

1.05 QUALITY CONTROL MEETINGS

A. In accordance with Section 01 45 16.13, Contractor Quality Control.

1.06 PROCESS INSTRUMENTATION AND CONTROL SYSTEMS (PICS) COORDINATION MEETINGS

A. Engineer will schedule meetings at Site, conducted monthly to review specific requirements of PICS work.

B. Attendees will include:

1. Contractor.
2. Owner.
3. PICS Subcontractor/Installer.
4. Engineer's representatives.

1.07 PREINSTALLATION MEETINGS

A. When required in individual Specification sections, convene at Site prior to commencing the Work of that section.

B. Require attendance of entities directly affecting, or affected by, the Work of that section.

C. Notify Engineer 7 days in advance of meeting date.

D. Provide suggested agenda to Engineer to include reviewing conditions of installation, preparation and installation or application procedures, and coordination with related Work and work of others.

1.08 FACILITY STARTUP MEETINGS

A. Schedule and attend a minimum of two facility startup meetings. The first of such meetings shall be held prior to submitting Facility Startup Plan, as specified in Section 01 91 14, Equipment Testing and Facility Startup, and shall include preliminary discussions regarding such plan.

B. Agenda items shall include, but not be limited to, content of Facility Startup Plan, coordination needed between various parties in attendance, and potential problems associated with startup.

C. Attendees will include:

1. Contractor.
2. Contractor's designated quality control representative.
3. Subcontractors and equipment manufacturer's representatives whom Contractor deems to be directly involved in facility startup.
4. Engineer's representatives.
5. Owner's operations personnel.
6. Others as required by Contract Documents or as deemed necessary by Contractor.

1.09 OTHER MEETINGS

A. In accordance with Contract Documents, and as may be required by Owner and Engineer.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 32 00
CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 GENERAL

1.01 SUBMITTALS

A. Informational Submittals:

1. Preliminary Progress Schedule: Submit within time specified in Paragraph 2.03 of the General Conditions.
2. Detailed Progress Schedule:
   a. Submit initial Detailed Progress Schedule within 60 days after Effective Date of the Agreement.
   b. Submit an Updated Progress Schedule at each update, in accordance with Article Detailed Progress Schedule.
3. Submit with Each Progress Schedule Submission:
   a. Contractor’s certification that Progress Schedule submission is actual schedule being used for execution of the Work.
   b. Progress Schedule: Two legible hard copies.
   c. Narrative Progress Report: Same number of copies as specified for Progress Schedule.
4. Prior to final payment, submit a final Updated Progress Schedule.

1.02 PRELIMINARY PROGRESS SCHEDULE

A. In addition to basic requirements outlined in General Conditions, show a detailed schedule, beginning with Notice to Proceed, for minimum duration of 90 days, and a summary of balance of Project through Final Completion.

B. Show activities including, but not limited to the following:

1. Notice to Proceed.
2. Permits.
3. Submittals, with review time. Contractor may use Schedule of Submittals specified in Section 01 33 00, Submittal Procedures.
4. Early procurement activities for long lead equipment and materials.
5. Initial Site work.
6. Demolition.
7. Earthwork.
8. Specified Work sequences and construction constraints.
9. Contract Milestone and Completion Dates.
10. Major structural, mechanical, equipment, electrical, architectural, and instrumentation and control Work.

11. System startup summary.
12. Project close-out summary.
13. Demobilization summary.

C. Update Preliminary Progress Schedule monthly as part of progress payment process. Failure to do so may result in the Owner withholding all or part of the monthly progress payment until the Preliminary Progress Schedule is updated in a manner acceptable to Engineer.

D. Format: In accordance with Article Progress Schedule—Bar Chart.

1.03 DETAILED PROGRESS SCHEDULE

A. In addition to requirements of General Conditions, submit Detailed Progress Schedule beginning with Notice to Proceed and continuing through Final Completion.

B. Show the duration and sequences of activities required for complete performance of the Work reflecting means and methods chosen by Contractor.

C. When accepted by Engineer, Detailed Progress Schedule will replace Preliminary Progress Schedule and become Baseline Schedule. Subsequent revisions will be considered as Updated Progress Schedules.

D. Software: Latest version of Project Planner (P6) by Primavera Systems, Inc., unless otherwise approved by Engineer.

E. Format: In accordance with Article Progress Schedule—Bar Chart.

F. Update monthly to reflect actual progress and occurrences to date, including weather delays.

1.04 PROGRESS SCHEDULE—BAR CHART

A. General: Comprehensive bar chart schedule, generally as outlined in Associated General Contractors of America (AGC) 580, “Construction Project Planning and Scheduling Guidelines.” If a conflict occurs between the AGC publication and this Specification, this Specification shall govern.

B. Format:

1. Unless otherwise approved, white paper, 11-inch by 17-inch sheet size.
2. Title Block: Show name of Project and Owner, date submitted, revision or update number, and name of scheduler.

3. Identify horizontally, across the top of the schedule, the time frame by year, month, and day.
4. Identify each activity with a unique number and a brief description of the Work associated with that activity.
5. Legend: Describe standard and special symbols used.

C. Contents:

1. Identify, in chronological order, those activities reasonably required to complete the Work, including as applicable, but not limited to:
   a. Obtaining permits, submittals for early product procurement, and long lead time items.
   b. Mobilization and other preliminary activities.
   c. Initial Site work.
   d. Specified Work sequences, constraints, and Milestones, including Substantial Completion date(s).
   e. Subcontract Work.
   f. Major equipment design, fabrication, factory testing, and delivery dates.
   g. Delivery dates for Owner-furnished products, as specified in Section 01 11 00, Summary of Work.
   h. Sitework.
   i. Concrete Work.
   j. Structural steel Work.
   k. Architectural features Work.
   l. Conveying systems Work.
   m. Equipment Work.
   n. Mechanical Work.
   o. Electrical Work.
   p. Instrumentation and control Work.
   q. Interfaces with Owner-furnished equipment.
   r. Other important Work for each major facility.
   s. Equipment and system startup and test activities.
   t. Project closeout and cleanup.
   u. Demobilization.

1.05 PROGRESS OF THE WORK

A. Updated Progress Schedule shall reflect:

1. Progress of Work to within 5 working days prior to submission.
2. Approved changes in Work scope and activities modified since submission.
3. Delays in Submittals or resubmittals, deliveries, or Work.

4. Adjusted or modified sequences of Work.
5. Other identifiable changes.
6. Revised projections of progress and completion.
7. Report of changed logic.

B. Produce detailed sub-schedules during Project, upon request of Owner or Engineer, to further define critical portions of the Work such as facility shutdowns.

C. If an activity is not completed by its latest scheduled completion date and this failure is anticipated to extend Contract Times (or Milestones), submit, within 7 days of such failure, a written statement as to how nonperformance will be corrected to return Project to acceptable current Progress Schedule. Actions by Contractor to complete the Work within Contract Times (or Milestones) will not be justification for adjustment to Contract Price or Contract Times.

D. Owner may order Contractor to increase plant, equipment, labor force, or working hours if Contractor fails to:

1. Complete a Milestone activity by its completion date.
2. Satisfactorily execute Work as necessary to prevent delay to overall completion of Project, at no additional cost to Owner.

1.06 NARRATIVE PROGRESS REPORT

A. Format:

1. Organize same as Progress Schedule.
2. Identify, on a cover letter, reporting period, date submitted, and name of author of report.

B. Contents:

1. Number of days worked over the period, work force on hand, construction equipment on hand (including utility vehicles such as pickup trucks, maintenance vehicles, stake trucks).
2. General progress of Work, including a listing of activities started and completed over the reporting period, mobilization/demobilization of subcontractors, and major milestones achieved.
3. Contractor’s plan for management of Site (for example, lay down and staging areas, construction traffic), use of construction equipment, buildup of trade labor, and identification of potential Contract changes.
4. Identification of new activities and sequences as a result of executed Contract changes.

5. Documentation of weather conditions over the reporting period, and any resulting impacts to the Work.
6. Description of actual or potential delays, including related causes, and the steps taken or anticipated to mitigate their impact.
7. Changes to activity logic.
8. Changes to the critical path.
9. Identification of, and accompanying reason for, any activities added or deleted since the last report.
10. Steps taken to recover the schedule from Contractor-caused delays.

1.07 SCHEDULE ACCEPTANCE

A. Engineer's acceptance will demonstrate agreement that:

1. Proposed schedule is accepted with respect to:
   a. Contract Times, including Final Completion and all intermediate Milestones, are within the specified times.
   b. Specified Work sequences and constraints are shown as specified.
   c. Specified Owner-furnished Equipment or Material arrival dates, or range of dates, are included.
   d. Access restrictions are accurately reflected.
   e. Startup and testing times are as specified.
   f. Submittal review times are as specified.
   g. Startup testing duration is as specified and timing is acceptable.
2. In all other respects, Engineer's acceptance of Contractor's schedule indicates that, in Engineer's judgment, schedule represents reasonable plan for constructing Project in accordance with the Contract Documents. Engineer's review will not make any change in Contract requirements. Lack of comment on any aspect of schedule that is not in accordance with the Contract Documents will not thereby indicate acceptance of that change, unless Contractor has explicitly called the nonconformance to Engineer's attention in submittal. Schedule remains Contractor's responsibility and Contractor retains responsibility for performing all activities, for activity durations, and for activity sequences required to construct Project in accordance with the Contract Documents.

B. Unacceptable Preliminary Progress Schedule:

1. Make requested corrections; resubmit within 10 days.
2. Until acceptable to Engineer as Baseline Progress Schedule, continue review and revision process, including updating schedule on a monthly basis to reflect actual progress and occurrences to date.

C. Unacceptable Detailed Progress Schedule:

1. Make requested corrections; resubmit within 10 days.
2. Until acceptable to Engineer as Baseline Progress Schedule, continue review and revision process.

D. Narrative Report: All changes to activity duration and sequences, including addition or deletion of activities subsequent to Engineer's acceptance of Baseline Progress Schedule, shall be delineated in Narrative Report current with proposed Updated Progress Schedule.

1.08 ADJUSTMENT OF CONTRACT TIMES

A. Reference General Conditions and Section 01 26 00, Contract Modification Procedures.

B. Evaluation and reconciliation of Adjustments of Contract Times shall be based on the Updated Progress Schedule at the time of proposed adjustment or claimed delay.

C. Schedule Contingency:

1. Contingency, when used in the context of the Progress Schedule, is time between Contractor's proposed Completion Time and Contract Completion Time.
2. Contingency included in Progress Schedule is a Project resource available to both Contractor and Owner to meet Contract Milestones and Contract Times. Use of Schedule contingency shall be shared to the proportionate benefit of both parties.
3. Use of schedule contingency suppression techniques such as preferential sequencing and extended activity times is prohibited.
4. Pursuant to Contingency sharing provisions of this Specification, no time extensions will be granted, nor will delay damages be paid until a delay occurs which (i) consumes all available contingency time, and (ii) extends Work beyond the Contract Completion date.

D. Claims Based on Contract Times:

1. Where Engineer has not yet rendered formal decision on Contractor's Claim for adjustment of Contract Times, and parties are unable to agree as to amount of adjustment to be reflected in Progress Schedule, reflect an interim adjustment in the Progress Schedule as acceptable to Engineer.
2. It is understood and agreed that such interim acceptance will not be binding on either Contractor or Owner, and will be made only for the

purpose of continuing to schedule Work until such time as formal decision has been rendered as to an adjustment, if any, of the Contract Times.

3. Revise Progress Schedule prepared thereafter in accordance with Engineer's formal decision.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 33 00
SUBMITTAL PROCEDURES

PART 1 GENERAL

1.01 DEFINITIONS

A. Action Submittal: Written and graphic information submitted by Contractor that requires Engineer's approval.

B. Deferred Submittal: Information in accordance with 2022 CBC Section 107.3.4.1 submitted by Contractor for portions of design that are to be submitted to permitting agency for approval prior to installation of that portion of the Work, along with Engineer's review documentation that Submittal has been found to be in general conformance with Project's design.

C. Informational Submittal: Information submitted by Contractor that requires Engineer's review and determination that submitted information is in accordance with the Conditions of the Contract.

1.02 PROCEDURES

A. Direct Submittals to Engineer at the following, unless specified otherwise.

JACOBS
Attn: Diana Dore
2525 Airpark Drive
Redding, CA 96001
Phone No.: (530) 229-3333
E-mail: diana.dore@jacobs.com and brad.memeo@jacobs.com

B. Electronic Submittals: Submittals shall, unless specifically accepted, be made in electronic format.

1. Each Submittal shall be an electronic file in Adobe Acrobat Portable Document Format (PDF). Use the latest version available at time of execution of the Agreement.
2. Electronic files that contain more than 10 pages in PDF format shall contain internal bookmarking from an index page to major sections of the document.
3. PDF files shall be set to open "Bookmarks and Page" view.
4. Add general information to each PDF file, including title, subject, author, and keywords.

5. PDF files shall be set up to print legibly at 8.5-inch by 11-inch, 11-inch by 17-inch, or 22-inch by 34-inch. No other paper sizes will be accepted.
6. Submit new electronic files for each Resubmittal.
7. Include a copy of the Transmittal of Contractor's Submittal form, located at end of section, with each electronic file.
8. Engineer will reject Submittal that is not electronically submitted, unless specifically accepted.
9. Provide Engineer with authorization to reproduce and distribute each file as many times as necessary for Project documentation.
10. Detailed procedures for handling electronic Submittals will be discussed at the preconstruction conference.

C. Transmittal of Submittal:

1. Contractor shall:
   a. Review each Submittal and check for compliance with Contract Documents.
   b. Stamp each Submittal with uniform approval stamp before submitting to Engineer.
      1) Stamp to include Project name, Submittal number, Specification number, Contractor's reviewer name, date of Contractor's approval, and statement certifying Submittal has been reviewed, checked, and approved for compliance with Contract Documents.
      2) Engineer will not review Submittals that do not bear Contractor's approval stamp and will return them without action.
2. Complete, sign, and transmit with each Submittal package, one Transmittal of Contractor's Submittal form attached at end of this section.
3. Identify each Submittal with the following:
   a. Numbering and Tracking System:
      1) Sequentially number each Submittal.
      2) Resubmission of Submittal shall have original number with sequential alphabetic suffix.
   b. Specification section and paragraph to which Submittal applies.
   c. Project title and Engineer's project number.
   d. Date of transmittal.
   e. Names of Contractor, Subcontractor or Supplier, and manufacturer as appropriate.
4. Identify and describe each deviation or variation from Contract Documents.

D. Format:

1. Do not base Shop Drawings on reproductions of Contract Documents.
2. Package Submittal information by individual specification section. Do not combine different specification sections together in Submittal package, unless otherwise directed in Specification.
3. Present in a clear and thorough manner and in sufficient detail to show kind, size, arrangement, and function of components, materials, and devices, and compliance with Contract Documents.
4. Index with labeled tab dividers in orderly manner.

E. Timeliness: Schedule and submit in accordance Schedule of Submittals and requirements of individual specification sections.

F. Processing Time:

1. Time for review shall commence on Engineer's receipt of Submittal.
2. Engineer will act upon Contractor's Submittal and transmit response to Contractor not later than 30 days after receipt, unless otherwise specified.
3. Resubmittals will be subject to same review time.
4. No adjustment of Contract Times or Price will be allowed as a result of delays in progress of Work caused by rejection and subsequent Resubmittals.

G. Resubmittals: Clearly identify each correction or change made.

H. Incomplete Submittals:

1. Engineer will return entire Submittal for Contractor's revision if preliminary review deems it incomplete.
2. When any of the following are missing, Submittal will be deemed incomplete:
   a. Contractor's review stamp; completed and signed.
   b. Transmittal of Contractor's Submittal; completed and signed.

I. Submittals not required by Contract Documents:

1. Will not be reviewed and will be returned stamped "Not Subject to Review."
2. Engineer will keep one copy and return Submittal to Contractor.

1.03 ACTION SUBMITTALS

A. Prepare and submit Action Submittals required by individual specification sections.

B. Shop Drawings:

1. Identify and Indicate:
   a. Applicable Contract Drawing and Detail number, products, units and assemblies, and system or equipment identification or tag numbers.
   b. Equipment and Component Title: Identical to title shown on Drawings.
   c. Critical field dimensions and relationships to other critical features of Work. Note dimensions established by field measurement.
   d. Project-specific information drawn accurately to scale.
2. Manufacturer's standard schematic drawings and diagrams as follows:
   a. Modify to delete information that is not applicable to the Work.
   b. Supplement standard information to provide information specifically applicable to the Work.
3. Product Data: Provide as specified in individual specifications.
4. Deferred Submittal: See Drawings for list of deferred Submittals.
   a. Contractor-design drawings and product data related to permanent construction.
      1) Written and graphic information.
      2) Drawings.
      3) Cut sheets.
      4) Data sheets.
      5) Action item Submittals requested in individual specification section.
   b. Prior to installation of indicated structural or nonstructural element, equipment, distribution system, or component or its anchorage, submit required supporting data and drawings for review and acceptance by Engineer. Documentation of review and approval provided on Engineer's comment form, along with completed Submittal, will be filed with permitting agency by Engineer and approved by permitting agency prior to installation.
5. Foreign Manufacturers: When proposed, include names and addresses of at least two companies that maintain technical service representatives close to Project.

C. Samples:

1. Copies: Two, unless otherwise specified in individual specifications.
2. Preparation:
    a. Mount, display, or package Samples in manner specified to facilitate review of quality. Attach label on unexposed side that includes the following:
        1) Manufacturer name.
        2) Model number.
        3) Material.
        4) Sample source.
3. Manufacturer's Color Chart: Units or sections of units showing full range of colors, textures, and patterns available.
4. Full-size Samples:
    a. Size as indicated in individual specification section.
    b. Prepared from same materials to be used for the Work.
    c. Cured and finished in manner specified.
    d. Physically identical with product proposed for use.

D. Action Submittal Dispositions:

1. Engineer will review, comment, stamp, and distribute as noted:
    a. Approved:
        1) Contractor may incorporate product(s) or implement Work covered by Submittal.
        2) Distribution: Electronic.
    b. Approved as Noted:
        1) Contractor may incorporate product(s) or implement Work covered by Submittal, in accordance with Engineer's notations.
        2) Distribution: Electronic.
    c. Partial Approval, Resubmit as Noted:
        1) Make corrections or obtain missing portions, and resubmit.
        2) Except for portions indicated, Contractor may begin to incorporate product(s) or implement Work covered by Submittal, in accordance with Engineer's notations.
        3) Distribution: Electronic.
    d. Revise and Resubmit:
        1) Contractor may not incorporate product(s) or implement Work covered by Submittal.
        2) Distribution: Electronic.

1.04 INFORMATIONAL SUBMITTALS

A. General:

1. Refer to individual specification sections for specific Submittal requirements.
2. Engineer will review each Submittal. If Submittal meets conditions of the Contract, Engineer will forward copy to appropriate parties. If Engineer determines Submittal does not meet conditions of the Contract and is therefore considered unacceptable, Engineer will retain one copy and return remaining copy with review comments to Contractor, and require that Submittal be corrected and resubmitted.

B. Certificates:

1. General:
   a. Provide notarized statement that includes signature of entity responsible for preparing certification.
   b. Signed by officer or other individual authorized to sign documents on behalf of that entity.
2. Welding: In accordance with individual specification sections.
3. Installer: Prepare written statements on manufacturer's letterhead certifying installer complies with requirements as specified in individual specification section.
4. Material Test: Prepared by qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements.
5. Certificates of Successful Testing or Inspection: Submit when testing or inspection is required by Laws and Regulations or governing agency or specified in individual specification sections.
6. Manufacturer's Certificate of Compliance: In accordance with Section 01 61 00, Common Product Requirements.
7. Manufacturer's Certificate of Proper Installation: In accordance with Section 01 43 33, Manufacturers' Field Services.

C. Construction Photographs and Video: In accordance with Section 01 31 13, Project Coordination, and as may otherwise be required in Contract Documents.

D. Closeout Submittals: In accordance with Section 01 77 00, Closeout Procedures.

E. Contractor-design Data (related to temporary construction):

1. Written and graphic information.
2. List of assumptions.
3. List of performance and design criteria.
4. Summary of loads or load diagram, if applicable.
5. Calculations.
6. List of applicable codes and regulations.
7. Name and version of software.
8. Information requested in individual specification section.

F. Deferred Submittals: See Drawings for list of deferred Submittals.

1. Contractor-design data related to permanent construction:
   a. List of assumptions.
   b. List of performance and design criteria.
   c. Summary of loads or load diagram, if applicable.
   d. Calculations.
   e. List of applicable codes and regulations.
   f. Name and version of design software.
   g. Factory test results.
   h. Informational Submittals requested in individual specification section.
2. Prior to installation of indicated structural or nonstructural element, equipment, distribution system, or component or its anchorage, submit calculations and test results of Contractor-designed components for review by Engineer. Documentation of review and indication of compliance with general design intent and project criteria provided on Engineer's comment form as meets conditions of the Contract, along with completed Submittal, will be filed with permitting agency by Engineer and approved by permitting agency prior to installation.

G. Manufacturer's Instructions: Written or published information that documents manufacturer's recommendations, guidelines, and procedures in accordance with individual specification section.

H. Operation and Maintenance Data: As required in Section 01 78 23, Operation and Maintenance Data.

I. Payment:

1. Application for Payment: In accordance with Section 01 29 00, Payment Procedures.
2. Schedule of Values: In accordance with Section 01 29 00, Payment Procedures.

3. Schedule of Estimated Progress Payments: In accordance with Section 01 29 00, Payment Procedures.

J. Quality Control Documentation: As required in Section 01 45 16.13, Contractor Quality Control.

K. Schedules:

1. Schedule of Submittals: Prepare separately or in combination with Progress Schedule as specified in Section 01 32 00, Construction Progress Documentation.
   a. Show for each, at a minimum, the following:
      1) Specification section number.
      2) Identification by numbering and tracking system as specified under Paragraph Transmittal of Submittal.
      3) Estimated date of submission to Engineer, including reviewing and processing time.
   b. On a monthly basis, submit updated Schedule of Submittals to Engineer if changes have occurred or Resubmittals are required.
2. Progress Schedules: In accordance with Section 01 32 00, Construction Progress Documentation.

L. Special Guarantee: Supplier’s written guarantee as required in individual specification sections.

M. Statement of Qualification: Evidence of qualification, certification, or registration as required in Contract Documents to verify qualifications of professional land surveyor, engineer, materials testing laboratory, specialty Subcontractor, trade, Specialist, consultant, installer, and other professionals. Reference Paragraph 1.01.A.38.b of Supplementary Conditions for definition of Specialist.

N. Submittals Required by Laws, Regulations, and Governing Agencies:

1. Promptly submit promptly notifications, reports, certifications, payrolls, and otherwise as may be required, directly to the applicable federal, state, or local governing agency or their representative.
2. Transmit to Engineer for Owner’s records one copy of correspondence and transmittals (to include enclosures and attachments) between Contractor and governing agency.

O. Test, Evaluation, and Inspection Reports:

1. General: Shall contain signature of person responsible for test or report.
2. Factory:
   a. Identification of product and specification section, type of inspection or test with referenced standard or code.
   b. Date of test, Project title and number, and name and signature of authorized person.
   c. Test results.
   d. If test or inspection deems material or equipment not in compliance with Contract Documents, identify corrective action necessary to bring into compliance.
   e. Provide interpretation of test results, when requested by Engineer.
   f. Other items as identified in individual specification sections.
3. Field:
   a. As a minimum, include the following:
      1) Project title and number.
      2) Date and time.
      3) Record of temperature and weather conditions.
      4) Identification of product and specification section.
      5) Type and location of test, Sample, or inspection, including referenced standard or code.
      6) Date issued, testing laboratory name, address, and telephone number, and name and signature of laboratory inspector.
      7) If test or inspection deems material or equipment not in compliance with Contract Documents, identify corrective action necessary to bring into compliance.
      8) Provide interpretation of test results, when requested by Engineer.
      9) Other items as identified in individual specification sections.

P. Testing and Startup Data: In accordance with Section 01 91 14, Equipment Testing and Facility Startup.

Q. Training Data: In accordance with Section 01 43 33, Manufacturers' Field Services.

1.05 SUPPLEMENTS

A. The supplement listed below, following "End of Section", is part of this Specification.

1. Transmittal of Contractor's Submittal.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

NATOMAS MUTUAL WATER COMPANY
ELKHORN PUMPING PLANT REPLACEMENT

Jacobs

TRANSMITTAL OF CONTRACTOR'S SUBMITTAL

(ATTACH TO EACH SUBMITTAL)

DATE: _____

TO: JACOBS Attn: Diana Dore 2525 Airpark Drive Redding, CA 96001 E-mail: diana.dore@jacobs.com and brad.memeo@jacobs.com **FROM**: _____ Contractor	Submittal No.: _____ ☐ New Submittal ☐ Resubmittal Project: Elkhorn Pumping Plant Replacement Project No.: W8Y09802 Specification Section No.: _____ **(Cover only one section with each transmittal)** Schedule Date of Submittal:

SUBMITTAL TYPE:	☐ Shop Drawing	☐ Sample	☐ Informational
	☐ Deferred		

The following items are hereby submitted:

Number of Copies	Description of Item Submitted (Type, Size, Model Number, Etc.)	Spec. and Para. No.	Drawing or Brochure Number	Contains Variation to Contract	
				No	Yes

Contractor hereby certifies that (i) Contractor has complied with the requirements of Contract Documents in preparation, review, and submission of designated Submittal and (ii) the Submittal is complete and in accordance with the Contract Documents and requirements of laws and regulations and governing agencies.

By: _____
Contractor (Authorized Signature)

SECTION 01 42 13
ABBREVIATIONS AND ACRONYMS

PART 1 GENERAL

1.01 REFERENCE TO STANDARDS AND SPECIFICATIONS OF TECHNICAL SOCIETIES

A. Reference to standards and specifications of technical societies and reporting and resolving discrepancies associated therewith shall be as provided in Article 3 of the General Conditions, and as may otherwise be required herein and in the individual specification sections.

B. Work specified by reference to published standard or specification of government agency, technical association, trade association, professional society or institute, testing agency, or other organization shall meet requirements or surpass minimum standards of quality for materials and workmanship established by designated standard or specification.

C. Where so specified, products or workmanship shall also meet or exceed additional prescriptive or performance requirements included within Contract Documents to establish a higher or more stringent standard of quality than required by referenced standard.

D. Where two or more standards are specified to establish quality, product and workmanship shall meet or exceed requirements of most stringent.

E. Where both a standard and a brand name are specified for a product in Contract Documents, proprietary product named shall meet or exceed requirements of specified reference standard.

F. Copies of Standards and Specifications of Technical Societies:

1. Copies of applicable referenced standards have not been bound in these Contract Documents.
2. Where copies of standards are needed by Contractor, obtain a copy or copies directly from publication source and maintain in an orderly manner at the Site as Work Site records, available to Contractor’s personnel, Subcontractors, Owner, and Engineer.

1.02 ABBREVIATIONS

A. Abbreviations for trade organizations and government agencies: Following is a list of construction industry organizations and government agencies to which references may be made in the Contract Documents, with abbreviations used.

1.	AA	Aluminum Association
2.	AABC	Associated Air Balance Council
3.	AAMA	American Architectural Manufacturers Association
4.	AASHTO	American Association of State Highway and Transportation Officials
5.	ABMA	American Bearing Manufacturers' Association
6.	ACI	American Concrete Institute
7.	AEIC	Association of Edison Illuminating Companies
8.	AGA	American Gas Association
9.	AGMA	American Gear Manufacturers' Association
10.	AI	Asphalt Institute
11.	AISC	American Institute of Steel Construction
12.	AISI	American Iron and Steel Institute
13.	AITC	American Institute of Timber Construction
14.	ALS	American Lumber Standards
15.	AMCA	Air Movement and Control Association
16.	ANSI	American National Standards Institute
17.	APA	APA – The Engineered Wood Association
18.	API	American Petroleum Institute
19.	APWA	American Public Works Association
20.	AHRI	Air-Conditioning, Heating, and Refrigeration Institute
21.	ASA	Acoustical Society of America
22.	ASABE	American Society of Agricultural and Biological Engineers
23.	ASCE	American Society of Civil Engineers
24.	ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
25.	ASME	American Society of Mechanical Engineers
26.	ASNT	American Society for Nondestructive Testing
27.	ASSE	American Society of Sanitary Engineering
28.	ASTM	ASTM International
29.	AWI	Architectural Woodwork Institute
30.	AWPA	American Wood Preservers' Association
31.	AWPI	American Wood Preservers' Institute
32.	AWS	American Welding Society
33.	AWWA	American Water Works Association

34.	BHMA	Builders Hardware Manufacturers' Association
35.	CBM	Certified Ballast Manufacturer
36.	CDA	Copper Development Association
37.	CGA	Compressed Gas Association
38.	CISPI	Cast Iron Soil Pipe Institute
39.	CMAA	Crane Manufacturers' Association of America
40.	CRSI	Concrete Reinforcing Steel Institute
41.	CS	Commercial Standard
42.	CSA	Canadian Standards Association
43.	CSI	Construction Specifications Institute
44.	DIN	Deutsches Institut für Normung e.V.
45.	DIPRA	Ductile Iron Pipe Research Association
46.	EIA	Electronic Industries Alliance
47.	EJCDC	Engineers Joint Contract Documents' Committee
48.	ETL	Electrical Test Laboratories
49.	FAA	Federal Aviation Administration
50.	FCC	Federal Communications Commission
51.	FDA	Food and Drug Administration
52.	FEMA	Federal Emergency Management Agency
53.	FIPS	Federal Information Processing Standards
54.	FM	FM Global
55.	Fed. Spec.	Federal Specifications (FAA Specifications)
56.	FS	Federal Specifications and Standards (Technical Specifications)
57.	GA	Gypsum Association
58.	GANA	Glass Association of North America
59.	HI	Hydraulic Institute
60.	HMI	Hoist Manufacturers' Institute
61.	IBC	International Building Code
62.	ICBO	International Conference of Building Officials
63.	ICC	International Code Council
64.	ICEA	Insulated Cable Engineers' Association
65.	IFC	International Fire Code
66.	IEEE	Institute of Electrical and Electronics Engineers, Inc.
67.	IESNA	Illuminating Engineering Society of North America
68.	IFI	Industrial Fasteners Institute
69.	IGMA	Insulating Glass Manufacturer's Alliance
70.	IMC	International Mechanical Code
71.	INDA	Association of the Nonwoven Fabrics Industry
72.	IPC	International Plumbing Code
73.	ISA	International Society of Automation

74.	ISO	International Organization for Standardization
75.	ITL	Independent Testing Laboratory
76.	JIC	Joint Industry Conferences of Hydraulic Manufacturers
77.	MIA	Marble Institute of America
78.	MIL	Military Specifications
79.	MMA	Monorail Manufacturers' Association
80.	MSS	Manufacturer's Standardization Society
81.	NAAMM	National Association of Architectural Metal Manufacturers
82.	NACE	NACE International
83.	NBGQA	National Building Granite Quarries Association
84.	NEBB	National Environmental Balancing Bureau
85.	NEC	National Electrical Code
86.	NECA	National Electrical Contractor's Association
87.	NEMA	National Electrical Manufacturers' Association
88.	NESC	National Electrical Safety Code
89.	NETA	InterNational Electrical Testing Association
90.	NFPA	National Fire Protection Association
91.	NHLA	National Hardwood Lumber Association
92.	NICET	National Institute for Certification in Engineering Technologies
93.	NIST	National Institute of Standards and Technology
94.	NRCA	National Roofing Contractors Association
95.	NRTL	Nationally Recognized Testing Laboratories
96.	NSF	NSF International
97.	NSPE	National Society of Professional Engineers
98.	NTMA	National Terrazzo and Mosaic Association
99.	NWWDA	National Wood Window and Door Association
100.	OSHA	Occupational Safety and Health Act (both Federal and State)
101.	PCI	Precast/Prestressed Concrete Institute
102.	PEI	Porcelain Enamel Institute
103.	PPI	Plastic Pipe Institute
104.	PS	Product Standards Section-U.S. Department of Commerce
105.	RMA	Rubber Manufacturers' Association
106.	RUS	Rural Utilities Service
107.	SAE	SAE International
108.	SDI	Steel Deck Institute
109.	SDI	Steel Door Institute
110.	SJI	Steel Joist Institute
111.	SMACNA	Sheet Metal and Air Conditioning Contractors National Association

112.	SPI	Society of the Plastics Industry
113.	SSPC	The Society for Protective Coatings
114.	STI/SPFA	Steel Tank Institute/Steel Plate Fabricators Association
115.	SWI	Steel Window Institute
116.	TEMA	Tubular Exchanger Manufacturers' Association
117.	TCA	Tile Council of North America
118.	TIA	Telecommunications Industry Association
119.	UBC	Uniform Building Code
120.	UFC	Uniform Fire Code
121.	UL	formerly Underwriters Laboratories Inc.
122.	UMC	Uniform Mechanical Code
123.	USBR	U.S. Bureau of Reclamation
124.	WCLIB	West Coast Lumber Inspection Bureau
125.	WI	Wood Institute
126.	WWPA	Western Wood Products Association

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 43 33
MANUFACTURERS' FIELD SERVICES

PART 1 GENERAL

1.01 DEFINITIONS

A. Person-Day: One person for 8 hours within regular Contractor working hours.

1.02 SUBMITTALS

A. Informational Submittals:

1. Training Schedule: Submit, in accordance with requirements of this Specification, not less than 21 days prior to start of equipment installation and revise as necessary for acceptance.
2. Lesson Plan: Submit, in accordance with requirements of this Specification, proposed lesson plan not less than 21 days prior to scheduled training and revise as necessary for acceptance.

1.03 QUALIFICATION OF MANUFACTURER'S REPRESENTATIVE

A. Authorized representative of the manufacturer, factory trained, and experienced in the technical applications, installation, operation, and maintenance of respective equipment, subsystem, or system, with full authority by the equipment manufacturer to issue the certifications required of the manufacturer. Additional qualifications may be specified in the individual specification section.

B. Representative subject to acceptance by Engineer. No substitute representatives will be allowed unless prior written approval by such has been given.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 FULFILLMENT OF SPECIFIED MINIMUM SERVICES

A. Furnish manufacturers' services, when required by an individual specification section, to meet the requirements of this section.

B. Where time is necessary in excess of that stated in the Specifications for manufacturers' services, or when a minimum time is not specified, time required to perform specified services shall be considered incidental.

C. Schedule manufacturer' services to avoid conflict with other onsite testing or other manufacturers' onsite services.

D. Determine, before scheduling services, that conditions necessary to allow successful testing have been met.

E. Only those days of service approved by Engineer will be credited to fulfill specified minimum services.

F. When specified in individual specification sections, manufacturer's onsite services shall include:

1. Assistance during product (system, subsystem, or component) installation to include observation, guidance, instruction of Contractor's assembly, erection, installation or application procedures.
2. Inspection, checking, and adjustment as required for product (system, subsystem, or component) to function as warranted by manufacturer and necessary to furnish Manufacturer's Certificate of Proper Installation.
3. Providing, on a daily basis, copies of manufacturers' representatives field notes and data to Engineer.
4. Revisiting the Site as required to correct problems and until installation and operation are acceptable to Engineer.
5. Resolution of assembly or installation problems attributable to or associated with respective manufacturer's products and systems.
6. Assistance during functional and performance testing, and facility startup and evaluation.
7. Training of Owner's personnel in the operation and maintenance of respective product as required.

3.02 MANUFACTURER'S CERTIFICATE OF PROPER INSTALLATION

A. When so specified, a Manufacturer's Certificate of Proper Installation form, a copy of which is attached to this section, shall be completed and signed by equipment manufacturer's representative.

B. Such form shall certify signing party is a duly authorized representative of manufacturer, is empowered by manufacturer to inspect, approve, and operate their equipment and is authorized to make recommendations required to ensure equipment is complete and operational.

3.03 TRAINING

A. General:

1. Furnish manufacturers' representatives for detailed classroom and hands-on training to Owner's personnel on operation and maintenance of specified product (system, subsystem, component) and as may be required in applicable Specifications.
2. Furnish trained, articulate personnel to coordinate and expedite training, to be present during training coordination meetings with Owner, and familiar with operation and maintenance manual information specified in Section 01 78 23, Operation and Maintenance Data.
3. Manufacturer's representative shall be familiar with facility operation and maintenance requirements as well as with specified equipment.
4. Furnish complete training materials, to include operation and maintenance data, to be retained by each trainee.

B. Training Schedule:

1. List specified equipment and systems that require training services and show:
   a. Respective manufacturer.
   b. Estimated dates for installation completion.
   c. Estimated training dates.
2. Allow for multiple sessions when several shifts are involved.
3. Adjust schedule to ensure training of appropriate personnel as deemed necessary by Owner, and to allow full participation by manufacturers' representatives. Adjust schedule for interruptions in operability of equipment.
4. Coordinate with Section 01 32 00, Construction Progress Documentation, and Section 01 91 14, Equipment Testing and Facility Startup.

C. Lesson Plan:

1. When manufacturer or vendor training of Owner personnel is specified, prepare a lesson plan for each required course containing the following minimum information:
   a. Title and objectives.
   b. Recommended attendees (such as, managers, engineers, operators, maintenance).
   c. Course description, outline of course content, and estimated class duration.
   d. Format (such as, lecture, self-study, demonstration, hands-on).

e. Instruction materials and equipment requirements.
f. Resumes of instructors providing training.

D. Prestartup Training:

1. Coordinate training sessions with Owner's operating personnel and manufacturers' representatives, and with submission of operation and maintenance manuals in accordance with Section 01 78 23, Operation and Maintenance Data.
2. Complete at least 14 days prior to beginning of facility startup.

E. Post-startup Training: If required in Specifications, furnish and coordinate training of Owner's operating personnel by respective manufacturer's representatives.

3.04 SUPPLEMENTS

A. The supplement listed below, following "End of Section," is part of this Specification.

1. Manufacturer's Certificate of Proper Installation.

END OF SECTION

MANUFACTURER'S CERTIFICATE OF PROPER INSTALLATION

OWNER: Natomas Mutual Water Company EQPT SERIAL NO: _____

EQPT TAG NO: _____ EQPT/SYSTEM: _____

PROJECT NO: W8Y09802 SPEC. SECTION: _____

I hereby certify that the above-referenced equipment/system has been:

(Check Applicable)

☐ Installed in accordance with Manufacturer's recommendations.

☐ Inspected, checked, and adjusted.

☐ Serviced with proper initial lubricants.

☐ Electrical and mechanical connections meet quality and safety standards.

☐ All applicable safety equipment has been properly installed.

☐ Functional tests.

☐ System has been performance tested, and meets or exceeds specified performance requirements. (When complete system of one manufacturer)

Note: Attach any performance test documentation from manufacturer.

Comments: _____

_____

_____

_____

I, the undersigned Manufacturer's Representative, hereby certify that I am (i) a duly authorized representative of the manufacturer, (ii) empowered by the manufacturer to inspect, approve, and operate their equipment and (iii) authorized to make recommendations required to ensure equipment furnished by the manufacturer is complete and operational, except as may be otherwise indicated herein. I further certify that all information contained herein is true and accurate.

Date: _____, 20___

Manufacturer: _____

By Manufacturer's Authorized Representative: _____
(Authorized Signature)

SECTION 01 45 00
PERMITS

PART 1 GENERAL

1.01 THE REQUIREMENT

A. Contractor shall comply with the conditions of permits acquired by Owner and obtain all other permits required for the execution of the Work, as indicated. Copies of permits acquired by Contractor shall be provided to Owner and Engineer.

B. The intent of this section is to furnish Contractor with the list of known required permits for the Work. Contractor should note that the list is not necessarily complete and that additional permit and associated requirements may exist or arise.

C. A copy of permits unique to the Project are included as Supplements to this section. Contractor shall examine the attached information and shall conform to the requirements contained therein, and such requirements are hereby made a part of these Contract Documents as fully and completely as though the same were set forth herein. All requirements of the permits apply to Contractor, regardless of language referring to “Owner”, “Applicant”, “Permittee” or similar designations. Contractor shall include in the Bid the cost of obtaining all necessary permits, including application fees and other costs, and the costs of complying with the conditions of all permits, unless specifically indicated otherwise.

D. Unless otherwise indicated, Contractor shall conduct all notifications required by permits.

E. Contractor shall provide all documentation, demonstrations, sampling, testing, quantity summaries, work summaries, and other monitoring activities required by the various permits.

F. Contractor shall prepare all reports required by the various permits.

1. Unless otherwise indicated, Contractor shall submit all reports required by the various permits described in this section to Engineer. Owner and Engineer will submit said reports to the permitting entity. Contractor shall provide reports to Engineer with reasonable time for review of said reports and subsequent revisions and submission to the permitting entity by the date required.

2. For permits obtained by Contractor that are not described in this section, Contractor shall prepare all reports and submit directly to the permitting agency.

G. Completeness of the listing of permits in this section is not guaranteed by Owner. The absence of information does not relieve Contractor of responsibility for determining and verifying the extent of permits required and for obtaining permits.

1.02 SUMMARY OF PERMITS TO BE OBTAINED BY CONTRACTOR

A. The following permits shall be obtained by Contractor. Copies of these and other permits obtained by Contractor shall be submitted to Engineer and be held onsite. Contractor shall comply with all conditions of the permits.

1. Central Valley Regional Water Quality Control Board (CVRWQCB):
   a. Contractor shall prepare a Storm Water Pollution Prevention Plan (SWPPP) pursuant to Section 01 30 00, Environmental Compliance, in full conformance with these Contract Documents and all aspects of State Water Resources Control Board National Pollutant Discharge Elimination System (NPDES) General Permit for Storm Water Discharges Associated with Construction Activity Water Quality Order 2009-0009-DWQ (General Permit) as amended by 2010-0014-DWQ and 2012-0006-DWQ.
      1) Permit forms are available online at: http://www.waterboards.ca.gov/publications_forms/forms/index.shtml.
      2) Contractor is responsible for posting all required documents, reports, and information in the California Water Boards' Stormwater Multiple Application and Reporting Tracking System (SMARTS) and notifying Engineer and Owner when documents and information have been posted.
   b. Contractor shall prepare and submit an application form for report of waste discharge (ROWD) to CVRWQCB to obtain a waste discharge requirements (WDR) permit for the discharge of dewatering water.
   c. Contractor shall comply with all WDR dewatering water and receiving water monitoring and reporting requirements as specified in WDR Permit.
   d. Contractor shall perform monitoring and reporting activities as specified in the WDR Permit and in accordance with Section 01 30 00, Environmental Compliance.

2. Sacramento Metropolitan Air Quality Management District (SMAQMD) and California Air Resources Board (CARB):
   a. Contractor shall comply with all SMAQMD rules and regulations. Contractor shall also possess valid permits with the California Air Resources Board through the Statewide Portable Equipment Registration Program to operate all vehicles and stationary and mobile equipment (application forms can be found at: http://www.arb.ca.gov/portable/perp/newforms.htm). Contractor shall also comply with specific requirements for construction projects as summarized below.
   b. Internal Combustion Engines:
      1) Contractor shall submit an Authority to Construct permit to SMAQMD if any portable internal combustion equipment over 50 hp will be operated onsite for a duration of 12 months or more.
      2) Contractor shall comply with construction mitigation requirements as follows:
         a) Prior to mobilizing at the Site, submit a list of all mobile, off-road, heavy-duty construction equipment (equal to or greater than 50 hp and being used 40 hours or more on the job) to the SMAQMD using the model equipment list spreadsheet (available on the SMAQMD website).
         b) Heavy-duty (equal to or greater than 50 hp), off-road vehicles to be used in the Work (including owned, leased, and subcontractor vehicles) shall achieve a project-wide fleet-average 20 percent NOx reduction and 45 percent particulate reduction compared to the most recent ARB fleet average at the time of construction.
         c) Submit a construction mitigation calculator run (available on SMAQMD website).
         d) Obtain an endorsement letter from the SMAQMD to show proof of mitigation compliance and submit to Engineer.
         e) Emissions from off-road, diesel-powered equipment used on the project site shall not exceed 40 percent opacity for more than 3 minutes in any 1 hour. Any equipment found to exceed 40 percent opacity (or Ringelmann 2.0) shall be repaired immediately, and SMAQMD shall be notified of noncompliant equipment within 48 hours of identification. Conduct visual inspections of equipment exhaust stacks weekly

and submit a summary monthly to the SMAQMD and Engineer.

f) Submit an updated equipment list when changes occur or monthly to the SMAQMD and Engineer.

3) If construction emissions exceed the threshold of 85 pounds per day (with consideration of any stated reduction) of NOx, mitigation of the air quality impact is required as described in SMAQMD Enhanced Exhaust Control Practice.

c. Contractor shall implement the following measures to minimize fugitive dust during construction:

1) All grading operations on a project should be suspended when winds exceed 20 miles per hour or when winds carry dust beyond the property line despite implementation of all feasible dust control measures.

2) Construction sites shall be watered as directed by the Department of Public Works or Air Quality Management District and as necessary to prevent fugitive dust violations.

3) An operational water truck should be onsite at all times. Apply water to control dust as needed to prevent visible emissions violations and offsite dust impacts.

4) Onsite dirt piles or other stockpiled particulate matter should be covered, wind breaks installed, and water and/or soil stabilizers employed to reduce wind blown dust emissions. Incorporate the use of approved non-toxic soil stabilizers according to manufacturer’s specifications to all inactive construction areas.

5) All transfer processes involving a free fall of soil or other particulate matter shall be operated in such a manner as to minimize the free fall distance and fugitive dust emissions.

6) Apply approved chemical soil stabilizers according to the manufacturers’ specifications, to all inactive construction areas (previously graded areas that remain inactive for 96 hours), including unpaved roads and employee/equipment parking areas.

7) To prevent track-out, install wheel washers where Project vehicles and/or equipment exit onto paved streets from unpaved roads. Vehicles and/or equipment shall be washed prior to each trip. Alternatively, a gravel bed may be installed as appropriate at vehicle/equipment site exit points to effectively remove soil buildup on tires and tracks to prevent/diminish track-out.

8) Paved streets shall be swept frequently (water sweeper with reclaimed water recommended; wet broom) if soil material

has been carried onto adjacent paved, public thoroughfares from the Project Site.

9) Provide temporary traffic control as needed during all phases of construction to improve traffic flow, as deemed appropriate by the Department of Public Works and/or Caltrans and to reduce vehicle dust emissions. An effective measure is to enforce vehicle traffic speeds at or below 15 mph.

10) Reduce traffic speeds on all unpaved surfaces to 15 miles per hour or less and reduce unnecessary vehicle traffic by restricting access. Provide appropriate training, onsite enforcement, and signage.

11) Re-establish ground cover on the construction site as soon as possible and prior to final occupancy, through seeding and watering.

12) Disposal by Burning: Open burning is prohibited at the Project Site. No open burning of vegetative waste (natural plant growth wastes) or other legal or illegal burn materials (trash, demolition debris, et. al.) may be conducted at the Project Site. Vegetative wastes should be chipped or delivered to waste to energy facilities (permitted biomass facilities), mulched, composted, or used for firewood. It is unlawful to haul waste materials offsite for disposal by open burning.

3. Construction Permit - Cal/OSHA:

a. In accordance with Title 8, California Code of Regulations, Chapter 4, Subchapter 4, conformance is required for any project with excavations deeper than 5 feet, structures higher than 36 feet (three stories), underground diesel operations, or demolition of any structures higher than 36 feet (three stories). Contractor shall schedule a safety permit conference appointment with the Cal/OSHA district office in Sacramento. During the conference, the potential safety and health risk of the activity shall be discussed, and the Contractor shall identify specific measures to be taken to minimize these risks to employees, and details of the activity shall be reviewed along with Title 8 Safety Orders applicable to the activity in which the Contractor will engage. The Contractor shall provide enough detail about the construction activity to allow the district office to make a reliable determination that the activity will proceed safely. The Contractor shall submit a completed application form, a completed activity notification form or activity notification form for holders of annual permits if Contractor already has an annual permit, a copy of the Contractor’s Injury and Illness Prevention Program, and a

copy of the Contractor's Code of Safe Practices. Contractor shall be responsible for all fees associated with this permit.

4. Federal Aviation Administration Notice of Proposed Construction or Alteration.
   a. Contractor shall comply with all FAA rules and regulations.
   b. Contractor shall verify crane height and FAA requirements for any necessary flags or lighting needed to operate a crane within any flight path near the Sacramento International Airport. Contractor may be required to lower crane at the end of each work day if required by FAA regulations. Contractor is responsible for all notification to FAA and airport related to crane height and operations.
   c. Contractor shall submit a Notice of Construction or Alteration a minimum of 45 days prior to the start of construction.
      1) The Notice of Construction or Alternation form is available online at: https://www.faa.gov/documentLibrary/media/Form/FAA_Form_7460-1_042024.pdf.
5. Sacramento County Permits.
   a. Encroachment Permit: Will be required. Application will be made by Contractor and permit fees will be paid for by Owner. This permit covers work required to complete the driveway/roadway transition work in and around the Garden Highway. Contractor shall comply with the measures and restrictions established in the Encroachment Permit regarding construction activities and the placement of materials. Copies of the signed Encroachment Permit and associated permit conditions shall be kept on the construction site at all times.
   b. Other Permits: If other permits for construction are required by Sacramento County, Owner will pay permit fees. Contractor will be responsible for obtaining the permit and complying with inspection notification requirements and coordination with Sacramento County.
6. Reclamation District No. 1000 (RD 1000).
   a. Temporary Use Permit and Hold Harmless Agreement: will be required. Application will be made by Contractor and a monetary deposit, in a form satisfactory to RD 1000, will be the responsibility of Contractor to ensure restoration of RD 1000 facilities (levees, canals, drainage ditches, etc.) to their pre-project condition and to the satisfaction of RD 1000.

1.03 SUMMARY OF PERMITS OBTAINED BY OWNER

A. No additional compensation or Contract Times shall be granted to Contractor because of delays by Owner to obtain any permit, unless Contractor is unable to proceed and complete Work because of such delays as demonstrated by Contractor's approved Progress Schedule.

B. Owner will obtain authorization to undertake construction and operation of the Project pursuant to Section 10 of the Rivers and Harbors Act of 1899, Section 404 of the Clean Water Act, and through Section 7 Consultation under the Endangered Species Act with the U.S. Fish and Wildlife Service and National Marine Fishery Services. Specific requirements of these authorizations will be provided to Contractor once these documents have been obtained. Owner does not plan to make copies of the documents related to these authorizations available.

C. Owner will obtain a Public Agency Lease Application Waiver from the State Lands Commission for authorization to undertake construction and operation of the Project. It is assumed that the Public Resource Code 6327 will apply, and a State Lands Commission Land Lease will not be required for the project. Owner does not plan to make copies of the documents related to these authorizations available.

D. Owner will obtain authorization to undertake construction and operation of the Project pursuant to Section 106 Consultation with the State Historic Preservation Office (SHPO). An Archaeological Reconnaissance Report (ARR) has been prepared in accordance with the U.S. Army Corps of Engineers and SHPO. Specific requirements of these authorizations shall be provided to the Contractor once these documents have been obtained. Owner does not plan to make copies of the documents related to these authorizations available.

E. The following permits have been, or will be, obtained by Owner for this Project. Contractor shall meet the conditions of said permits.

1. Encroachment Permit—California Department of Water Resources, Central Valley Flood Protection Board (CVFPB):
    a. Owner will obtain a permit from the CVFPB for the portion of the Work within the influence of the Sacramento River and levee system. The Contractor is required to accomplish this work under the direct supervision of the Department of Water Resources and comply with all of the conditions and requirements contained within the CVFPB Permit. A copy of the CVFPB Permit shall be kept on the construction site at all times.

b. Contractor shall provide descriptions of work, descriptions of means and methods, and cooperate with Owner to obtain permit waivers to allow work within the floodway between November 1 and April 15 of any year. Contractor shall assume that work will be allowed in the floodway on a year-round basis except for up to 15 calendar days of short duration suspensions during flood events each winter flood season. Owner will develop a schedule with the Contractor to obtain seasonal work waivers. Detailed Submittals regarding work activities and contingency plans will be required to obtain said waiver, or waivers. Contractor shall complete these Submittals on a schedule to allow such waivers to be obtained. No schedule delays will be recognized due to Contractor's failure to provide suitable information regarding this aspect of the work on Owner's waiver application schedule(s).

c. No excavation will be allowed into the levee prism or into the extension of the levee prism below original grade between October 31 and April 16.

d. If adverse weather conditions are forecast or other emergency conditions arises, the Contractor shall immediately remove any equipment or material stored in the floodway.

e. Levee section shall mean the same as levee prism as designated in the Contract Documents.

f. Design flood plain elevation is the entire area within the Sacramento River floodway.

g. A copy of the permit obtained by Owner will be provided to Contractor after it is acquired.

2. Central Valley Regional Water Quality Control Board Water Quality Certification (Section 401 of the Clean Water Act):

a. This permit covers discharges to waters of the United States and specifically regulates discharge into the river. Water quality protection, monitoring, and reporting requirements are specified in the permit. Contractor shall comply with all requirements of the permit. Contractor shall notify Owner at least 1 week in advance of starting any in-water activities. Contractor shall provide all reporting and testing results, including proposed mitigation measures to clean spills, to Owner and will notify Owner immediately if a spill occurs or if criteria thresholds are exceeded. Contractor shall provide reports, testing results, and proposed mitigation to the Water Board as required.

b. Contractor shall be responsible for all water quality sampling required by the permit (turbidity, pH, etc.) regardless of responsible party named in permit.

c. A copy of the permit obtained by Owner will be provided to Contractor after it is acquired.

3. California Department of Fish and Wildlife (CDFW) Section 1602 Streambed Alteration Agreement:
   a. Owner has obtained a Section 1602 Streambed Alteration Agreement from the CDFW for work within the Sacramento River. The Contractor shall sign the Streambed Alteration Agreement prior to commencing Work. Alterations to the river channel and the vegetation and wildlife species associated with the channel, as well as any activities that would alter the course of water or deposit debris or other materials into the river are subject to the Streambed Alteration Agreement. Contractor shall comply with the measures and restrictions established in the Streambed Alteration Agreement regarding construction activities and the placement of materials, and removal and replacement of vegetation and listed species. Copies of the signed Streambed Alteration Agreement and the associated permit conditions shall be kept on the construction site at all times.
   b. A copy of the permit is included in Supplements.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 SUPPLEMENTS

A. The supplements listed below, following “End of Section”, are part of this Specification.

1. CDFW Section 1602 Streambed Alteration Agreement.

END OF SECTION

California Natural Resources Agency
DEPARTMENT OF FISH AND WILDLIFE
North Central Region
1701 Nimbus Road, Suite A
Rancho Cordova, CA 95670-4599
916-358-2900
www.wildlife.ca.gov

***GAVIN NEWSOM**, Governor*
CHARLTON H. BONHAM, Director

2/16/2024

Brett Gray
Natomas Mutual Water Company
2601 West Elkhorn Boulevard
Rio Linda, CA 95673
bgray@natomaswater.com

Dear Brett Gray:

Final Streambed Alteration Agreement
EPIMS Notification No. SAC-37386-R2
Sacramento River; Elkhorn Pumping Plant Replacement

Attached is the final Streambed Alteration Agreement (Agreement) for the Elkhorn Pumping Plant Replacement (Project). Before the California Department of Fish and Wildlife (CDFW) may issue an Agreement, it must comply with the California Environmental Quality Act (CEQA). In this case, CDFW acting as a responsible agency filed a Notice of Determination (NOD) within five working days of signing the Agreement. The NOD was based on information contained in the final Environmental Impact Report prepared by the lead agency.

Under CEQA, the filing of an NOD triggers a 30-day statute of limitations period during which an interested party may challenge the filing agency's approval of the Project. You may begin the Project before the statute of limitations expires if you have obtained all necessary local, state, and federal permits or other authorizations. However, if you elect to do so, it will be at your own risk.

If you have any questions regarding this letter, please contact Harvey Tran, Senior Environmental Scientist (Specialist) at (916) 358-4035 or by email at harvey.tran@wildlife.ca.gov.

Sincerely,

DocuSigned by:
Tanya Sheya
1ABC45303752499...

Tanya Sheya
Environmental Program Manager

ec: Harvey Tran, Senior Environmental Scientist (Specialist)
harvey.tran@wildlife.ca.gov

Tara Zuroweste, Senior Environmental Planner
Tara.Zuroweste@jacobs.com

Permit Details

Permit: EPIMS-SAC-37386-R2 - Elkhorn Pumping Plant Replacement - 2024

Status:	Underway
Region:	Region 2
Permittee Organization:	Natomas Mutual Water Company (NMWC)
CDFW Contact:	Region 2 CDFW

Standard Agreement

Signature Page

This Standard Agreement is being issued to:

Natomas Mutual Water Company

Final Standard Agreement:* EPIMS-SAC-37386-R2_Final_Standard_Agreement.pdf
Open and print the attached PDF file.

Exhibits

Concurrence

I am the applicant or I have the authority to sign for the applicant. By my signature, I accept and agree to comply with all the provisions contained herein.

Final Agreement Effective Date:	02/16/2024
Permittee Electronic Signature:	Tara Zuroweste First and Last Name
Date Signed:	02/16/2024

Department of Fish and Wildlife

CDFW Electronic Signature:	Tanya Sheya
CDFW Representative Title:	Environmental Program Manager
Date Signed:	02/16/2024
Acting for:	

CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE
NORTH CENTRAL REGION
1701 NIMBUS ROAD, SUITE A
RANCHO CORDOVA, CA 95670

STREAMBED ALTERATION AGREEMENT
EPIMS NOTIFICATION NO. SAC-37386-R2
SACRAMENTO RIVER

NATOMAS MUTUAL WATER COMPANY
ELKHORN PUMPING PLANT REPLACEMENT

This Streambed Alteration Agreement (Agreement) is entered into between the California Department of Fish and Wildlife (CDFW) and Natomas Mutual Water Company (Permittee) as represented by Brett Gray.

RECITALS

WHEREAS, pursuant to Fish and Game Code section 1602, Permittee notified CDFW on November 7, 2023 that Permittee intends to complete the project described herein.

WHEREAS, pursuant to Fish and Game Code section 1603, CDFW has determined that the project could substantially adversely affect existing fish or wildlife resources and has included measures in this Agreement necessary to protect those resources.

WHEREAS, Permittee has reviewed this Agreement and accepts its terms and conditions, including the measures to protect fish and wildlife resources.

NOW THEREFORE, Permittee agrees to complete the project in accordance with this Agreement.

PROJECT LOCATION

The project is located at the Sacramento River, in the County of Sacramento, State of California; Latitude 38.705233, Longitude -121.617811 (WGS 84 datum, decimal degrees); Township 10 N; Range 3 E; Assessor's Parcel Number 201-0250-039-0000. The Project site is located on the east side of the Sacramento River on the right between 7701 and 7651 Garden Highway at River Mile 73.7.

Exhibit A shows the project location.

PROJECT DESCRIPTION

The project is limited to the construction of a new pumping plant and fish screen facility to replace the existing Elkhorn Pumping Plant. The Project will include the following main components:

- Demolition of the existing pumping plant structure, including structural, mechanical, and electrical components.
- Construction of a new pump support structure (42 feet by 27 feet) on the bank and within the Sacramento River. Eight 24-inch steel pipe piles will be driven into the bed and banks with both an impact hammer and vibratory hammer, then filled with concrete. A bubble curtain will be utilized during the pile driving.
- Construction of an improved access deck to the pumping plant from Garden Highway.
- Installation of two cylindrical tee fish screen units with integral brush cleaning system and retrieval system with an operational depth of 1.5 feet above the river bottom. Each screen unit will be 36 inches in diameter. The overall length of each screen unit is 16 feet. The drums on each screen are made of wedge wire with a 50 percent open area and a spacing of 1.75 millimeters. Each screen will allow just over 30 cubic feet per second of water to be pumped at an approach velocity of 0.33 foot per second.
- Installation of log boom and deflector boom in the river to minimize damage from floating debris. Two 18-inch steel pipe piles and six 30-inch steel pipe piles will be driven the bed and banks with both an impact hammer and vibratory hammer, then filled with concrete. A bubble curtain will be utilized during the pile driving.
- Installation of two mixed-flow irrigation pumps, with adjustable frequency drive, and motor; each pump will be rated at 30 cubic feet per second at approximately 38 feet total dynamic head. Installation of the pumps will involve excavation 12 feet below the riverbed, removal of approximately 34 cubic yards of streambed material, and installation of pipe piles and steel casings.
- Extension of the discharge piping from the new pumps to a temporary junction box on the waterside of Garden Highway connected to the existing discharge pipe through the levee.
- Installation of electrical, controls, and lighting for the pumping plant.

The project activities listed above will require the removal of riparian vegetation (trees, shrubs, and forbs) less than 4” trunk diameter at breast height (DBH) and trimming of one riparian tree. All areas temporarily disturbed for access will be regraded, Best Management Practice (BMP) will be installed and then hydroseeded with a native seed mix, if needed.

In-river work will be required for the installation of the above-mentioned activities. Project activities will be conducted from shore by land-based equipment and personnel. Cranes will be used to install piling and other component of the platform, including pump equipment. While workboats or a construction barge may be required at times, no equipment is expected to be placed in the water.

A variety of earthmoving equipment such as excavators, backhoes, and graders will do most of the earthmoving work within the site. Cranes, an impact hammer, a vibratory hammer, a loader, a dump truck, crew trucks, haul trucks, work boats, and construction barge will be present. Access to the site/staging area will occur at the other side of Garden Highway.

The project includes the diversion of water from the Sacramento River at a maximum rate of 60 cubic feet per second (cfs) and up to 5,000 acre feet per year.

Exhibit B shows the project plans.

PROJECT IMPACTS

Existing fish or wildlife resources the project could substantially adversely affect include: fish species, giant garter snake (*Thamnophis gigas*), western pond turtle (*Actinemys marmorata*), amphibians, and other aquatic and terrestrial plant and wildlife species.

The adverse effects the project could have on the fish or wildlife resources identified above include: loss of foraging, nesting, and shelter habitat; disruption to wildlife; disturbance of nesting due to increased human activity, noise, and vibrations; direct take of fish and other aquatic species; direct mortality or injury to individual plants and animals caused by project activities; impediment to migration of aquatic and terrestrial species during the project; direct loss of resources for aquatic organisms; introduction of sedimentation or other pollutants into the watercourse; short-term release of contaminants (e.g., incidental from project activities); loss of natural bed or bank; change in contour of bed, channel or bank; degradation of channel; loss of bank stability during the project; increase of bank erosion during the project; disturbance from project activity; and diversion of flow water from, or around, activity site.

The project will permanently impact 0.089 acre of Sacramento River habitat due to new pump platform, access deck, log boom, deflector boom, and intake structure placement over the river and its bank. There will be no additional temporary impacts.

Removal of smaller vegetation in the stream is anticipated and will not include trees with a diameter at breast height (DBH) of four inches or more.

Exhibit C shows the project impacts maps.

MEASURES TO PROTECT FISH AND WILDLIFE RESOURCES

1. Administrative Measures

Permittee shall meet each administrative requirement described below.

1.1 Documentation at Project Site. Permittee shall make this Agreement, any extensions and amendments to this Agreement, and all related notification materials and California Environmental Quality Act (CEQA) documents, readily available at the project site at all times and shall be presented to CDFW personnel, or personnel from another state, federal, or local agency upon request.

1.2 Providing Agreement to Persons at Project Site. Permittee shall provide copies of this Agreement and any extensions and amendments to this Agreement to all persons who will be working on the project at the project site on behalf of

Permittee, including but not limited to contractors, subcontractors, inspectors, and monitors.

1.3 Notification of Conflicting Provisions. Permittee shall notify CDFW if Permittee determines or learns that a provision in this Agreement might conflict with a provision imposed on the project by another local, state, or federal agency. In that event, CDFW shall work with the Permittee to resolve any conflict.

1.4 Project Site Entry. Permittee agrees that CDFW personnel may enter the project site at any time to verify compliance with this Agreement.

1.5 No Trespass. To the extent that any provisions of this Agreement provide for activities that require Permittee to traverse another owner's property, such provisions are agreed to with the understanding that the Permittee possesses the legal right to so traverse. In the absence of such right, any such provision is void.

1.6 Notification of Project Modification. Permittee agrees to notify CDFW of any modifications made to the project plans submitted to CDFW.

1.7 Change of Conditions and Need to Cease Operations. If conditions arise, or change, in such a manner as to be considered deleterious to the stream or wildlife, operations shall cease until corrective measures approved by CDFW are taken.

1.8 Does Not Authorize "Take." This Agreement does not authorize "take" of any California Endangered Species Act (CESA) listed species. Take is defined in Fish and Game Code section 86, as hunt, pursue, catch, capture or kill or attempt to hunt, pursue, catch, capture, or kill. If there is potential for take of any listed species to occur, Permittee shall consult with CDFW and demonstrate compliance with CESA.

1.9 CEQA Compliance. Permittee shall implement and adhere to the mitigation measures in the Environmental Impact Report (EIR) (SCH No. 2008072060), and all associated documents adopted by the Sacramento Area Flood Control Agency as lead agency for the project pursuant to the CEQA (Pub. Resources Code, § 21000 et seq.). If the results of focused or pre-commencement surveys indicate that additional impacts may result from project activities that were not analyzed in the CEQA document, then Permittee should comply with CEQA before the project commences.

1.10 Limitations on Authorization of Water Use. This Agreement does not authorize any diversion, use, or storage of water unless already permitted by law. Permittee is responsible for obtaining all necessary water rights and maintaining compliance with the State Water Code and Title 23 California Code of Regulations as appropriate. Permittee shall store and use water in accordance with a valid water right, including any limitations on when water may be stored and used, the purpose for which it may be stored and used, and the location(s) where water may be stored and used. Information regarding water right registrations can be found at

https://www.waterboards.ca.gov/waterrights/water_issues/programs/registrations. Information about water right permits and applications can be found here: https://www.waterboards.ca.gov/waterrights/water_issues/programs/applications.

2. Avoidance and Minimization Measures

To avoid or minimize adverse impacts to fish and wildlife resources identified above, Permittee shall implement each measure listed below.

2.1 In-Water Work Period. Project activities within the Sacramento River covered under this Agreement shall be confined to the period between July 15 and October 1 during the term of this Agreement.

2.2 Work Period. Project activities covered under this Agreement shall be confined to the period between June 1 and October 31 during the term of this Agreement. *Revegetation, restoration, and erosion control work located outside of flowing water is not confined to this time period*.

2.3 Work Period Modification. If Permittee needs more time to complete the project activity, the work may be permitted outside of the work period and extended on a day-to-day basis (or for some other set period of time) by CDFW (see Contact Information). Permittee shall submit a written request for a work period modification to CDFW. The work period modification request shall: 1) describe the extent of work already completed; 2) provide a schedule for activities to be conducted within the requested modification period; 3) detail the time required to complete each activity; and 4) provide photographs of current site conditions. Work period modifications are issued at the discretion of CDFW. CDFW will review the written request to work outside of the established work period. CDFW will have ten (10) business days to review the proposed work period variance. CDFW reserves the right to require additional measures to protect fish and wildlife resources as a condition for granting the modification.

2.4 Work Period in Low Rainfall / Dry Weather Only. The work period within the project area shall be restricted to periods of low rainfall (less than ¼-inch per 24-hour period) or periods of dry weather (with less than a 50% chance of rain). Permittee shall monitor the National Weather Service (NWS) 72-hour forecast for the project area. No work shall occur during a dry-out period of 24 hours after the above referenced wet weather. Weather forecasts shall be provided upon request by the CDFW. All erosion control measures shall be initiated prior to all storm events. *Revegetation, restoration, and erosion control work outside of flowing water is not confined to this work period*.

2.5 Vegetation Removal. Disturbance or removal of vegetation shall be kept to the minimum necessary to complete project related activities. No native riparian trees with a DBH in excess of four (4) inches shall be removed or damaged without prior consultation and approval of a CDFW representative. Where native trees or woody riparian vegetation split into several trunks close to ground level, the DBH shall be

measured for each trunk and calculated as one tree. Vegetation that will not be removed by the project shall be marked for protection and may only be trimmed with hand tools to the extent necessary to gain access to the work sites.

2.6 Vegetation Removal Methods. Hand tools (e.g., trimmer, chain saw, etc.) shall be used to trim vegetation to the extent necessary to gain access to the work site(s); larger equipment shall not be used for vegetation removal unless already described in the project description.

2.7 Designated Representative. Before initiating in-water or ground-disturbing project activities, Permittee shall designate a representative (Designated Representative) responsible for communications with CDFW and overseeing compliance with this Agreement. Permittee shall notify CDFW in writing five (5) business days prior to commencement of project activities of the Designated Representative's name, business address, and contact information. Permittee shall notify CDFW in writing if a substitute Designated Representative is selected or identified at any time during the term of this Agreement.

2.8 Designated Biologist. At least thirty (30) business days before initiating in-water, ground- or vegetation-disturbing activities, Permittee shall submit to CDFW in writing the name, qualifications, business address, and contact information for a biological monitor(s) (Designated Biologists). Permittee shall obtain CDFW's written approval of the Designated Biologist(s) prior to the commencement of project activities. The Designated Biologist(s) shall be knowledgeable and experienced in the biology and natural history of local fish and wildlife resources present at the project site. Permittee shall not enter into any agreement or contract of any kind, including but not limited to non-disclosure agreements and confidentiality agreements, with the Designated Biologist(s) that prohibit or impede open communication with CDFW, including but not limited to providing CDFW staff with the results of any surveys, reports, or studies or notifying CDFW of any non-compliance or take. Permittee shall notify CDFW in writing if a substitute Designated Biologist(s) is selected or identified at any time during the term of this Agreement.

2.9 On-site Biologist with Stop Work Authorization. Permittee shall have a Designated Biologist on-site as needed during project activities to ensure avoidance and minimization measures are implemented. The Designated Biologist, in consultation with the Project Manager, shall be authorized to stop construction, if necessary to protect fish and wildlife resources.

Biological Resources

2.10 Leave Wildlife Unharmed. Wildlife shall be allowed to leave the project area unharmed.

2.11 Special-Status Species encountered during work. If Permittee encounters any special-status species during project activities, work shall be suspended, CDFW

notified, and conservation measures shall be developed in agreement with CDFW prior to re-initiating the activity. If during project activities, Permittee encounters any species listed pursuant to the CESA, work shall be `suspended, and CDFW notified. Work may not re-initiate until the Permittee has consulted with CDFW and can demonstrate compliance with CESA.

2.12 Nesting Bird Survey. If project-related activities are scheduled between February 1 to August 31 (the typical nesting season), a focused survey for nests shall be conducted by a Designated Biologist no greater than seven (7) calendar days prior to the beginning of Project-related activities. The Designated Biologist shall survey a minimum radius of 500-foot (for migratory birds) and 1/2-mile (for raptors) around the Project area that can be accessed by Permittee. The results of the survey shall be provided to CDFW upon completion. If no active nests are found, project activities may proceed as scheduled.

2.12.1 Active Nests. If an active nest is found, active nests should be avoided, and a no disturbance or destruction buffer shall be determined and established by a Designated Biologist. The buffer shall be kept in place until after the breeding nesting season or the Designated Biologist confirms the young have fledged, are foraging independently, and the nest is no longer active for the season. The extent of these buffers shall be determined by the Designated Biologist and will depend on the species present, the level of noise or construction disturbance, line of sight between the nest and the disturbance, ambient levels of noise and other disturbances, and other topographical or artificial barriers.

2.12.2 Project Delay. If a lapse in project-related work of seven (7) calendar days or longer occurs, the Designated Biologist shall complete another focused survey before Project work can be reinitiated.

2.12.3 Permittee Responsibility. It is the Permittee's responsibility to comply with Fish and Game Code Sections 3503, 3503.5, and 3513, regardless of the time of year. This Agreement does not authorize take of birds, their nests, or their eggs.

2.13 Bird Management and Monitoring Plan (BMMP). If a survey identifies an active nest, the Designated Biologist shall prepare and implement a Bird Management and Monitoring Plan (BMMP) which includes survey results and appropriate avoidance measures such as, but not limited to, temporary no-disturbance buffers, sound walls, visual barriers, and/or changes in project phasing to protect the nest and the birds. The BMMP design shall be based upon site conditions, project activities, and species present or likely to be present during all construction activities. The Designated Biologist shall be onsite during the initiation of project activities and if there is a change in the level of activity (i.e., noise level, etc.). If the Designated Biologist determines that avoidance measures are insufficient to avoid take of the birds, their nest, or their eggs, all specific project activities shall cease, and the Designated Biologist or Permittee shall immediately consult with CDFW.

2.14 Swainson's Hawk (SWHA) Survey and Buffer. If project activities are scheduled during the SWHA nesting season (March 1 to September 30) and suitable nesting habitat is present in or within 1/2-mile of the project area, the Designated Biologist shall conduct a focused survey for active Swainson's hawk nests prior to beginning construction. Survey shall be conducted in all suitable SWHA nesting habitat within 1/2-mile of the project area that can be accessed by Permittee or visible from the project area. The results of the survey and the survey methodology shall be provided to CDFW upon completion in a report due no later than fourteen (14) calendar days prior to the start of project activities. If SWHA breeding activity is identified during any of the surveys or during construction activities at or within 1/4-mile of the project area, Permittee shall adhere to Measure 2.11 of this Agreement. A minimum of 1/2-mile no disturbance buffer shall be placed around the active SWHA nest until the nesting season has ended or until the Designated Biologist has determined, that all young have fledged and are no longer reliant upon the nest or parental care for survival.

2.15 Western Pond Turtle Survey. Permittee shall retain a Designated Biologist to survey the Work Area and 300 feet around it where suitable habitat occurs for the western pond turtle. Surveys shall be performed no more than seven (7) calendar days prior to starting project activities within areas that can be accessed by the Permittee. The results of the survey and the survey methodology shall be provided to CDFW upon completion in a report due prior to the start of project activities. If western pond turtles are identified during surveys or during project activities at or within 300 feet of the project area, Permittee shall adhere to Measures 2.11 and 2.15 of this Agreement.

2.16 Wildlife Relocation Plan. If Permittee would like approval to relocate specific non-CESA listed wildlife species that are not Fully Protected away from the project area, Permittee shall prepare a Wildlife Relocation Plan (WRP) and submit to CDFW for review and approval prior to starting construction activities within the areas where the species were discovered. The WRP shall include, but not be limited to: (1) a discussion of the species and habitat features to be relocated; (2) a schedule for survey and monitoring species presence; (3) methods to capture, handle, and relocate individuals or habitat features out of the project area; (4) names and qualifications of biologists who will handle the species; (5) specifications for wildlife exclusion fencing which may be installed to exclude the wildlife species from the project area; (6) details regarding the use of coverboards which will be employed accessory to the exclusion fencing; (7) description and maps of where the salvaged individuals or habitat features will be relocated to; and (8) identification of a wildlife rehabilitation center or veterinary facility where injured individuals of the will be taken. The WRP should also provide Permittee's plan to respond to an atypical detection of individual(s).

2.16.1 Relocated Wildlife. Permittee shall move wildlife to the nearest appropriate site outside of the project area. Permittee shall maintain a Wildlife Relocation Record that includes, at a minimum: the date of capture and of

relocation; the method of capture, location of relocation in relation to the project area; and the number, age-class and species captured and relocated. The Wildlife Relocation Record shall also quantify the number and species of project- and relocation-related mortality. The Wildlife Relocation Record shall be submitted with the Notification of Project Completion (Measure 4.3)

2.17 Giant Garter Snake (GGS) Survey. Permittee shall retain a Designated Biologist to conduct a preconstruction giant garter snake survey no more than 24 hours prior to the initiation of construction activity within 100 feet of suitable aquatic and upland habitat for GGS that can be accessed by Permittee. The results of the survey and the survey methodology shall be provided to CDFW upon completion in a report due no later than seven (7) calendar days after the survey was conducted. The Designated Biologist will conduct a new survey at the project area where there has been a lapse in construction activities of seven (7) or more consecutive calendar days prior to any renewed activities. If GGS is detected during surveys or at any time during Project Activities at or within 100 feet of the project area, Permittee shall halt work that may result in take of GGS until the individual leaves of its own volition and shall adhere to Measure 2.11 of this Agreement.

2.18 Invasive Species. Permittee shall conduct project activities in a manner that prevents the introduction, transfer, and spread of aquatic, riparian, and terrestrial invasive species from one work site and/or water body to another. Prior to entering the project area, Permittee shall inspect equipment for invasive species and, if any signs of invasive species are found, the equipment shall be cleaned to remove those species. All visible soil/mud, plant materials, and animal remnants on equipment will be removed prior to entering and exiting the work site and/or between each use in different water bodies. Permittee shall notify CDFW immediately if an invasive species not previously known to occur within the work site is discovered during work activities by contacting CDFW's Invasive Species Program by email at Invasives@wildlife.ca.gov.

Revegetation and Restoration

2.19 Seeding. Permittee shall restore all exposed/disturbed areas and access points within the project area, by seeding with a locally native seed mix of known genetic origin whose original stock seed was collected from the Great Central Valley, unless otherwise agreed upon with CDFW. Revegetation shall be completed as soon as possible after construction activities.

2.20 Native Plant Materials. Revegetation shall include only local plant materials native to the project area, unless otherwise approved by CDFW in writing.

2.21 Prohibited Plant Species. Permittee shall not plant, seed or otherwise introduce invasive non-native plant species. Prohibited invasive non-native plant species include those identified in the California Invasive Plant Council's database, which is accessible at: http://www.cal-ipc.org.

Erosion Control/Stabilization

2.22 Erosion Control. Permittee shall actively implement best management practices (BMPs) to minimize turbidity and siltation and prevent erosion and the discharge of sediment where it may pass into waters of the state (Fish & G. Code § 89.1), the stream bed, bank, or channel (including but not limited to dry, ponded, flowing, or wetland areas), drainages, lakes, other sensitive habitat during project activities. Precautions shall include, but are not limited to: pre-project planning to identify site specific turbidity and siltation minimization measures; best management erosion control practices during project activity; and settling, filtering, or otherwise treating silty and turbid water prior to discharge into a stream or storm drain. This may require the placement of silt fencing, coir logs, coir rolls, straw bale dikes, or other siltation barriers so that silt and/or other deleterious materials are not allowed to pass to downstream reaches.

2.22.1 Monitoring. BMPs shall be monitored daily and repaired if necessary to ensure maximum erosion and sediment control.

2.22.2 Materials. All fiber rolls, straw wattles, and/or hay bales utilized within and adjacent to the project site shall be free of non-native plant materials. Fiber rolls or erosion control mesh shall be made of loose-weave mesh that is not fused at the intersections of the weave, such as jute, or coconut (coir) fiber, or other products without welded weaves. Products with plastic monofilament or cross joints in the netting that are bound/stitched (such as found in straw wattles/fiber rolls and some erosion control blankets), which may cause entrapment of wildlife, shall not be allowed. Permittee shall remove and dispose of all temporary BMPs and any related material upon completion of project activities.

2.22.3 Implementation. Passage of sediment beyond the sediment barrier(s) is prohibited. If any sediment barrier fails to retain sediment, corrective measures shall be taken. The sediment barrier(s) shall be maintained in good operating condition throughout the construction period and the following rainy season. Maintenance includes, but is not limited to, removal of accumulated silt and/or replacement of damaged silt fencing, coir logs, coir rolls, and/or straw bale dikes. Upon the CDFW's determination that turbidity/siltation levels resulting from project-related activities constitute a threat to aquatic life, activities associated with the turbidity/siltation shall be halted until effective CDFW-approved control devices are installed or abatement procedures are initiated.

2.23 Prohibition Against Use of Plastic Netting in Erosion Control Measures. Permittee shall not use temporary or permanent erosion control devices containing plastic netting, including photo- or bio-degradable plastic netting. These items are commonly found in straw wattles (fiber rolls) and erosion control blankets.

2.24 Post Storm Event Inspection. After any storm event, Permittee shall inspect all sites scheduled to begin or continue construction within the next 72 hours. Corrective action for erosion and sedimentation shall be taken as needed. National Weather Service 72-hour weather forecasts shall be reviewed prior to the start of any phase of the project that may result in sediment runoff to the stream, and construction plans adjusted to meet this requirement. The National Weather Service forecast can be found at: http://www.nws.noaa.gov.

Avoid/Minimize Effects of Equipment

2.25 Heavy Equipment Maintenance. Any equipment or vehicles driven and/or operated shall be checked and maintained daily to prevent leaks of materials that could be deleterious to aquatic and terrestrial life or riparian habitat. If maintenance or refueling of vehicles or equipment must occur on-site, Permittee shall use a designated area and/or a secondary containment, located away from drainage courses to prevent the runoff of storm water and the runoff of spills. Permittee shall place drip pans or absorbent materials under vehicles and equipment when not in use. Equipment shall be stored in areas that any possible contamination from the equipment would not pass into waters of the state (Fish & G. Code § 89.1), the stream bed, bank, or channel (including but not limited to dry, ponded, flowing, or wetland areas), drainages, lakes, other sensitive habitat.

2.26 Minimize Vehicle Parking. Vehicles may enter and exit the work area as necessary for project activities, but shall not be parked overnight within ten (10) feet of the drip line of any trees; nor shall vehicles be parked where mechanical fluid leaks may potentially pass into waters of the state (Fish & G. Code § 89.1), the stream bed, bank, or channel (including but not limited to dry, ponded, flowing, or wetland areas), drainages, lakes, other sensitive habitat.

2.27 Staging and Storage Areas. Staging and storage areas for equipment, materials, fuels, lubricants, and solvents shall be located where they may not pass into waters of the state (Fish & G. Code § 89.1), the stream bed, bank, or channel (including but not limited to dry, ponded, flowing, or wetland areas), drainages, lakes, or other sensitive habitat.

2.28 Decontamination of Project Equipment. Permittee shall decontaminate all tools, waders and boots, and other equipment that will enter the water prior to entering and exiting the project site to avoid the introduction and transfer of organisms. Permittee shall decontaminate project gear and equipment that will enter the water by utilizing one of three methods: drying, using a hot water soak, or freezing, as appropriate to the type of gear or equipment. For all methods, Permittee shall begin the decontamination process by thoroughly scrubbing personal equipment, paying close attention to small crevices such as boot laces, seams, net corners, etc., with a stiff-bristled brush to remove all organisms. To decontaminate by drying, Permittee shall allow larger equipment to dry thoroughly (i.e., until there is a complete absence of water), preferably in the sun, for a minimum of 48 hours. To decontaminate using a hot water soak, Permittee shall immerse equipment in 140

degrees Fahrenheit or hotter water and soak for a minimum of 5 minutes. To decontaminate by freezing, Permittee shall place equipment in a freezer 32 degrees Fahrenheit or colder for a minimum of eight (8) hours. Repeat decontamination is required only if the equipment/clothing is removed from the site, used within a different waterbody, and returned to the project site.

2.29 Decontamination Sites. Permittee shall perform decontamination of vehicles, watercraft, and other project gear and equipment in a designated location where runoff can be contained and not allowed to pass into waters of the state (Fish & G. Code § 89.1), the stream bed, bank, or channel (including but not limited to dry, ponded, flowing, or wetland areas), drainages, lakes, or other sensitive habitat.

2.30 Stationary Equipment Leaks. Stationary equipment such as motors, pumps, generators, and welders shall be positioned over drip pans and secondary containment, as necessary. Stationary equipment shall have suitable containment to handle any spill/leak. Equipment shall be stored in areas that any possible contamination from the equipment would not pass into waters of the state (Fish & G. Code § 89.1), the stream bed, bank, or channel (including but not limited to dry, ponded, flowing, or wetland areas), drainages, lakes, other sensitive habitat.

2.31 Pile Driving. Permittee shall take precautions (e.g., bubble curtain, etc.) to minimize noise levels resulting from pile driving activities to levels below the injury thresholds listed in *NMFS Approved Criteria for Injury to Fish from Pile Driving, 2006*. As such, peak noise levels shall not exceed 206 decibel (dB) peak and 187 accumulated Sound Exposure Levels (SEL). The Designated Biologist shall monitor the pile driving to ensure injury thresholds are not exceeded. If pile driving activities exceed the peak noise level threshold or disturbance to fish species is observed, then all pile driving activities shall cease, and Permittee shall consult with CDFW to implement additional attenuation measures.

2.32 Soft Start. Whenever there has been downtime of 30 minutes or more without pile driving, Permittee shall reinitiate the pile driving with ramp-up procedures. For impact driving, an initial set of three strikes shall be made by the hammer at 40% energy, followed by a 1-minute waiting period, then two subsequent three-strike sets at 40% energy, with 1-minute waiting periods, before initiating continuous pile driving.

Debris Materials and Waste

2.33 Remove Structures. Project-related structures and associated materials not designed to withstand high water flows or placed in seasonally dry portions of a stream or lake that could be washed downstream or could be deleterious to aquatic life, wildlife, or riparian habitat shall be moved to areas outside the floodplain before such flows occur.

2.34 No Dumping. Permittee and all contractors, subcontractors, and employees shall not dump any litter or project debris on the project site.

2.35 Remove Temporary Flagging, Fencing, and Barriers. Permittee shall remove all temporary flagging, fencing, and/or barriers from the project area and vicinity immediately upon completion of project activities.

2.36 Wash Water. Water containing mud, silt, or other pollutants from equipment washing or other activities, shall not be allowed to enter sensitive areas, or placed in locations where it may pass into waters of the state (Fish & G. Code § 89.1), the stream bed, bank, or channel (including but not limited to dry, ponded, flowing, or wetland areas), drainages, lakes, or other sensitive habitat.

2.37 Hazardous Materials. Debris, soil, silt, sand, rubbish, project waste, cement or concrete or washings thereof, asphalt, paint, oil or other petroleum products or any other substances which could be hazardous to aquatic life, or other organic or earthen material from project activities shall not be stored where it may pass into waters of the state (Fish & G. Code § 89.1), the stream bed, bank, or channel (including but not limited to dry, ponded, flowing, or wetland areas), drainages, lakes, other sensitive habitat. Staging and storage areas for equipment, materials, fuels, lubricants and solvents, shall be located more than 100 feet from the waters of the state, the stream bed, bank, or channel (including but not limited to dry, ponded, flowing, or wetland areas), drainages, lakes, other sensitive habitat, unless otherwise approved by CDFW in writing. Permittee shall ensure that all project areas have proper spill clean-up materials (absorbent pads, sealed containers, booms, etc.) to contain the movement of any spilled substances. All debris shall be disposed of properly. BMPs shall be employed to accomplish these requirements. CDFW shall be notified immediately by the Permittee of any spills and shall be consulted regarding cleanup procedures.

2.38 Removal of Debris, Materials and Rubbish. Permittee shall remove all project generated debris, building materials and rubbish from the project area following completion of project activities.

2.39 Concrete – Primary Containment. Permittee shall install the necessary containment structures to control the placement of wet concrete and to prevent it from entering the drainage outside of those structures.

2.40 General Concrete Condition. To prevent the release of materials that may be toxic to fish and wildlife species, poured concrete shall be isolated from contact with water and allowed to dry/cure for the minimum curing time (Table 1) or until 70% of the specified compressive or flexural strength is attained, whichever is longer. During this time, Permittee shall ensure water that comes into contact with concrete shall not be allowed to enter waters of the state (Fish & G. Code § 89.1), the stream bed, bank, channel (including but not limited to dry, ponded, flowing, or wetland areas), drainages, lakes, or other sensitive habitats, unless otherwise approved by CDFW in writing. Any water that comes into contact with concrete before the minimum curing time or before 70% of the specified compressive or flexural strength is attained, whichever is longer, after it's poured shall be absorbed

through BMP materials (and disposed of offsite) or pumped into containment trucks and hauled offsite.

Table 1. Concrete Curing Times[4]

Cement Type	Minimum Curing Time
ASTM C 150 Type III	3 days
ASTM C 150 Type I	7 days
ASTM C 150 Type II	10 days
ASTM C 150 Type IV or V	14 days

[4]ACI 308.1-98, "Standard Specification for Curing Concrete," American Concrete Institute, Farmington Hills, MI.

3. Compensatory Measures

To compensate for adverse impacts to fish and wildlife resources identified above that cannot be avoided or minimized, Permittee shall implement each measure listed below.

3.1 Compensatory Mitigation. Permittee shall mitigate for 0.089 acre of permanent impacts to the Sacramento River by utilizing one of the methods in either Measure 3.2, Measure 3.3, or measure 3.4.

3.2 Habitat Mitigation and Monitoring Plan (HMMP): No later than ninety (90) calendar days before the start of project activities, Permittee shall submit to CDFW for review and approval a HMMP habitat creation or restoration on-site or at a CDFW-approved off-site location for 0.267 acre of riparian habitat. Based on the habitat activity selected above (creation/restoration or enhancement), the HMMP shall include the following information, as applicable:

3.2.1 A description of the existing physical conditions of the proposed creation and/or restoration site, including water resources, habitat types, soil composition, and plant species composition, and a map that identifies the location of the site;

3.2.2 A habitat comparison of the above (i) to the Project impact site;

3.2.3 Documentation of how placing the mitigation on the restoration site is going to maintain or enhance the current ecological and public use values of the land;

3.2.4 A plan for the preparation of the restoration site, including the initial removal and subsequent management of nonnative plant species, non-

wetland/riparian plant species;

3.2.5 A local California native plant palette;

3.2.6 A planting plan, including the native riparian species that will be planted on-site, quantity, and location,

3.2.7 Monitoring and maintenance measures and a timeline;

3.2.8 An irrigation plan;

3.2.9 Procedures to ensure that nonnative plants are not introduced or allowed to sustain within the creation or restoration site and a nonnative plant removal plan;

3.2.10 Interim performance criteria and adaptive management strategies, as well as success standards with contingency measures if they are not met. Monitoring and maintenance of the restoration site shall be conducted annually for a minimum of five (5) years, or until CDFW determines the mitigation site is successful;

3.2.11 Description of what the funding mechanism would be and the breakdown of the individual costs of planting, maintenance, and monitoring activities for the duration of the mitigation (this includes but is not limited to all capital improvements, restoration, enhancement, monitoring, and long-term management and maintenance for at least 5 years or until CDFW determines that mitigation is successful, on all lands), as applicable;

3.2.12 Description of how the restoration site will be protected from disturbance, if there are any existing land uses and easements, how the mitigation is consistent with the purpose for which the land was acquired and the funding source used for acquisition, and if there are any risks to the mitigation;

3.2.13 Description of the entities involved in the restoration activities and what each of their roles are;

3.2.14 Other pertinent information that CDFW requires to evaluate the effectiveness of the mitigation; and

3.2.15 Reporting shall be submitted as outlined in Measure 4.4 below.

3.3 Bank Credits. If on-site or off-site restoration is found to be infeasible, then with CDFW approval, Permittee shall purchase biologically suitable mitigation credits as substitute. Permittee shall purchase habitat credits at a CDFW-approved Mitigation Bank at a minimum 0.267 acre. Permittee shall submit the Bill of Sale and Payment Receipt to CDFW before the commencement of project activities.

3.4 Alternative Mitigation Plan (AMP). If Measures 3.2 and 3.3 above are not feasible, then no later than ninety (90) calendar days before the start of project activities, Permittee shall submit to CDFW for review and approval an AMP that identifies how the 0.089 acre of permanent habitat impacts to the Sacramento River will be mitigated with another mechanism of equivalent mitigation in alternative forms. Permittee shall submit a written proposal for the substitute to be reviewed and approved by CDFW prior to submitting the AMP.

4. Reporting Measures

Permittee shall meet each reporting requirement described below.

4.1 Notification of Project Initiation. The Permittee shall notify the CDFW two (2) business days prior to beginning work for each construction season. Notification shall be submitted as instructed in Contact Information section below. Email submittal is preferred.

4.2 Notification of Project Completion. Upon completion of the project activities described in this Agreement, the project activities shall be photographed. Photographs shall be submitted to CDFW within fifteen (15) business days of project completion. Photographs and project completion notification shall be submitted as instructed in Contact Information section below. Email submittal is preferred.

4.3 Notification to the California Natural Diversity Database. If any special-status species are observed during project implementation, the Permittee shall submit the California Natural Diversity Data Base (CNDDB) Online Field Survey Form electronically at https://www.wildlife.ca.gov/data/CNDDB/submitting-data within five (5) business days of the sightings, and provide a copy of the form, survey map and/or report to the CDFW's Regional office as instructed in Contact Information section below.

4.4 Restoration Monitoring Reports. After completion of the restoration activities for permanent habitat impacts, the area of restoration shall be monitored for a minimum of five (5) years or until CDFW determines the success criteria have been met. Each year for five (5) years after restoration, a monitoring report shall be submitted to CDFW for review and approval. The report shall discuss the mitigation performance as it relates to the success criteria. The report shall include the success of natural revegetation establishment, survival, percent cover, and height of both tree and shrub species. The number by species of plants replaced, an overview of the revegetation effort, and the method used to assess these parameters shall also be included. The report shall include photos from designated photo stations and other relevant information such as: a summary of invasive species control, methods used to remove non-native plants, and a list of wildlife observed on site.

CONTACT INFORMATION

Any communication that Permittee or CDFW submits to the other shall be in writing and any communication or documentation shall be delivered to the address below by U.S. mail, fax, or email, or to such other address as Permittee or CDFW specifies by written notice to the other.

To Permittee:

Brett Gray
Natomas Mutual Water Company
2601 West Elkhorn Boulevard
Rio Linda, CA 95673
Phone: (916) 826-7672
Email: bgray@natomaswater.com

Contact:

Tara Zuroweste
Jacobs
Phone: (707) 494-6284
Email: Tara.Zuroweste@jacobs.com

To CDFW:

California Department of Fish and Wildlife
North Central Region
1701 Nimbus Road, Suite A
Rancho Cordova, CA 95670
Attn: Lake and Streambed Alteration Program
EPIMS Notification No. SAC-37386-R2
Phone: (916) 358-1163
Email: R2LSA@wildlife.ca.gov

LIABILITY

Permittee shall be solely liable for any violations of this Agreement, whether committed by Permittee or any person acting on behalf of Permittee, including its officers, employees, representatives, agents or contractors and subcontractors, to complete the project or any activity related to it that this Agreement authorizes.

This Agreement does not constitute CDFW's endorsement of, or require Permittee to proceed with the project. The decision to proceed with the project is Permittee's alone.

SUSPENSION AND REVOCATION

CDFW may suspend or revoke in its entirety this Agreement if it determines that Permittee or any person acting on behalf of Permittee, including its officers, employees,

representatives, agents, or contractors and subcontractors, is not in compliance with this Agreement.

Before CDFW suspends or revokes this Agreement, it shall provide Permittee written notice by certified or registered mail that it intends to suspend or revoke. The notice shall state the reason(s) for the proposed suspension or revocation, provide Permittee an opportunity to correct any deficiency before CDFW suspends or revokes this Agreement, and include instructions to Permittee, if necessary, including but not limited to a directive to immediately cease the specific activity or activities that caused CDFW to issue the notice.

ENFORCEMENT

Nothing in this Agreement precludes CDFW from pursuing an enforcement action against Permittee instead of, or in addition to, suspending or revoking this Agreement.

Nothing in this Agreement limits or otherwise affects CDFW's enforcement authority or that of its enforcement personnel.

OTHER LEGAL OBLIGATIONS

This Agreement does not relieve Permittee or any person acting on behalf of Permittee, including its officers, employees, representatives, agents, or contractors and subcontractors, from complying with, from obtaining any other permits or authorizations that might be required under, other federal, state, or local laws or regulations before beginning the project or an activity related to it. For example, if the project causes take of a species listed as threatened or endangered under the Endangered Species Act (ESA), such take will be unlawful under the ESA absent a permit or other form of authorization from the U.S. Fish and Wildlife Service or National Marine Fisheries Service.

This Agreement does not relieve Permittee or any person acting on behalf of Permittee, including its officers, employees, representatives, agents, or contractors and subcontractors, from complying with other applicable statutes in the Fish and Game Code including, but not limited to, Fish and Game Code sections 2050 *et seq*. (threatened and endangered species), section 3503 (bird nests and eggs), section 3503.5 (birds of prey), section 5650 (water pollution), section 5652 (refuse disposal into water), section 5901 (fish passage), section 5937 (sufficient water for fish), and section 5948 (obstruction of stream).

Nothing in this Agreement authorizes Permittee or any person acting on behalf of Permittee, including its officers, employees, representatives, agents, or contractors and subcontractors, to trespass.

AMENDMENT

CDFW may amend this Agreement at any time during its term if CDFW determines the amendment is necessary to protect an existing fish or wildlife resource.

Permittee may amend this Agreement at any time during its term, provided the amendment is mutually agreed to in writing by CDFW and Permittee. To request an amendment, Permittee shall submit to CDFW a completed CDFW "Request to Amend Lake or Streambed Alteration" form and include with the completed form payment of the corresponding amendment fee identified in CDFW's current fee schedule (see Cal. Code Regs., tit. 14, § 699.5).

TRANSFER AND ASSIGNMENT

This Agreement may not be transferred or assigned to another entity, and any purported transfer or assignment of this Agreement to another entity shall not be valid or effective, unless the transfer or assignment is requested by Permittee in writing, as specified below, and thereafter CDFW approves the transfer or assignment in writing.

The transfer or assignment of this Agreement to another entity shall constitute a minor amendment, and therefore to request a transfer or assignment, Permittee shall submit to CDFW a completed CDFW "Request to Amend Lake or Streambed Alteration" form and include with the completed form payment of the minor amendment fee identified in CDFW's current fee schedule (see Cal. Code Regs., tit. 14, § 699.5).

EXTENSIONS

In accordance with Fish and Game Code section 1605, subdivision (b), Permittee may request one extension of this Agreement, provided the request is made prior to the expiration of this Agreement's term. To request an extension, Permittee shall submit to CDFW a completed CDFW "Request to Extend Lake or Streambed Alteration" form and include with the completed form payment of the extension fee identified in CDFW's current fee schedule (see Cal. Code Regs., tit. 14, § 699.5). CDFW shall process the extension request in accordance with Fish and Game Code section 1605, subdivisions (b) through (e).

If Permittee fails to submit a request to extend this Agreement prior to its expiration, Permittee must submit a new notification and notification fee before beginning or continuing the project this Agreement covers (Fish & G. Code § 1605, subd. (f)).

EFFECTIVE DATE

This Agreement becomes effective on the date of CDFW's signature, which shall be: 1) after Permittee's signature; 2) after CDFW complies with all applicable requirements under the California Environmental Quality Act (CEQA); and 3) after payment of the applicable Fish and Game Code section 711.4 filing fee listed at https://www.wildlife.ca.gov/Conservation/CEQA/Fees.

TERM

This Agreement shall **expire five (5) years** from the date signed by CDFW. All provisions in this Agreement shall remain in force throughout its term. Permittee shall remain responsible for implementing any provisions specified herein to protect fish and wildlife resources after this Agreement expires or is terminated, as Fish and Game Code section 1605, subdivision (a)(2) requires.

EXHIBITS

The documents listed below are included as exhibits to this Agreement and incorporated herein by reference.

Exhibit A. Project Location
Exhibit B. Project Plans
Exhibit C. Project Impacts

AUTHORITY

If the person signing this Agreement (signatory) is doing so as a representative of Permittee, the signatory hereby acknowledges that he or she is doing so on Permittee's behalf and represents and warrants that he or she has the authority to legally bind Permittee to the provisions herein.

AUTHORIZATION

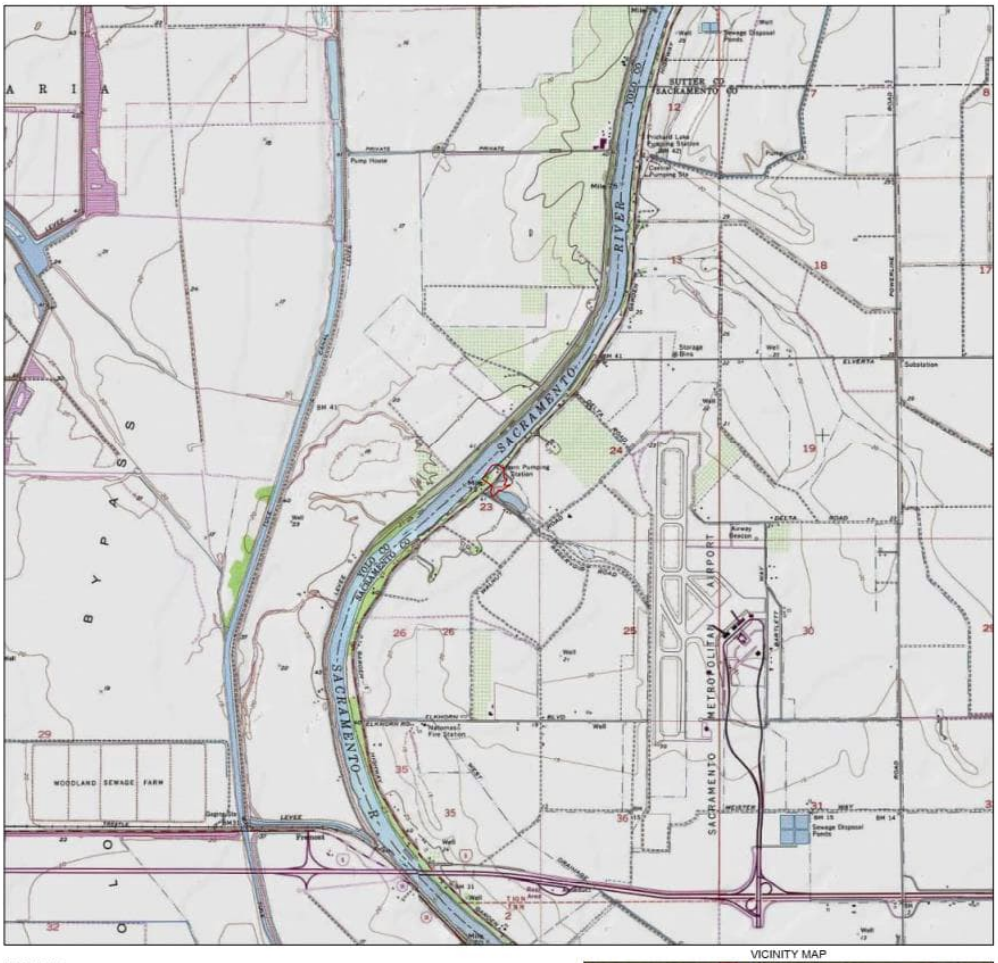
This Agreement authorizes only the project described herein. If Permittee begins or completes a project different from the project this Agreement authorizes, Permittee may be subject to civil or criminal prosecution for failing to notify CDFW in accordance with Fish and Game Code section 1602.

CONCURRENCE

Through the electronic signature by Permittee or Permittee's representative as evidenced by the attached concurrence from CDFW's Environmental Permit Information Management System (EPIMS), Permittee accepts and agrees to comply with all provisions contained herein.

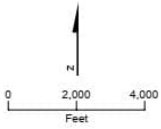
The EPIMS concurrence page containing electronic signatures must be attached to this agreement to be valid.

Exhibit A: Project Location



LEGEND

Action Area (8.85 Acres)



VICINITY MAP

Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China

FIGURE 1
Project Location
Elkhorn Pumping Plant Replacement Project
Natomas, Sacramento County, California

UNK \\DC1VS01\GISPROJ\NNATOMASMUTUALWATERCOMPANY\W8Y09802_ELKHORN\MAPFILES\NMFS_BA\FIGURE1_PROJECTLOCATION.MXD ED035443 8/9/2023 1:50:53 PM

Jacobs

Exhibit B: Project Plans

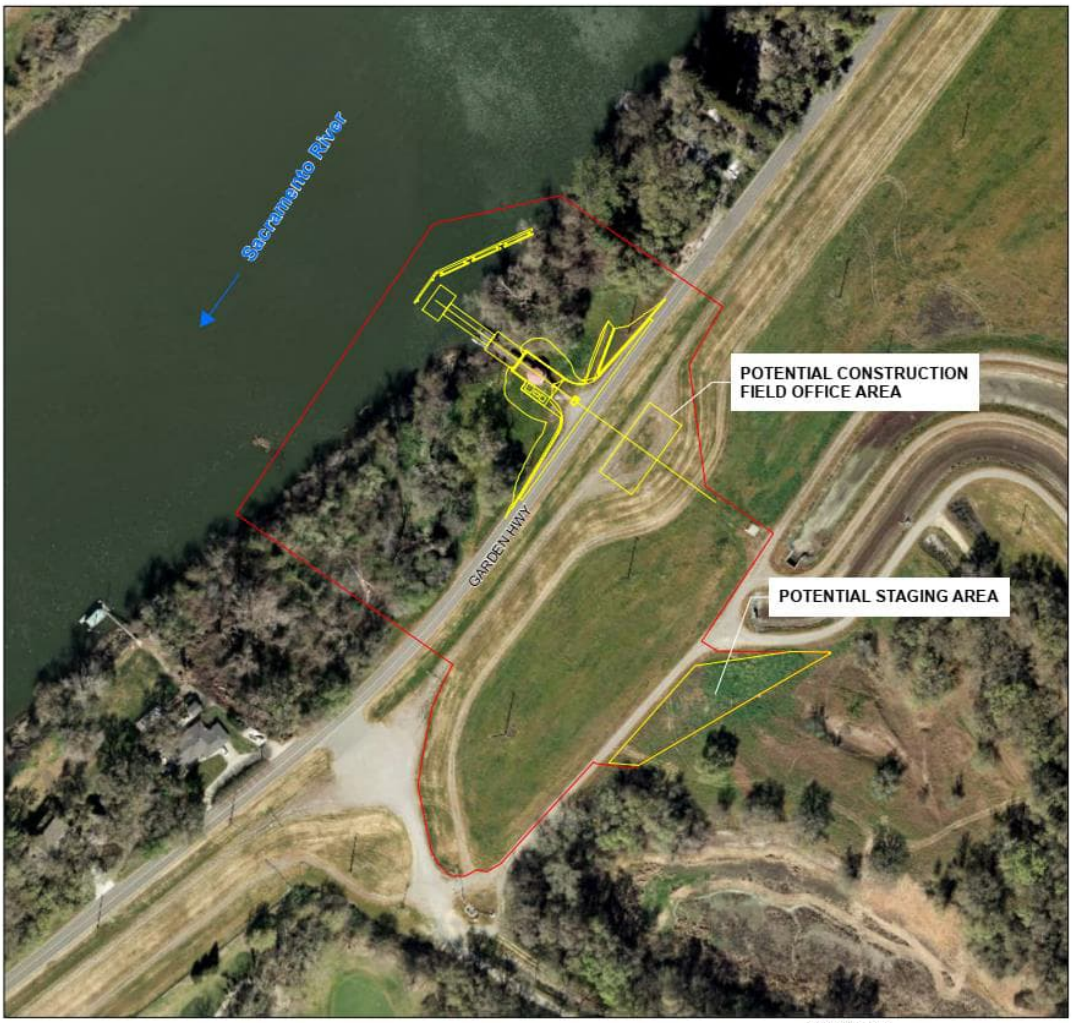


FIGURE 2
Construction Footprint
Elkhorn Pumping Plant Replacement Project
Natomas, Sacramento County, California

Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China

UNK \\DC1VS01\GISPROJ\NNATOMASMUTUALWATERCOMPANY\W8Y09802_ELKHORN\MAPFILES\PDX\FIGURE2_CONSTRUCTIONFOOTPRINT.MXD ED035443 6/30/2023 9:02:15 AM

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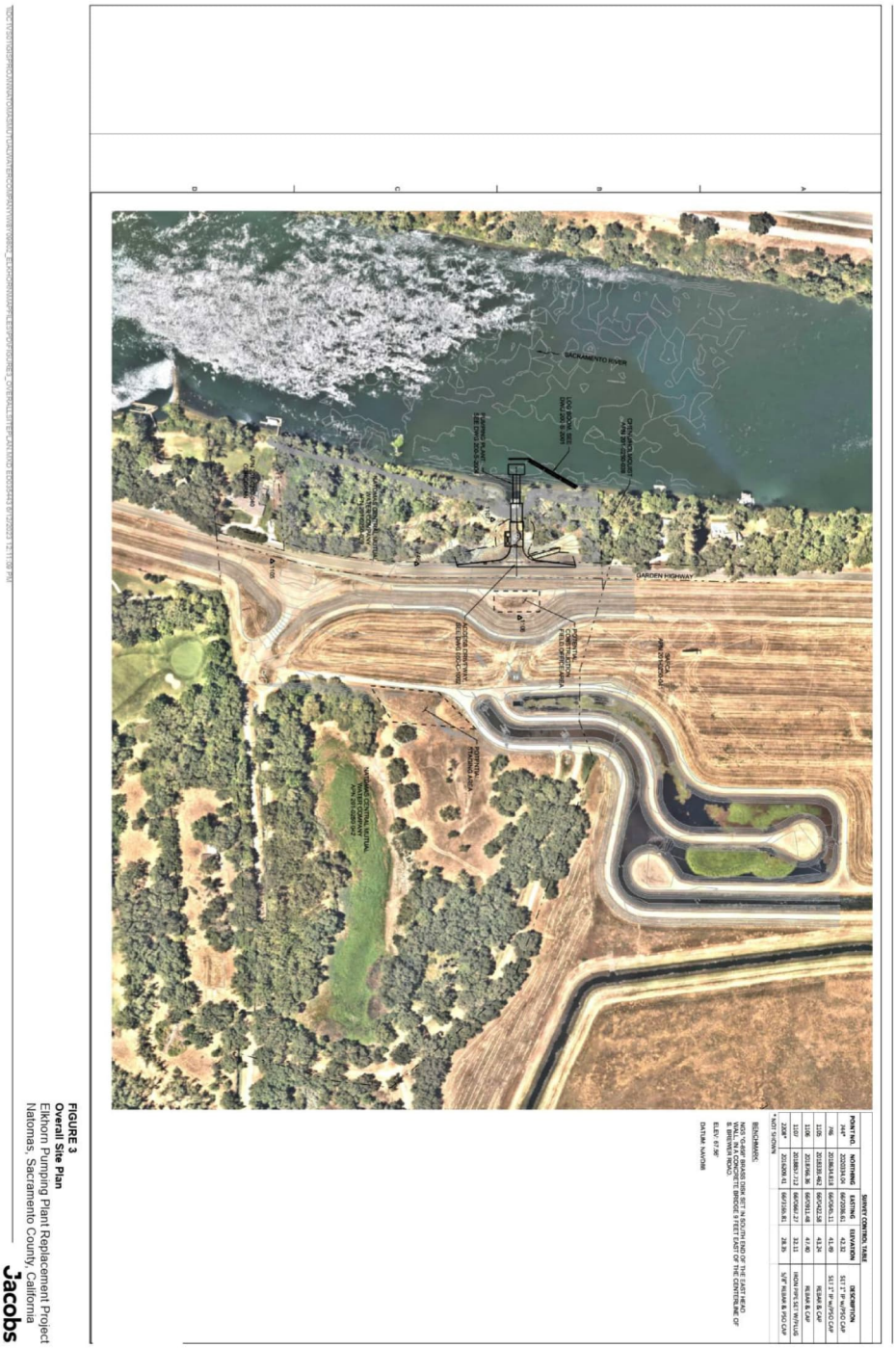

FIGURE 3
Overall Site Plan
Elkhorn Pumping Plant Replacement Project
Natomas, Sacramento County, California

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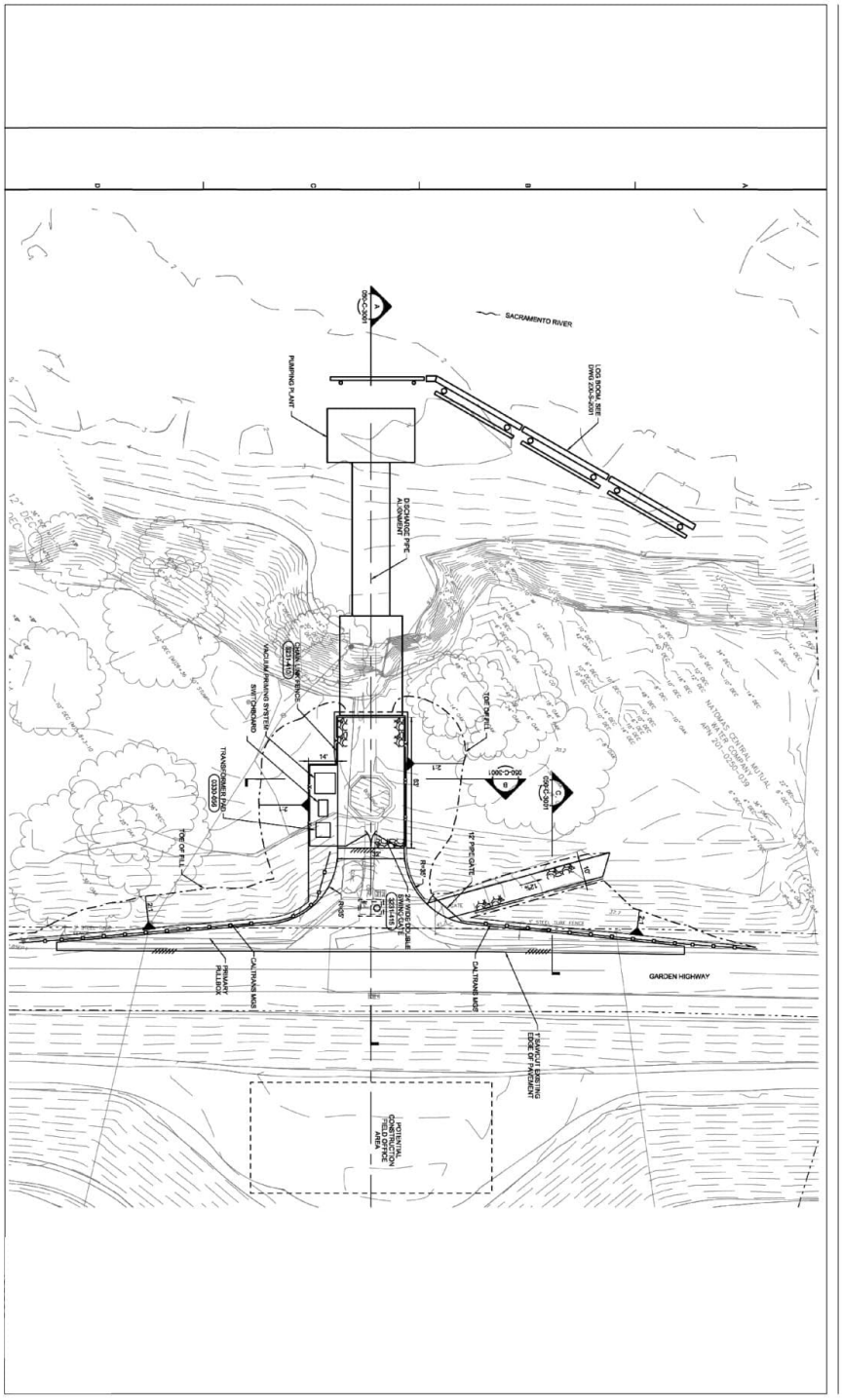

FIGURE 4
Site Plan
Elkhorn Pumping Plant Replacement Project
Natomas, Sacramento County, California

Jacobs

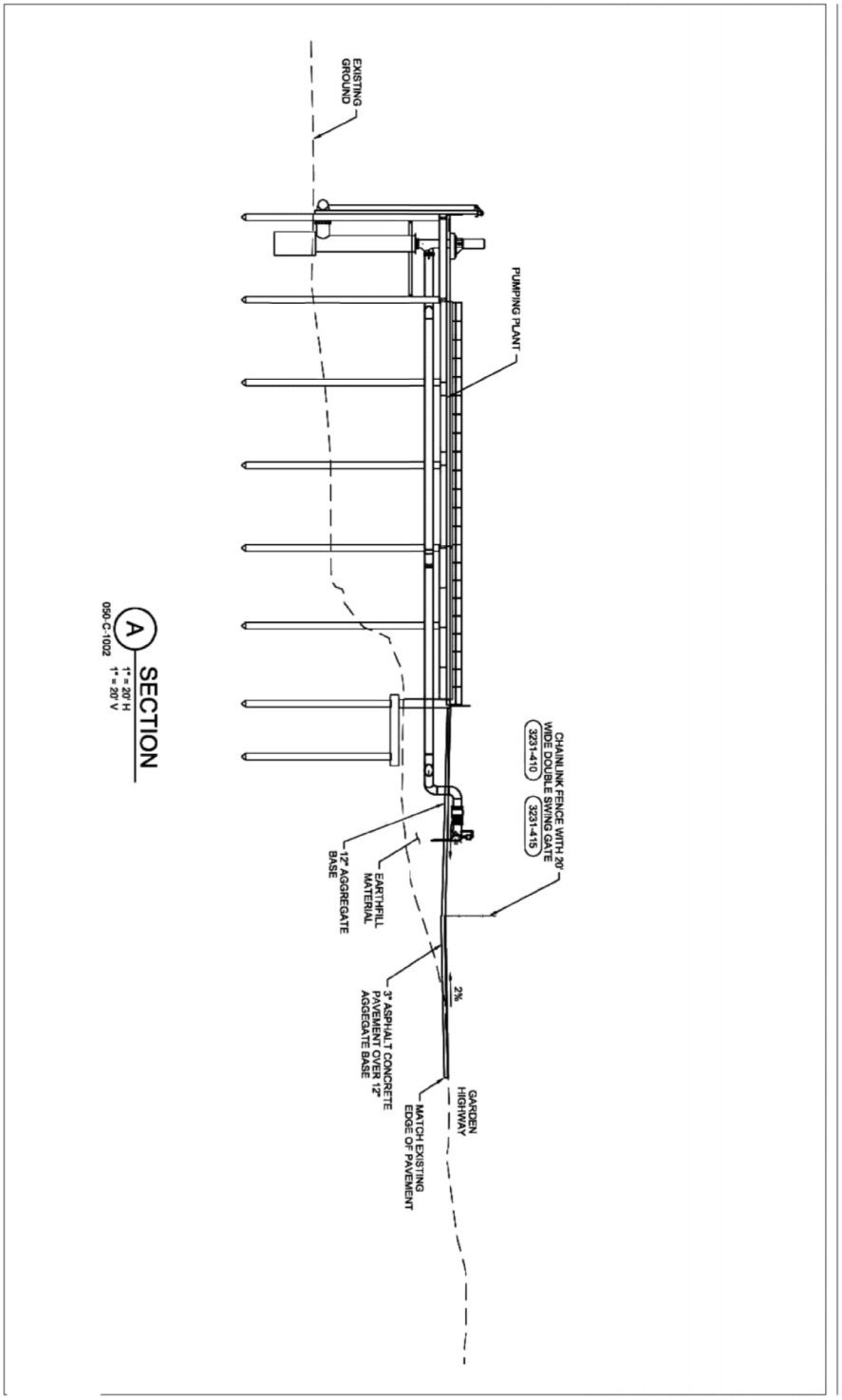

FIGURE 5
Pumping Plant Cross Section
Elkhorn Pumping Plant Replacement Project
Natomas, Sacramento County, California

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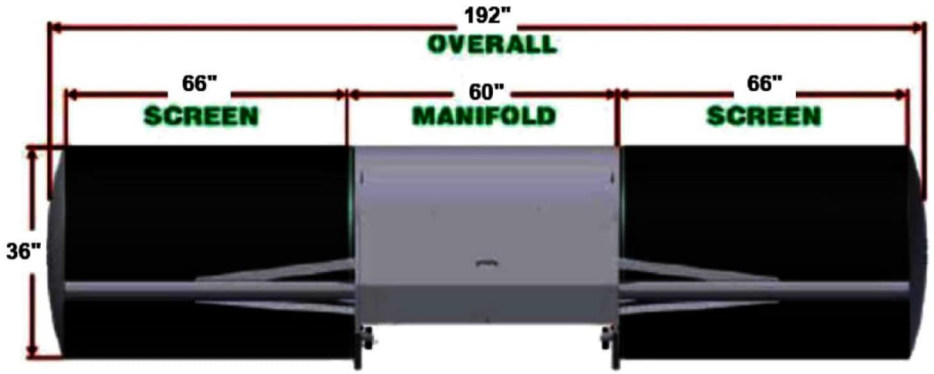
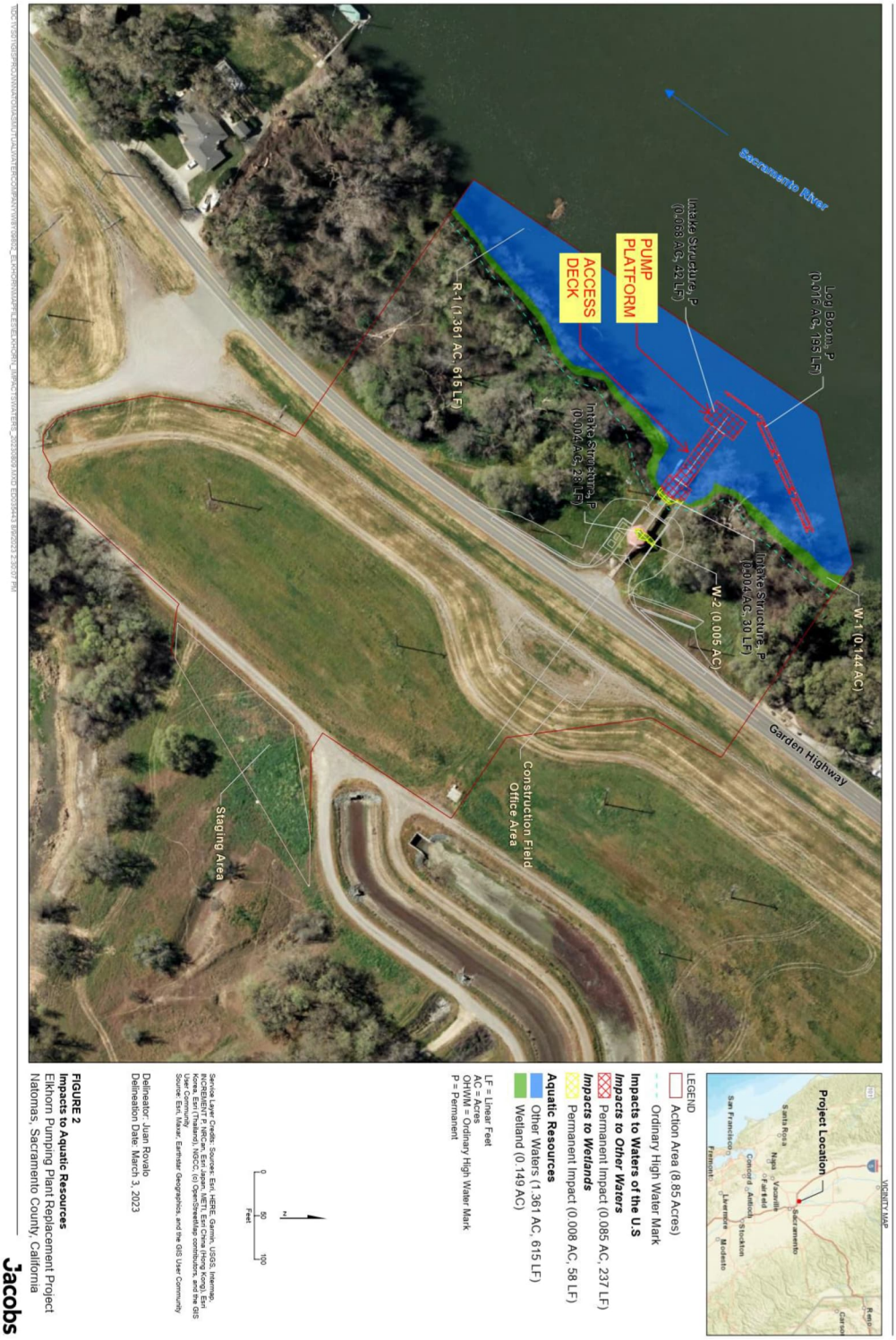


Note: Measurements are for Model ISI T36-66.

Source: ISI 2012 http://intakescreensinc.com/sizing-information/

FIGURE 6
Schematic of the Standard ISI Brushed Cylinder Screen
Elkhorn Pumping Plant Replacement Project
Natomas, Sacramento County, California

Exhibit C: Project Impacts



Delineator: Juan Rovalo
Delineation Date: March 3, 2023

FIGURE 2
Impacts to Aquatic Resources
Elkhorn Pumping Plant Replacement Project
Natomas, Sacramento County, California

Jacobs

SECTION 01 45 16.13
CONTRACTOR QUALITY CONTROL

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. D3740, Evaluation of Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
   b. E329, Use in the Evaluation of Testing and Inspection Agencies as Used in Construction.

1.02 DEFINITIONS

A. Contractor Quality Control (CQC): The means by which Contractor ensures that the construction, to include that performed by Subcontractors and Suppliers, complies with the requirements of the Contract.

1.03 SUBMITTALS

A. Informational Submittals:

1. Qualifications of CQC Manager.
2. CQC Plan: Submit, not later than 30 days after receipt of Notice to Proceed.
3. CQC Report: Submit, weekly, an original and one copy in report form.

1.04 OWNER'S QUALITY ASSURANCE

A. All Work is subject to Owner's quality assurance inspection and testing at all locations and at all reasonable times before acceptance to ensure strict compliance with the terms of the Contract Documents.

B. Owner's quality assurance inspections and tests are for the sole benefit of Owner and do not:

1. Relieve Contractor of responsibility for providing adequate quality control measures;
2. Relieve Contractor of responsibility for damage to or loss of the material before acceptance;

3. Constitute or imply acceptance; or
4. Affect the continuing rights of Owner after acceptance of the completed Work.

C. The presence or absence of a quality assurance inspector does not relieve Contractor from any Contract requirement.

D. Promptly furnish all facilities, labor, and material reasonably needed for performing such safe and convenient inspections and tests as may be required by Engineer.

E. Owner may charge Contractor for any additional cost of inspection or test when Work is not ready at the time specified by Contractor for inspection or test, or when prior rejection makes re-inspection or retest necessary. Quality assurance inspections and tests will be performed in a manner that will not unnecessarily delay the Work.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. Maintain an adequate inspection system and perform such inspections as will ensure that the Work conforms to the Contract Documents.

B. Maintain complete inspection records and make them available at all times to Owner and Engineer.

C. The quality control system shall consist of plans, procedures, and organization necessary to produce an end product that complies with the Contract Documents. The system shall cover all construction and demolition operations, both onsite and offsite, including Work by Subcontractors, fabricators, suppliers and purchasing agents, and shall be keyed to the proposed construction sequence.

3.02 COORDINATION MEETING

A. After the Preconstruction Conference, but before start of construction, and prior to acceptance of the CQC Plan, schedule a meeting with Engineer and Owner to discuss the quality control system.

B. Develop a mutual understanding of the system details, including the forms for recording the CQC operations, control activities, testing, administration of the

system for both onsite and offsite Work, and the interrelationship of Contractor's management and control with the Owner's Quality Assurance.

C. There may be occasions when subsequent conferences may be called by either party to reconfirm mutual understandings and/or address deficiencies in the CQC system or procedures that may require corrective action by Contractor.

3.03 QUALITY CONTROL ORGANIZATION

A. CQC System Manager:

1. Designate an individual within Contractor's organization who will be responsible for overall management of CQC and have the authority to act in CQC matters for the Contractor.
2. CQC System Manager may perform other duties on the Project.
3. CQC System Manager shall be an experienced construction person, with a minimum of 3 years construction experience on similar type Work.
4. CQC System Manager shall report to the Contractor's project manager or someone higher in the organization. Project manager in this context shall mean the individual with responsibility for the overall quality and production management of the Project.
5. CQC System Manager shall be onsite during construction; periods of absence may not exceed 2 weeks at any one time.
6. Identify an alternate for CQC System Manager to serve with full authority during the System Manager's absence. The requirements for the alternate will be the same as for designated CQC System Manager.

3.04 QUALITY CONTROL PHASING

A. CQC shall include at least three phases of control to be conducted by CQC System Manager for all definable features of Work, as follows:

1. Preparatory Phase:
   a. Notify Owner at least 48 hours in advance of beginning any of the required action of the preparatory phase.
   b. This phase shall include a meeting conducted by the CQC System Manager and attended by the superintendent, other CQC personnel (as applicable), and the foreman responsible for the definable feature. The CQC System Manager shall instruct applicable CQC staff as to the acceptable level of workmanship required in order to meet Contract requirements.
   c. Document the results of the preparatory phase meeting by separate minutes prepared by the CQC System Manager and attached to the QC report.

d. Perform prior to beginning Work on each definable feature of Work:
   1) Review applicable Contract Specifications.
   2) Review applicable Contract Drawings.
   3) Verify that all materials and/or equipment have been tested, submitted, and approved.
   4) Verify that provisions have been made to provide required control inspection and testing.
   5) Examine the Work area to verify that all required preliminary Work has been completed and is in compliance with the Contract.
   6) Perform a physical examination of required materials, equipment, and sample Work to verify that they are on hand, conform to approved Shop Drawing or submitted data, and are properly stored.
   7) Review the appropriate activity hazard analysis to verify safety requirements are met.
   8) Review procedures for constructing the Work, including repetitive deficiencies.
   9) Document construction tolerances and workmanship standards for that phase of the Work.
   10) Check to verify that the plan for the Work to be performed, if so required, has been accepted by Engineer.

2. Initial Phase:
   a. Accomplish at the beginning of a definable feature of Work:
      1) Notify Owner at least 48 hours in advance of beginning the initial phase.
      2) Perform prior to beginning Work on each definable feature of Work:
         a) Review minutes of the preparatory meeting.
         b) Check preliminary Work to verify compliance with Contract requirements.
         c) Verify required control inspection and testing.
         d) Establish level of workmanship and verify that it meets minimum acceptable workmanship standards. Comparison with sample panels is appropriate.
         e) Resolve all differences.
         f) Check safety to include compliance with and upgrading of the safety plan and activity hazard analysis. Review the activity analysis with each worker.
      3) Separate minutes of this phase shall be prepared by the CQC System Manager and attached to the QC report. Exact

location of initial phase shall be indicated for future reference and comparison with follow-up phases.

4) The initial phase should be repeated for each new crew to work onsite, or any time acceptable specified quality standards are not being met.

3. Follow-up Phase:
   a. Perform daily checks to verify continuing compliance with Contract requirements, including control testing, until completion of the particular feature of Work.
   b. Daily checks shall be made a matter of record in the CQC documentation and shall document specific results of inspections for all features of Work for the day or shift.
   c. Conduct final follow-up checks and correct all deficiencies prior to the start of additional features of Work that will be affected by the deficient Work. Constructing upon or concealing nonconforming Work will not be allowed.
4. Additional Preparatory and Initial Phases: Additional preparatory and initial phases may be conducted on the same definable features of Work as determined by Owner if the quality of ongoing Work is unacceptable; or if there are changes in the applicable QC staff or in the onsite production supervision or work crew; or if work on a definable feature is resumed after a substantial period of inactivity, or if other problems develop.

3.05 CONTRACTOR QUALITY CONTROL PLAN

A. General:

1. Plan shall identify personnel, procedures, control, instructions, test, records, and forms to be used.
2. An interim plan for the first 30 days of operation will be considered.
3. Construction will be permitted to begin only after acceptance of the CQC Plan or acceptance of an interim plan applicable to the particular feature of Work to be started.
4. Work outside of the features of Work included in an accepted interim plan will not be permitted to begin until acceptance of a CQC Plan or another interim plan containing the additional features of Work to be started.

B. Content:

1. Plan shall cover the intended CQC organization for the entire Contract and shall include the following, as a minimum:
   a. Organization: Description of the quality control organization, including a chart showing lines of authority and acknowledgment that the CQC staff will implement the three-phase control system (see Article Quality Control Phasing) for all aspects of the Work specified.
   b. CQC Staff: The name, qualifications (in resume format), duties, responsibilities, and authorities of each person assigned a QC function.
   c. Letters of Authority: A copy of a letter to the CQC System Manager signed by an authorized official of the firm, describing the responsibilities and delegating sufficient authorities to adequately perform the functions of the CQC System Manager, including authority to stop Work which is not in compliance with the Contract. The CQC System Manager shall issue letters of direction to all other various quality control representatives outlining duties, authorities and responsibilities. Copies of these letters will also be furnished to Owner.
   d. Submittals: Procedures for scheduling, reviewing, certifying, and managing Submittals, including those of Subcontractors, offsite fabricators, suppliers and purchasing agents.
   e. Testing: Control, verification and acceptance testing procedures for each specific test to include the test name, frequency, Specification paragraph containing the test requirements, the personnel and laboratory responsible for each type of test, and an estimate of the number of tests required.
   f. Procedures for tracking preparatory, initial, and follow-up control phases and control, verification, and acceptance tests, including documentation.
   g. Procedures for tracking deficiencies from identification through acceptable corrective action. These procedures will establish verification that identified deficiencies have been corrected.
   h. Reporting procedures, including proposed reporting formats; include a copy of the CQC report form.

C. Acceptance of Plans: Acceptance of the Contractor’s basic and addendum CQC plans is required prior to the start of construction. Acceptance is conditional and will be predicated on satisfactory performance during the construction. Owner reserves the right to require Contractor to make changes in the CQC plan and operations including removal of personnel, as necessary, to obtain the quality specified.

D. Notification of Changes: After acceptance of the CQC plan, Contractor shall notify Engineer, in writing, a minimum of 7 calendar days prior to any proposed change. Proposed changes are subject to acceptance by Engineer.

3.06 CONTRACTOR QUALITY CONTROL REPORT

A. As a minimum, prepare a CQC report for every 7 calendar days. Account for all days throughout the life of the Contract. Reports shall be signed and dated by CQC System Manager. Include copies of test reports and copies of reports prepared by QC staff.

B. Maintain current records of quality control operations, activities, and tests performed, including the Work of Subcontractors and suppliers.

C. Records shall be on an acceptable form and shall be a complete description of inspections, the results of inspections, daily activities, tests, and other items, including but not limited to the following:

1. Contractor/Subcontractor and their areas of responsibility.
2. Operating plant/equipment with hours worked, idle, or down for repair.
3. Work performed today, giving location, description, and by whom. When a network schedule is used, identify each phase of Work performed each day by activity number.
4. Test and/or control activities performed with results and references to Specifications/plan requirements. The control phase should be identified (Preparatory, Initial, Follow-up). List deficiencies noted along with corrective action.
5. Material received with statement as to its acceptability and storage.
6. Identify Submittals reviewed, with Contract reference, by whom, and action taken.
7. Offsite surveillance activities, including actions taken.
8. Job safety evaluations stating what was checked, results, and instructions or corrective actions.
9. List instructions given/received and conflicts on Drawings and/or Specifications.
10. Contractor’s verification statement.
11. Indicate a description of trades working on the Project; the number of personnel working; weather conditions encountered; and any delays encountered.
12. These records shall cover both conforming and deficient features and shall include a statement that equipment and materials incorporated in file work and workmanship comply with the Contract.

3.07 SUBMITTAL QUALITY CONTROL

A. Submittals shall be as specified in Section 01 33 00, Submittal Procedures. The CQC organization shall be responsible for certifying that all Submittals are in compliance with the Contract requirements. Owner will furnish copies of test report forms upon request by Contractor. Contractor may use other forms as approved.

3.08 TESTING QUALITY CONTROL

A. Testing Procedure:

1. Perform tests specified or required to verify that control measures are adequate to provide a product which conforms to Contract requirements. Procure services of a licensed testing laboratory. Perform the following activities and record the following data:
   a. Verify testing procedures comply with Contract requirements.
   b. Verify facilities and testing equipment are available and comply with testing standards.
   c. Check test instrument calibration data against certified standards.
   d. Verify recording forms and test identification control number system, including all of the test documentation requirements, have been prepared.
   e. Documentation:
      1) Record results of all tests taken, both passing and failing, on the CQC report for the date taken.
      2) Include Specification paragraph reference, location where tests were taken, and the sequential control number identifying the test.
      3) Actual test reports may be submitted later, if approved by Engineer, with a reference to the test number and date taken.
      4) Provide directly to Engineer an information copy of tests performed by an offsite or commercial test facility. Test results shall be signed by an engineer registered in the state where the tests are performed.
      5) Failure to submit timely test reports, as stated, may result in nonpayment for related Work performed and disapproval of the test facility for this Contract.

B. Testing Laboratories: Laboratory facilities, including personnel and equipment, utilized for testing soils, concrete, asphalt and steel shall meet criteria detailed in ASTM D3740 and ASTM E329, and be accredited by the American Association of Laboratory Accreditation (AALA), National Institute of Standards and Technology (NIST), National Voluntary Laboratory

Accreditation Program (NVLAP), the American Association of State Highway and Transportation Officials (AASHTO), or other approved national accreditation authority. Personnel performing concrete testing shall be certified by the American Concrete Institute (ACI).

3.09 COMPLETION INSPECTION

A. CQC System Manager shall conduct an inspection of the Work at the completion of all Work or any milestone established by a completion time stated in the Contract.

B. Punchlist:

1. CQC System Manager shall develop a punchlist of items which do not conform to the Contract requirements.
2. Include punchlist in the CQC report, indicating the estimated date by which the deficiencies will be corrected.
3. CQC System Manager or staff shall make a second inspection to ascertain that all deficiencies have been corrected and so notify the Owner.
4. These inspections and any deficiency corrections required will be accomplished within the time stated for completion of the entire Work or any particular increment thereof if the Project is divided into increments by separate completion dates.

END OF SECTION

SECTION 01 45 33
SPECIAL INSPECTION, OBSERVATION, AND TESTING

PART 1 GENERAL

1.01 SUMMARY

A. This section covers requirements for Special Inspection, Observation, and Testing required in accordance with Chapter 17 of the 2022 CBC and is in addition to and supplements requirements included in Statement of Special Inspections shown on Drawings.

1.02 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Society of Civil Engineers (ASCE): 7-16, Minimum Design Loads for Buildings and Other Structures.
2. International Code Council (ICC):
   a. California Building Code (CBC).
   b. Evaluation Service (ICC-ES) Reports and Legacy Reports.

1.03 DEFINITIONS

A. Agencies and Personnel:

1. Agency Having Jurisdiction (AHJ): Permitting building agency; may be a federal, state, local, or other regional department, or individual including building official, fire chief, fire marshal, chief of a fire prevention bureau, labor department, or health department, electrical inspector; or others having statutory authority. AHJ may be Owner when authorized to be self-permitting by governmental permitting agency or when no governmental agency has authority.
2. Approved Agency: An established and recognized agency regularly engaged in conducting tests or furnishing inspection services, when such agency has been approved.
3. Registered Design Professional in Responsible Charge: An individual who is registered or licensed to practice their respective design profession as defined by statutory requirements of professional registration laws of state or jurisdiction in which Project is to be constructed.
4. Special Inspector: Qualified person employed by Owner or Owner's Registered Design Professional who will demonstrate competence to the

satisfaction of AHJ for inspection of a particular type of construction or operation requiring Special Inspection.

B. Statement of Special Inspections: Detailed written procedure contained on Drawings establishing systems and components subject to Special Inspection, Observation, and Testing during construction, type and frequency of testing, extent and duration of Special Inspection, and reports to be completed and distributed by Special Inspector.

C. Special Inspection:

1. Special Inspection: Inspection required of materials, installation, fabrication, erection, or placement of components and connections requiring special expertise to ensure compliance with approved Contract Documents and referenced standards.
2. Special Inspection, Continuous: Full-time observation of work requiring Special Inspection by an approved Special Inspector who is present in area where the Work is being performed.
3. Special Inspection, Periodic: Part-time or intermittent observation of the Work requiring Special Inspection by an approved Special Inspector who is present in area where the Work has been or is being performed, and at completion of the Work.

D. Structural Systems and Components:

1. Diaphragm: Component of structural lateral load resisting system consisting of roof, floor, or other membrane or bracing system acting to transfer lateral forces to vertical resisting elements of structure.
2. Drag Strut or Collector: Component of structural lateral load resisting system consisting of diaphragm or shear wall element that collects and transfers diaphragm shear forces to vertical force-resisting elements or distributes forces within diaphragm or shear wall.
3. Seismic-Force-Resisting System: That part of structural lateral load resisting system that has been considered in the design to provide required resistance to seismic forces identified on Drawings.
4. Wind Force Resisting System: That part of the structural system that has been considered in the design to provide required resistance to wind forces identified on Drawings.

E. Nonstructural Components:

1. Electrical Component Supports: Structural members or assemblies which transmit loads and forces from electrical equipment to structure, including braces, frames, legs, pedestals, and tethers, as well as elements forged or cast as part of component for anchorage.

2. Mechanical Component Supports: Structural members or assemblies which transmit loads and forces from mechanical equipment to structure, including braces, frames, skirts, legs, saddles, pedestals, snubbers, and tethers, as well as elements forged or cast as part of component for anchorage.

F. Professional Observation:

1. Does not include or waive responsibility for required Special Inspection or inspections by building official.
2. Requirements are indicated on Statement of Special Inspections provided on Drawings.
3. Geotechnical Observation: Visual observation of selected subgrade bearing surfaces and installation of deep foundation elements by a registered design professional for general conformance to Contract Documents.

1.04 SUBMITTALS

A. Informational Submittals:

1. Contractor’s Statement of Responsibility: Form shall be completed by entity responsible for construction of main seismic-force-resisting system listed in Statement of Special Inspections. Refer to Article Supplements, located at end of this section.

1.05 STATEMENT OF SPECIAL INSPECTIONS REQUIREMENTS

A. Designated Systems for Inspection:

1. Seismic-force-resisting systems designated under CBC Section 1705.13.
2. Wind-force-resisting Systems: None required.
3. Mechanical and Electrical Components subject to Special Inspection under CBC Section 1705.13.6 for Seismic Resistance: None required.

B. Statement of Special Inspections:

1. As included on Drawings and in support of building permit application, Project-specific requirements were prepared by Registered Design Professional in Responsible Charge. The following identifies elements of inspection, observation, and testing program to be followed in construction of the Work:
   a. Designated seismic systems and main seismic force-resisting systems and components that are subject to Special Inspection for lateral load resistance.

b. Special Inspection and testing required by CBC Section 1705 and other applicable sections and referenced standards therein.
c. Type and frequency of Special Inspection required.
d. Type and frequency of testing required.
e. Required frequency and distribution of testing and Special Inspection reports to be distributed by Special Inspector to Engineer, Contractor, building official, and Owner.
f. Geotechnical Observation to be Performed: Required frequency and distribution of Geotechnical Observation reports by registered design professional to Contractor, building official, and Owner.
g. Structural Observations to be Performed: Not required for this Project.

C. Special Inspection and associated testing of shop fabrication and field construction will be performed by an approved accredited independent agency or by Authority Having Jurisdiction's (AHJ) approved, qualified inspection staff. Owner or Owner's Registered Design Professional in Responsible Charge will secure and pay for services of agency to perform Special Inspection and associated testing.

D. Code required Special Inspection with associated testing, as provided in Statement of Special Inspections on Drawings and further provided in this section, is for benefit of Owner and does not:

1. Relieve Contractor of responsibility for providing adequate quality control measures.
2. Relieve Contractor of responsibility for damage to or loss of material before acceptance.
3. Constitute or imply acceptance.
4. Affect continuing rights of Owner after acceptance of completed Work.

E. The presence or absence of code required Special Inspector does not relieve Contractor from Contract requirements.

F. Contractor is responsible for additional costs associated with Special Inspection and Testing when Work is not ready at time identified by Contractor and Special Inspectors are onsite, but not able to provide contracted services.

G. Contractor is responsible for associated costs for additional Special Inspection and Testing by Special Inspectors required because of rejection of materials of in place Work that cannot be made compliant to Contract Document without additional inspections and testing.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. Requirements of the Statement of Special Inspections are provided by the Owner. All other testing and inspections, unless noted otherwise, are provided by Contractor.

B. Provide access to shop or Site for Special Inspection and Testing requirements.

C. Notify Engineer in advance of required Special Inspection no later than 48 hours prior to date of Special Inspection.

D. Provide access for Special Inspector to construction documents.

E. Retain special inspection records onsite to be readily available for review.

F. Cooperate with Special Inspector and provide safe access to the Work to be inspected.

G. Submit Fabricator's Certificates of Compliance for approved fabricators.

H. Provide reasonable auxiliary services as requested by the Special Inspector. Auxiliary services required include, but not limited to:

1. Providing access to the Work and furnishing incidental labor and facilities necessary to facilitate inspections and tests to assist the Special Inspector in performing test/inspections.
2. Providing storage space for the Special Inspector’s exclusive use, such as for storing and curing concrete test samples and delivery of samples to testing laboratories.
3. Providing the Special Inspector with access to all Approved Submittals.
4. Providing security and protection of samples and test equipment at the Project Site.
5. Provide samples of materials to be tested in required quantities.

I. When required by Registered Design Professional in Responsible Charge, provide access for mechanical and electrical component inspections for those items requiring certification.

J. Materials and systems shall be inspected during placement where Continuous Special Inspection is required.

K. Where Periodic Special Inspection is indicated in the Statement of Special Inspections:

1. Schedule inspections for either during or at completion of their placement or a combination or both.
2. Schedule periodically inspected Work (either inspected during or after its placement) so that corrections can be completed and re-inspected before Work is inaccessible.
3. Sampling a portion of the Work is not allowed. Schedules shall provide for inspection of all Work requiring periodic inspection.

3.02 SUPPLEMENTS

A. The supplement listed below, following "End of Section," is part of this Specification:

1. Contractor's Statement of Responsibility.

END OF SECTION

CONTRACTOR'S STATEMENT OF RESPONSIBILITY

Elkhorn Pumping Plant Replacement
(Project)

(Name of Contracting Company)

(Business Address)

(_____) _____ (_____) _____
(Telephone) (Fax)

I, (We) hereby certify that I am (we are) aware of the Special Inspection and Testing requirements contained in Contract Documents for this Project for seismic force-resisting systems, and for components including mechanical and electrical components, as listed in Statement of Special Inspections on Drawings that:

1. I, (We) aware of the systems and the requirements of the special inspection and acknowledge our responsibility in the implementation of the Statement of Special Inspections for the construction of the following systems:

Facility	Lateral Force-Resisting System
100-Pumping Plant	Steel Special Cantilevered Colum System
200-Log Boom	Steel Special Cantilevered Colum System

2. Control of this Work will be exercised to obtain conformance with Contract Documents approved by building official.

3. Procedures within the Contractor's organization to be used for exercising control of the Work, method and frequency of reporting, and distribution of reports required under Statement of Special Inspections for Project are attached to this statement.

4. I, (We) will provide 48-hour notification to Engineer and approved inspection agency as required for structural tests and Special Inspection for Project.

5. The following person is hereby identified as exercising control over requirements of this section for the Work designated above:

Name: _____

Qualifications: _____

_____

_____

(Print name and official title of person signing this form)

Signed by: _____

Date: _____

Project Name: Elkhorn Pumping Plant Replacement

SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Association of Nurserymen (AAN): American Standards for Nursery Stock.
2. Federal Emergency Management Agency (FEMA).
3. National Fire Prevention Association (NFPA): 241, Standard for Safeguarding Construction, Alteration, and Demolition Operations.
4. Telecommunications Industry Association (TIA); Electronic Industries Alliance (EIA): 568B, Commercial Building Telecommunications Cabling Standard.
5. U.S. Department of Agriculture (USDA): Urban Hydrology for Small Watersheds.
6. U.S. Weather Bureau: Rainfall-Frequency Atlas of the U.S. for Durations from 30 Minutes to 24 Hours and Return Periods from 1 to 100 Years.

1.02 SUBMITTALS

A. Informational Submittals:

1. Copies of permits and approvals for construction as required by Laws and Regulations and governing agencies.
2. Temporary Construction Submittals:
   a. Parking area plans.
   b. Contractor’s field office, storage yard, and storage building plans, including gravel surfaced area.
   c. Fencing and protective barrier locations and details.
   d. Engineer’s field office plans.
   e. Staging area location plan.
   f. Traffic and Pedestrian Control and Routing Plans: As specified herein, and proposed revisions thereto.
3. Temporary Control Submittals: Noise control plan.

1.03 MOBILIZATION

A. Mobilization includes, but is not limited to, these principal items:

1. Obtaining required permits.
2. Moving Contractor's field office and equipment required for first month operations onto Site.
3. Installing temporary construction power, wiring, and lighting facilities.
4. Providing onsite Internet service.
5. Providing onsite sanitary facilities and potable water facilities as specified and as required by Laws and Regulations, and governing agencies.
6. Arranging for and erection of Contractor's work and storage yard.
7. Posting OSHA required notices and establishing safety programs and procedures.
8. Having Contractor's superintendent at Site full time.
9. Providing Engineer's facilities.

B. Use area designated for Contractor's temporary facilities as shown on Drawings.

1.04 PROTECTION OF WORK AND PROPERTY

A. Comply with Owner's safety rules while on Owner's property.

B. Keep Owner informed of serious onsite accidents and related claims.

C. Use of Explosives: No blasting or use of explosives will be allowed onsite.

1.05 VEHICULAR TRAFFIC

A. Traffic Control Plan: Prepare and adhere to traffic control plan reviewed and accepted by Engineer. Changes to this plan shall be made only by written approval of Sacramento County and Engineer. Secure approvals for necessary changes so as not to delay progress of the Work.

B. Traffic Routing Plan: Show sequences of construction affecting use of roadways, time required for each phase of the Work, provisions for decking over excavations and phasing of operations to provide necessary access, and plans for signing, barricading, and striping to provide passages for pedestrians and vehicles.

PART 2 PRODUCTS

2.01 ENGINEER'S FIELD OFFICES

A. Furnish equipment specified for exclusive use of Engineer and its' representatives.

B. Ownership of equipment furnished under this article will remain, unless otherwise specified, that of Contractor.

C. Equipment furnished shall be new or like new in appearance and function.

D. Minimum Features:

1. 110-volt lighting and wall plugs.
2. Fluorescent ceiling lights.
3. Electric heating and self-contained air conditioning unit, properly sized for Project locale and conditions. Provide ample electric power to operate installed systems.
4. Provide railed stairways, and landings.
5. Sign on Entrance Door Reading: JACOBS, letter height 4 inches minimum.
6. Exterior Door(s):
    a. Number: One.
    b. Type: Solid core.
    c. Lock(s): Cylindrical.
7. Number of Windows: Two.
8. Minimum Interior Height: 8 feet.

E. Floor Space: Minimum 200 square feet.

F. Security guard screens on windows.

G. Blinds or drapes on windows.

H. Office Equipment—General:

1. Bottled Water Service.
2. Small refrigerator.
3. Desk: One, steel, 30 inches by 60 inches with desk surface located 29 inches from floor.
4. Desk Chair:
    a. One, with the following characteristics:
        1) Five castor base.
        2) Adjustable height.

3) Swivels.
4) Locking back.
5) Adjustable seat back for height and angle.
6) Adjustable arms.

5. Folding Table: One, 36 inches by 96 inches.
6. Steel Folding Chairs: Eight.
7. Four-Drawer Steel File with Lock: One, legal width.
8. Bookcase: One, 36 inches wide by 48 inches high.
9. Wastepaper Basket: Two.
10. First-Aid Kit: One.
11. Tri-Class (ABC), Dry Chemical Fire Extinguisher, 10-Pound: One.
12. Printer/Copier/Scanner, dry type, color, self-feeding, capable of providing 11-inch by 17-inch, 8-1/2-inch by 11-inch, and 8-1/2-inch by 14-inch copies and collating multiple copies to 10, and reduction, enlargement capabilities. Scanner shall have built-in capability to scan documents, produce color and black and white Adobe Acrobat Portable Document Format (PDF) files that can be transmitted to user-selected email address. Provide all required supplies, including toner and paper.
13. Maintenance service agreements for all hardware for duration of Contract.

2.02 PROJECT SIGN

A. Provide and maintain one, 8-foot-wide by 4-foot-high sign constructed of 3/4-inch exterior high density overlaid plywood. Sign shall bear name of Project, Owner, Contractor, Engineer, and other participating agencies. Lettering shall be blue, black, and green applied on white background by an experienced sign painter. Provide exterior type enamel paint. Information to be included will be provided by Engineer.

PART 3 EXECUTION

3.01 ENGINEER'S FIELD OFFICE

A. Make available for Engineer's use prior to start of the Work at Site and to remain onsite for minimum of 30 days after final acceptance of the Work.

B. Locate where directed by Engineer; level, block, tie down, skirt, provide stairways, and relocate when necessary and approved. Construct on proper foundations, and provide proper surface drainage and connections for utility services.

C. Provide minimum 100 square feet of gravel or crushed rock base, minimum depth of 4 inches, at each entrance.

D. Raise grade under field office, as necessary, to elevation adequate to avoid flooding.

E. Provide sanitary facilities in compliance with state and local health authorities.

F. Exterior Door Keys: Furnish two set(s) of keys.

G. Maintain in good repair and appearance, and provide weekly cleaning service and replenishment, as required, of paper towels, paper cups, hand soap, toilet paper, first-aid kit supplies, and bottled water.

H. Replenish, as needed, copy paper and toner.

3.02 TEMPORARY UTILITIES

A. Power: The Contractor shall provide, at his own expense, all necessary power for execution of all Work. Owner will not provide power to the Contractor.

B. Lighting: Provide temporary lighting to meet applicable safety requirements to allow erection, application, or installation of materials and equipment, and observation or inspection of the Work.

C. Heating, Cooling, and Ventilating:

1. Provide as required to maintain adequate environmental conditions to facilitate progress of the Work, to meet specified minimum conditions for installation of materials, and to protect materials, equipment, and finishes from damage because of temperature or humidity.
2. Provide adequate forced air ventilation of enclosed areas to cure installed materials, to dispense humidity, and to prevent hazardous accumulations of dust, fumes, vapors, or gases.
3. Pay costs of installation, maintenance, operation, removal, and fuel consumed.
4. Provide portable unit heaters, complete with controls, oil- or gas-fired, and suitably vented to outside as required for protection of health and property.
5. If permanent natural gas piping is used for temporary heating units, do not modify or reroute gas piping without approval of utility company. Provide separate gas metering as required by utility.

D. Water: No construction or potable water is available at Site. Make arrangements for and bear costs of providing water required for construction purposes and for drinking by construction personnel during construction.

E. Sanitary and Personnel Facilities: Provide and maintain facilities for Contractor's employees, Subcontractors, and other onsite employers' employees. Service, clean, and maintain facilities and enclosures.

F. Fire Protection: Furnish and maintain onsite adequate firefighting equipment capable of extinguishing incipient fires. Comply with applicable parts of NFPA 241.

3.03 PROTECTION OF WORK AND PROPERTY

A. General:

1. Perform Work within right-of-way and easements in a systematic manner that minimizes inconvenience to property owners and the public.
2. No residence or business shall be cut off from vehicular traffic for a period exceeding 4 hours, unless special arrangements have been made.
3. Maintain in continuous service existing oil and gas pipelines, underground power, telephone or communication cable, water mains, irrigation lines, sewers, poles and overhead power, and other utilities encountered along line of the Work, unless other arrangements satisfactory to owners of said utilities have been made.
4. Where completion of the Work requires temporary or permanent removal or relocation of existing utility, coordinate activities with owner of said utility and perform work to their satisfaction.
5. Protect, shore, brace, support, and maintain underground pipes, conduits, drains, and other underground utility construction uncovered or otherwise affected by construction operations.
6. Keep fire hydrants and water control valves free from obstruction and available for use at all times.
7. In areas where Contractor's operations are adjacent to or near a utility, such as gas, telephone, television, electric power, water, sewer, or irrigation system, and such operations may cause damage or inconvenience, suspend operations until arrangements necessary for protection have been made by Contractor.
8. Notify property owners and utility offices that may be affected by construction operation at least 2 days in advance before exposing a utility, obtain utility owner's permission. Should service of utility be interrupted due to Contractor's operation, notify proper authority immediately. Cooperate with said authority in restoring service as promptly as possible and bear costs incurred.
9. Do not impair operation of existing sewer system. Prevent construction material, pavement, concrete, earth, volatile and corrosive wastes, and

other debris from entering sewers, pump stations, or other sewer structures.

10. Maintain original Site drainage wherever possible.

B. Site Security: Provide and maintain temporary security fences as necessary to protect the Work and Contractor-furnished products not yet installed.

C. Barricades and Lights:

1. Provide as required by the California Manual on Uniform Traffic Control Devices and in sufficient quantity to safeguard public and the Work.
2. Provide as necessary to prevent unauthorized entry to construction areas and affected roads, streets, and alleyways, inside and outside of fenced area, and as required to ensure public safety and the safety of Contractor's employees, other employer's employees, and others who may be affected by the Work.
3. Provide to protect existing facilities and adjacent properties from potential damage.
4. Locate to enable access by facility operators and property owners.
5. Protect streets, roads, highways, and other public thoroughfares that are closed to traffic by effective barricades with acceptable warning signs.
6. Locate barricades at the nearest intersecting public thoroughfare on each side of blocked section.
7. Illuminate barricades and obstructions with warning lights from sunset to sunrise.

D. Signs and Equipment:

1. Conform to requirements of manual published by the California Department of Transportation.
2. Traffic Cones: Provide to delineate traffic lanes to guide and separate traffic movements.
3. Road Construction Ahead Signs: Provide and place in conspicuous locations, approximately 200 feet in advance of the Work, and facing approaching traffic.
4. Provide at obstructions, such as material piles and equipment.
5. Use to alert general public of construction hazards, which would include surface irregularities, unramped walkways, grade changes, and trenches or excavations in roadways and in other public access areas.

E. Trees and Plantings:

1. Protect from damage and preserve trees, shrubs, and other plants outside limits of the Work and within limits of the Work. Unless otherwise indicated, all trees onsite are designated to remain undisturbed.
    a. Do not stockpile materials or permit traffic within drip lines of trees.
    b. Provide and maintain temporary barricades around trees.
    c. Cover temporarily exposed roots with wet burlap, and keep burlap moist until soil is replaced around roots.
    d. No trees, except those specifically shown on Drawings to be removed, shall be removed without written approval of Engineer.
    e. Dispose of removed trees in a legal manner off the Site.
2. In event of damage to bark, trunks, limbs, or roots of plants that are not designated for removal, treat damage by corrective pruning, bark tracing, application of a heavy coating of tree paint, and other accepted horticultural and tree surgery practices.
3. Replace each plant that dies as a result of construction activities.

F. Existing Structures:

1. Where Contractor contemplates removal of small structures such as mailboxes, signposts, and culverts that interfere with Contractor's operations, obtain approval of property owner and Engineer.
2. Move mailboxes to temporary locations accessible to postal service.
3. Replace items removed in their original location and a condition equal to or better than original.

G. Finished Construction: Protect finished floors and concrete floors exposed as well as those covered with composition tile or other applied surfacing.

H. Waterways: Keep ditches, culverts, and natural drainages continuously free of construction materials and debris.

I. Dewatering: Construct, maintain, and operate cofferdams, channels, flume drains, sumps, pumps, or other temporary diversion and protection works. Furnish materials required, install, maintain, and operate necessary pumping and other equipment for the environmentally safe removal and disposal of water from the various parts of the Work. Maintain foundations and parts of the Work free from water.

J. Archaeological Finds: Comply with Section 01 30 00, Environmental Compliance.

K. Endangered and Threatened Species: Comply with Section 01 30 00, Environmental Compliance.

3.04 TEMPORARY CONTROLS

A. Air Pollution Control:

1. Minimize air pollution from construction operations.
2. Burning of waste materials, rubbish, or other debris will not be permitted on or adjacent to Site.
3. Conduct operations of dumping rock and of carrying rock away in trucks to cause a minimum of dust. Give unpaved streets, roads, detours, or haul roads used in construction area a dust-preventive treatment or periodically water to prevent dust. Strictly adhere to applicable environmental regulations for dust prevention.
4. Provide and maintain temporary dust-tight partitions, bulkheads, or other protective devices during construction to permit normal operation of existing facilities. Construct partitions of plywood, insulating board, plastic sheets, or similar material. Construct partitions in such a manner that dust and dirt from demolition and cutting will not enter other parts of existing building or facilities. Remove temporary partitions as soon as need no longer exists.

B. Noise Control:

1. Provide acoustical barriers so noise emanating from tools or equipment will not exceed legal noise levels.
2. Noise Control Ordinance: Sacramento County.
3. Noise Control Plan: Propose plan to mitigate construction noise and to comply with noise control ordinances, including method of construction, equipment to be used, and acoustical treatments.

C. Water Pollution Control:

1. Divert sanitary sewage and nonstorm waste flow interfering with construction and requiring diversion to sanitary sewers. Do not cause or permit action to occur which would cause an overflow to existing waterway.
2. Prior to commencing excavation and construction, obtain Engineer’s agreement with detailed plans showing procedures intended to handle and dispose of sewage, groundwater, and dewatering pump discharges.
3. Comply with the SWPPP for stormwater flow and surface runoff.
4. Do not dispose of volatile wastes such as mineral spirits, oil, chemicals, or paint thinner in storm or sanitary drains. Disposal of wastes into

streams or waterways is prohibited. Provide acceptable containers for collection and disposal of waste materials, debris, and rubbish.

D. Erosion, Sediment, and Flood Control: Provide, maintain, and operate temporary facilities as described in the SWPPP to control erosion and sediment releases, and to protect the Work and existing facilities from flooding during construction period.

3.05 STORAGE YARDS AND BUILDINGS

A. Coordinate requirements with Section 01 61 00, Common Product Requirements.

B. Temporary Storage Yards: Construct temporary storage yards for storage of products that are not subject to damage by weather conditions.

C. Temporary Storage Buildings:

1. Provide environmental control systems that meet recommendations of manufacturers of equipment and materials stored.
2. Arrange or partition to provide security of contents and ready access for inspection and inventory.
3. Store combustible materials (paints, solvents, fuels) in a well-ventilated and remote building meeting safety standards.

3.06 ACCESS ROADS

A. Construct access roads as shown and required and within easements, rights-of-way, or Project limits.

B. Maintain drainage ways. Install and maintain culverts to allow water to flow beneath access roads. Provide corrosion-resistant culvert pipe of adequate strength to resist construction loads.

C. Provide gravel, crushed rock, or other stabilization material to permit access by all motor vehicles at all times.

D. Maintain road grade and crown to eliminate potholes, rutting, and other irregularities that restrict access.

E. Coordinate with Engineer detours and other operations affecting traffic and access. Provide at least 72 hours’ notice to Engineer of operations that will alter access to Site.

F. Upon completion of construction, restore ground surface disturbed by access road construction to original grade. Replace damaged or broken culverts with new culvert pipe of same diameter and material.

3.07 PARKING AREAS

A. Control vehicular parking to preclude interference with public traffic or parking, access by emergency vehicles, Owner's operations, or construction operations.

B. Provide parking facilities for personnel working on Project.

3.08 VEHICULAR TRAFFIC

A. Comply with Laws and Regulations regarding closing or restricting use of public streets or highways. No public or private road shall be closed, except by written permission of proper authority. Ensure the least possible obstruction to traffic and normal commercial pursuits.

B. Conduct the Work to interfere as little as possible with public travel, whether vehicular or pedestrian.

C. Whenever it is necessary to cross, close, or obstruct roads, driveways, and walks, whether public or private, provide and maintain suitable and safe bridges, detours, or other temporary expedients for accommodation of public and private travel.

D. Road Closures: Maintain satisfactory means of exit for persons residing or having occasion to transact business along route of the Work. If it is necessary to close off roadway or alley providing sole vehicular access to property for periods greater than 2 hours, provide written notice to each owner so affected 3 days prior to such closure. In such cases, closings of up to 4 hours may be allowed. Closures of up to 10 hours may be allowed if a week's written notice is given and undue hardship does not result.

E. Maintenance of traffic is not required if Contractor obtains written permission from Owner and tenant of private property, or from authority having jurisdiction over public property involved, to obstruct traffic at designated point.

F. In making street crossings, do not block more than one-half the street at a time. Whenever possible, widen shoulder on opposite side to facilitate traffic flow. Provide temporary surfacing on shoulders as necessary.

G. Maintain top of backfilled trenches before they are paved, to allow normal vehicular traffic to pass over. Provide temporary access driveways where required. Cleanup operations shall follow immediately behind backfilling.

H. When flaggers and guards are required by regulation or when deemed necessary for safety, furnish them with approved orange wearing apparel and other regulation traffic control devices.

I. Notify fire department and police department before closing street or portion thereof. Notify said departments when streets are again passable for emergency vehicles. Do not block off emergency vehicle access to consecutive arterial crossings or dead-end streets, in excess of 300 linear feet, without written permission from fire department. Conduct operations with the least interference to fire equipment access, and at no time prevent such access. Furnish Contractor's night emergency telephone numbers to police department.

J. Coordinate traffic routing with that of others working in same or adjacent areas.

3.09 CLEANING DURING CONSTRUCTION

A. In accordance with General Conditions, as may be specified in other Specification sections, and as required herein.

B. Wet down exterior surfaces prior to sweeping to prevent blowing of dust and debris. At least weekly, sweep floors (basins, tunnels, platforms, walkways, roof surfaces), and pick up and dispose of debris.

C. Provide approved containers for collection and disposal of waste materials, debris, and rubbish. At least weekly, dispose of such waste materials, debris, and rubbish offsite.

D. At least weekly, brush sweep entry drive, roadways, and other streets and walkways affected by the Work and where adjacent to the Work.

END OF SECTION

SECTION 01 61 00
COMMON PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 DEFINITIONS

A. Products:

1. New items for incorporation in the Work, whether purchased by Contractor or Owner for the Project, or taken from previously purchased stock, and may also include existing materials or components required for reuse.
2. Includes the terms material, equipment, machinery, components, subsystem, system, hardware, software, and terms of similar intent and is not intended to change meaning of such other terms used in Contract Documents, as those terms are self-explanatory and have well recognized meanings in construction industry.
3. Items identified by manufacturer's product name, including make or model designation, indicated in manufacturer's published product literature, that is current as of the date of the Contract Documents.

1.02 DESIGN REQUIREMENTS

A. Where Contractor design is specified, design of installation, systems, equipment, and components, including supports and anchorage, shall be in accordance with provisions of latest edition of California Building Code (CBC) by International Code Council.

1. See General Structural Notes on Drawings for Contractor design criteria requirements for loadings such as wind, seismic, soil properties, groundwater table, and related design parameters.

1.03 ENVIRONMENTAL REQUIREMENTS

A. Altitude: Provide materials and equipment suitable for installation and operation under rated conditions at 50 feet above sea level.

B. Provide equipment and devices installed outdoors or in unheated enclosures capable of continuous operation within an ambient temperature range of 10 degrees F to 120 degrees F.

1.04 PREPARATION FOR SHIPMENT

A. When practical, factory assemble products. Mark or tag separate parts and assemblies to facilitate field assembly. Cover machined and unpainted parts that may be damaged by the elements with strippable protective coating.

B. Package products to facilitate handling and protect from damage during shipping, handling, and storage. Mark or tag outside of each package or crate to indicate its purchase order number, bill of lading number, contents by name, name of Project and Contractor, equipment number, and approximate weight. Include complete packing list and bill of materials with each shipment.

C. Extra Materials, Special Tools, Test Equipment, and Expendables:

1. Furnish as required by individual Specifications.
2. Schedule:
    a. Ensure that shipment and delivery occurs concurrent with shipment of associated equipment.
    b. Transfer to Owner shall occur immediately subsequent to Contractor’s acceptance of equipment from Supplier.
3. Packaging and Shipment:
    a. Package and ship extra materials and special tools to avoid damage during long term storage in original cartons insofar as possible, or in appropriately sized, hinged-cover, wood, plastic, or metal box.
    b. Prominently displayed on each package, the following:
        1) Manufacturer’s part nomenclature and number, consistent with Operation and Maintenance Manual identification system.
        2) Applicable equipment description.
        3) Quantity of parts in package.
        4) Equipment manufacturer.
4. Deliver materials to Site.
5. Notify Engineer upon arrival for transfer of materials.
6. Replace extra materials and special tools found to be damaged or otherwise inoperable at time of transfer to Owner.

D. Request a minimum 7-day advance notice of shipment from manufacturer.

E. Factory Test Results: Reviewed and accepted by Engineer before product shipment as required in individual Specification sections.

1.05 DELIVERY AND INSPECTION

A. Deliver products in accordance with accepted current Progress Schedule and coordinate to avoid conflict with the Work and conditions at Site. Deliver anchor bolts and templates sufficiently early to permit setting prior to placement of structural concrete.

B. Deliver products in undamaged condition, in manufacturer's original container or packaging, with identifying labels intact and legible. Include on label, date of manufacture and shelf life, where applicable.

C. Unload products in accordance with manufacturer's instructions for unloading or as specified. Record receipt of products at Site. Promptly inspect for completeness and evidence of damage during shipment.

D. Remove damaged products from Site and expedite delivery of identical new undamaged products, and remedy incomplete or lost products to provide that specified, so as not to delay progress of the Work.

1.06 HANDLING, STORAGE, AND PROTECTION

A. Handle and store products in accordance with manufacturer's written instructions and in a manner to prevent damage. Store in approved storage yards or sheds provided in accordance with Section 01 50 00, Temporary Facilities and Controls. Provide manufacturer's recommended maintenance during storage, installation, and until products are accepted for use by Owner.

B. Manufacturer's instructions for material requiring special handling, storage, or protection shall be provided prior to delivery of material.

C. Arrange storage in a manner to provide easy access for inspection. Make periodic inspections of stored products to ensure that products are maintained under specified conditions, and free from damage or deterioration. Keep running account of products in storage to facilitate inspection and to estimate progress payments for products delivered, but not installed in the Work.

D. Store electrical, instrumentation, and control products, and equipment with bearings in weather-tight structures maintained above 60 degrees F. Protect electrical, instrumentation, and control products, and insulate against moisture, water, and dust damage. Connect and operate continuously space heaters furnished in electrical equipment.

E. Store fabricated products above ground on blocking or skids, and prevent soiling or staining. Store loose granular materials in well-drained area on solid surface to prevent mixing with foreign matter. Cover products that are subject to deterioration with impervious sheet coverings; provide adequate ventilation to avoid condensation.

F. Store finished products that are ready for installation in dry and well-ventilated areas. Do not subject to extreme changes in temperature or humidity.

G. After installation, provide coverings to protect products from damage due to traffic and construction operations. Remove coverings when no longer needed.

H. Hazardous Materials: Prevent contamination of personnel, storage area, and Site. Meet requirements of product specification, codes, and manufacturer's instructions.

PART 2 PRODUCTS

2.01 GENERAL

A. Provide manufacturer's standard materials suitable for service conditions, unless otherwise specified in the individual Specifications.

B. Where product specifications include a named manufacturer, with or without model number, and also include performance requirements, named manufacturer's products must meet the performance specifications.

C. Like items of products furnished and installed in the Work shall be end products of one manufacturer and of the same series or family of models to achieve standardization for appearance, operation and maintenance, spare parts and replacement, manufacturer's services, and implement same or similar process instrumentation and control functions in same or similar manner.

D. Do not use materials and equipment removed from existing premises, except as specifically permitted by Contract Documents.

E. Provide interchangeable components of the same manufacturer, for similar components, unless otherwise specified.

F. Equipment, Components, Systems, and Subsystems: Design and manufacture with due regard for health and safety of operation, maintenance, and accessibility, durability of parts, and shall comply with applicable OSHA, state, and local health and safety regulations.

G. Regulatory Requirement: Coating materials shall meet federal, state, and local requirements limiting the emission of volatile organic compounds and for worker exposure.

H. Safety Guards: Provide for all belt or chain drives, fan blades, couplings, or other moving or rotary parts. Cover rotating part on all sides. Design for easy installation and removal. Use 16-gauge or heavier; galvanized steel, aluminum coated steel, or galvanized or aluminum coated 1/2-inch mesh expanded steel. Provide galvanized steel accessories and supports, including bolts. For outdoors application, prevent entrance of rain and dripping water.

I. Authority Having Jurisdiction (AHJ):

1. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.
2. Materials and equipment manufactured within the scope of standards published by UL shall conform to those standards and shall have an applied UL listing mark.

J. Equipment Finish:

1. Provide manufacturer’s standard finish and color, except where specific color is indicated.
2. If manufacturer has no standard color, provide equipment with black finish as approved by Engineer.

K. Special Tools and Accessories: Furnish to Owner, upon acceptance of equipment, all accessories required to place each item of equipment in full operation. These accessory items include, but are not limited to, adequate oil and grease (as required for first lubrication of equipment after field testing), light bulbs, fuses, hydrant wrenches, valve keys, handwheels, chain operators, special tools, and other spare parts as required for maintenance.

L. Lubricant: Provide initial lubricant recommended by equipment manufacturer in sufficient quantity to fill lubricant reservoirs and to replace consumption during testing, startup, and operation until final acceptance by Owner.

2.02 FABRICATION AND MANUFACTURE

A. General:

1. Manufacture parts to U.S.A. standard sizes and gauges.
2. Two or more items of the same type shall be identical, by the same manufacturer, and interchangeable.
3. Design structural members for anticipated shock and vibratory loads.
4. Use 1/4-inch minimum thickness for steel that will be submerged, wholly or partially, during normal operation.
5. Modify standard products as necessary to meet performance Specifications.

B. Lubrication System:

1. Require no more than weekly attention during continuous operation.
2. Convenient and accessible; oil drains with bronze or stainless steel valves and fill-plugs easily accessible from the normal operating area or platform. Locate drains to allow convenient collection of oil during oil changes without removing equipment from its installed position.
3. Provide constant-level oilers or oil level indicators for oil lubrication systems.
4. For grease type bearings, which are not easily accessible, provide and install stainless steel tubing; protect and extend tubing to convenient location with suitable grease fitting.

2.03 SOURCE QUALITY CONTROL

A. Where Specifications call for factory testing to be witnessed by Engineer, notify Engineer not less than 14 days prior to scheduled test date, unless otherwise specified.

B. Calibration Instruments: Bear the seal of a reputable laboratory certifying instrument has been calibrated within the previous 12 months to a standard endorsed by the National Institute of Standards and Technology (NIST).

C. Factory Tests: Perform in accordance with accepted test procedures and document successful completion.

PART 3 EXECUTION

3.01 INSPECTION

A. Inspect materials and equipment for signs of pitting, rust decay, or other deleterious effects of storage. Do not install material or equipment showing

such effects. Remove damaged material or equipment from the Site and expedite delivery of identical new material or equipment. Delays to the Work resulting from material or equipment damage that necessitates procurement of new products will be considered delays within Contractor's control.

3.02 MANUFACTURER'S CERTIFICATE OF COMPLIANCE

A. When so specified, a Manufacturer's Certificate of Compliance, a copy of which is attached to this section, shall be completed in full, signed by entity supplying the product, material, or service, and submitted prior to shipment of product or material or execution of the services.

B. Engineer may permit use of certain materials or assemblies prior to sampling and testing if accompanied by accepted certification of compliance.

C. Such form shall certify proposed product, material, or service complies with that specified. Attach supporting reference data, affidavits, and certifications as appropriate.

D. May reflect recent or previous test results on material or product, if acceptable to Engineer.

3.03 INSTALLATION

A. Equipment Drawings show general locations of equipment, devices, and raceway, unless specifically dimensioned.

B. No shimming between machined surfaces is allowed.

C. Install the Work in accordance with NECA Standard of Installation, unless otherwise specified.

D. Repaint painted surfaces that are damaged prior to equipment acceptance.

E. Do not cut or notch any structural member or building surface without specific approval of Engineer.

F. Handle, install, connect, clean, condition, and adjust products in accordance with manufacturer's instructions, and as may be specified. Retain a copy of manufacturers' instruction at Site, available for review at all times.

G. For material and equipment specifically indicated or specified to be reused in the Work:

1. Use special care in removal, handling, storage, and reinstallation to assure proper function in the completed Work.
2. Arrange for transportation, storage, and handling of products that require offsite storage, restoration, or renovation. Include costs for such Work in the Contract Price.

3.04 FIELD FINISHING

A. In accordance with Section 09 90 00, Painting and Coating, and individual Specification sections.

3.05 ADJUSTMENT AND CLEANING

A. Perform required adjustments, tests, operation checks, and other startup activities.

3.06 LUBRICANTS

A. Fill lubricant reservoirs and replace consumption during testing, startup, and operation prior to acceptance of equipment by Owner.

3.07 SUPPLEMENTS

A. The supplement listed below, following “End of Section”, is part of this Specification.

1. Manufacturer’s Certificate of Compliance.

END OF SECTION

MANUFACTURER'S CERTIFICATE OF COMPLIANCE

OWNER: Natomas Mutual Water Company

PROJECT NAME: Elkhorn Pumping Plant Replacement

PROJECT NO: W8Y09802

PRODUCT, MATERIAL, OR SERVICE SUBMITTED: _____

Comments: _____

_____

_____

_____

_____

_____

I hereby certify that the above-referenced product, material, or service called for by the Contract for the named Project will be furnished in accordance with all applicable requirements. I further certify that the product, material, or service are of the quality specified and conform in all respects with the Contract requirements, and are in the quantity shown.

Date of Execution: _____, 20___

Manufacturer: _____

Manufacturer's Authorized Representative *(print)*: _____

_____

(Authorized Signature)

SECTION 01 77 00
CLOSEOUT PROCEDURES

PART 1 GENERAL

1.01 SUBMITTALS

A. Informational Submittals:

1. Submit prior to application for final payment.
   a. Record Documents: As required in General Conditions.
   b. Special bonds, Special Guarantees, and Service Agreements.
   c. Consent of Surety to Final Payment: As required in General Conditions.
   d. Releases or Waivers of Liens and Claims: As required in General Conditions.
   e. Releases from Agreements.
   f. Final Application for Payment: Submit in accordance with procedures and requirements stated in Section 01 29 00, Payment Procedures.
   g. Extra Materials: As required by individual Specification sections.

1.02 RECORD DOCUMENTS

A. Quality Assurance:

1. Furnish qualified and experienced person, whose duty and responsibility shall be to maintain Record Documents.
2. Accuracy of Records:
   a. Coordinate changes within Record Documents, making legible and accurate entries on each sheet of Drawings and other documents where such entry is required to show change.
   b. Purpose of Project Record Documents is to document factual information regarding aspects of the Work, both concealed and visible, to enable future modification of the Work to proceed without lengthy and expensive Site measurement, investigation, and examination.
3. Make entries within 24 hours after receipt of information that a change in the Work has occurred.
4. Prior to submitting each request for progress payment, request Engineer’s review and approval of current status of Record Documents. Failure to properly maintain, update, and submit Record Documents may result in a deferral by Engineer to recommend whole or any part of Contractor’s Application for Payment, either partial or final.

1.03 RELEASES FROM AGREEMENTS

A. Furnish Owner written releases from property owners or public agencies where side agreements or special easements have been made, or where Contractor's operations have not been kept within the Owner's construction right-of-way.

B. In the event Contractor is unable to secure written releases:

1. Inform Owner of the reasons.
2. Owner or its representatives will examine the Site, and Owner will direct Contractor to complete the Work that may be necessary to satisfy terms of the side agreement or special easement.
3. Should Contractor refuse to perform this Work, Owner reserves right to have it done by separate contract and deduct cost of same from Contract Price, or require Contractor to furnish a satisfactory bond in a sum to cover legal Claims for damages.
4. When Owner is satisfied that the Work has been completed in agreement with Contract Documents and terms of side agreement or special easement, right is reserved to waive requirement for written release if: (i) Contractor's failure to obtain such statement is due to grantor's refusal to sign, and this refusal is not based upon any legitimate Claims that Contractor has failed to fulfill terms of side agreement or special easement, or (ii) Contractor is unable to contact or has had undue hardship in contacting grantor.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 MAINTENANCE OF RECORD DOCUMENTS

A. General:

1. Promptly following commencement of Contract Times, secure from Engineer at no cost to Contractor, one complete set of Contract Documents.
2. Label or stamp each Record Document with title, "RECORD DOCUMENTS," in neat large printed letters.
3. Record information concurrently with construction progress and within 24 hours after receipt of information that change has occurred. Do not cover or conceal Work until required information is recorded.

B. Preservation:

1. Maintain documents in a clean, dry, legible condition and in good order. Do not use Record Documents for construction purposes.
2. Make documents and Samples available at all times for observation by Engineer.

C. Making Entries on Drawings:

1. Using an erasable colored pencil (not ink or indelible pencil), clearly describe change by graphic line and note as required.
   a. Color Coding:
      1) Green when showing information deleted from Drawings.
      2) Red when showing information added to Drawings.
      3) Blue and circled in blue to show notes.
2. Date entries.
3. Call attention to entry by “cloud” drawn around area or areas affected.
4. Legibly mark to record actual changes made during construction, including, but not limited to:
   a. Depths of various elements of foundation in relation to finished first floor data if not shown or where depth differs from that shown.
   b. Horizontal and vertical locations of existing and new Underground Facilities and appurtenances, and other underground structures, equipment, or Work. Reference to at least two measurements to permanent surface improvements.
   c. Location of internal utilities and appurtenances concealed in the construction referenced to visible and accessible features of the structure.
   d. Locate existing facilities, piping, equipment, and items critical to the interface between existing physical conditions or construction and new construction.
   e. Changes made by Addenda and Field Orders, Work Change Directive, Change Order, and Engineer’s written interpretation and clarification using consistent symbols for each and showing appropriate document tracking number.
5. Dimensions on Schematic Layouts: Show on Record Drawings, by dimension, the centerline of each run of items such as are described in previous subparagraph above.
   a. Clearly identify the item by accurate note such as “cast iron drain,” “galv. water,” and the like.
   b. Show, by symbol or note, vertical location of item (“under slab,” “in ceiling plenum,” “exposed,” and the like).

c. Make identification so descriptive that it may be related reliably to Specifications.

3.02 FINAL CLEANING

A. At completion of the Work or of a part thereof and immediately prior to Contractor's request for certificate of Substantial Completion; or if no certificate is issued, immediately prior to Contractor's notice of completion, clean entire Site or parts thereof, as applicable.

1. Leave the Work and adjacent areas affected in a cleaned condition satisfactory to Engineer.
2. Remove grease, dirt, dust, paint or plaster splatter, stains, labels, fingerprints, and other foreign materials from exposed surfaces.
3. Repair, patch, and touch up marred surfaces to specified finish and match adjacent surfaces.
4. Clean all windows.
5. Broom clean exterior paved driveways and parking areas.
6. Hose clean sidewalks, loading areas, and others contiguous with principal structures.
7. Rake clean all other surfaces.
8. Replace air-handling filters and clean ducts, blowers, and coils of ventilation units operated during construction.
9. Leave water courses, gutters, and ditches open and clean.

B. Use only cleaning materials recommended by manufacturer of surfaces to be cleaned.

END OF SECTION

SECTION 01 78 23
OPERATION AND MAINTENANCE DATA

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Detailed information for the preparation, submission, and Engineer's review of Operations and Maintenance (O&M) Data, as required by individual Specification sections.

1.02 DEFINITIONS

A. Final Data: Engineer-accepted data, submitted as specified herein.

B. Maintenance Operation: As used on Maintenance Summary Form is defined to mean any routine operation required to ensure satisfactory performance and longevity of equipment. Examples of typical maintenance operations are lubrication, belt tensioning, adjustment of pump packing glands, and routine adjustments.

C. Preliminary Data: Initial and subsequent submissions for Engineer's review.

1.03 SEQUENCING AND SCHEDULING

A. Equipment and System Data:

1. Preliminary Data:
   a. Do not submit until Shop Drawing for equipment or system has been reviewed and approved by Engineer.
   b. Submit prior to shipment date.
2. Final Data: Submit Instructional Manual Formatted data not less than 30 days prior to equipment or system field functional testing. Submit Compilation Formatted and Electronic Media Formatted data prior to Substantial Completion of Project.

1.04 DATA FORMAT

A. Prepare preliminary data in the form of an instructional manual. Prepare final data in data compilation format.

B. Instructional Manual Format:

1. Binder: Commercial quality, permanent, three-ring or three-post binders with durable plastic cover.

2. Size: 8-1/2 inches by 11 inches, minimum.
3. Cover:
    a. Identify manual with typed or printed title “OPERATION AND MAINTENANCE DATA” and list:
        1) Project title.
        2) Designate applicable system, equipment, material, or finish.
        3) Identity of separate structure as applicable.
        4) Identify volume number if more than one volume.
        5) Identity of general subject matter covered in manual. Identity of equipment number and Specification section.
4. Spine:
    a. Project title.
    b. Identify volume number if more than one volume.
5. Title Page:
    a. Contractor name, address, and telephone number.
    b. Subcontractor, Supplier, installer, or maintenance contractor’s name, address, and telephone number, as appropriate.
        1) Identify area of responsibility of each.
        2) Provide name and telephone number of local source of supply for parts and replacement.
6. Table of Contents:
    a. Neatly typewritten and arranged in systematic order with consecutive page numbers.
    b. Identify each product by product name and other identifying numbers or symbols as set forth in Contract Documents.
7. Paper: 20-pound minimum, white for typed pages.
8. Text: Manufacturer’s printed data, or neatly typewritten.
9. Three-hole punch data for binding and composition; arrange printing so that punched holes do not obliterate data.
10. Material shall be suitable for reproduction, with quality equal to original. Photocopying of material will be acceptable, except for material containing photographs.

C. Data Compilation Format:

1. Compile all Engineer-accepted preliminary O&M data into a hard-copy, hard-bound set.
2. Each set shall consist of the following:
    a. Binder: Commercial quality, permanent, three-ring or three-post binders with durable plastic cover.
    b. Cover: Identify each volume with typed or printed title “OPERATION AND MAINTENANCE DATA, VOLUME NO. ___ OF ___”, and list:
        1) Project title.

2) Contractor's name, address, and telephone number.
3) If entire volume covers equipment or system provided by one Supplier include the following:
a) Identity of general subject matter covered in manual.
b) Identity of equipment number and Specification section.

c. Provide each volume with title page and typed table of contents with consecutive page numbers. Place contents of entire set, identified by volume number, in each binder.

d. Table of contents neatly typewritten, arranged in a systematic order:
1) Include list of each product, indexed to content of each volume.
2) Designate system or equipment for which it is intended.
3) Identify each product by product name and other identifying numbers or symbols as set forth in Contract Documents.

e. Section Dividers:
1) Heavy, 80 pound cover weight, tabbed with numbered plastic index tabs.
2) Fly-Leaf:
a) For each separate product, or each piece of operating equipment, with typed description of product and major component parts of equipment.
b) List with Each Product:
(1) Name, address, and telephone number of Subcontractor, Supplier, installer, and maintenance contractor, as appropriate.
(2) Identify area of responsibility of each.
(3) Provide local source of supply for parts and replacement.
c) Identity of separate structure as applicable.

f. Assemble and bind material, as much as possible, in same order as specified in the Contract Documents.

D. Electronic Media Format:

1. Portable Document Format (PDF):
a. After all preliminary data has been found to be acceptable to Engineer, submit Operation and Maintenance data in PDF format on CD.
b. Files to be exact duplicates of Engineer-accepted preliminary data. Arrange by specification number and name.
c. Files to be fully functional and viewable in most recent version of Adobe Acrobat.

1.05 SUBMITTALS

A. Informational:

1. Data Outline: Submit two copies of a detailed outline of proposed organization and contents of Final Data prior to preparation of Preliminary Data.
2. Preliminary Data:
   a. Submit two copies for Engineer's review.
   b. If data meets conditions of the Contract:
      1) One copy will be returned to Contractor.
      2) One copy will be forwarded to Owner.
   c. If data does not meet conditions of the Contract:
      1) All copies will be returned to Contractor with Engineer's comments (on separate document) for revision.
      2) Engineer's comments will be retained in Engineer's file.
      3) Resubmit two copies revised in accordance with Engineer's comments.
3. Final Data: Submit two copies in format specified herein.

1.06 DATA FOR EQUIPMENT AND SYSTEMS

A. Content For Each Unit (or Common Units) and System:

1. Product Data:
   a. Include only those sheets that are pertinent to specific product.
   b. Clearly annotate each sheet to:
      1) Identify specific product or part installed.
      2) Identify data applicable to installation.
      3) Delete references to inapplicable information.
   c. Function, normal operating characteristics, and limiting conditions.
   d. Performance curves, engineering data, nameplate data, and tests.
   e. Complete nomenclature and commercial number of replaceable parts.
   f. Original manufacturer's parts list, illustrations, detailed assembly drawings showing each part with part numbers and sequentially numbered parts list, and diagrams required for maintenance.
   g. Spare parts ordering instructions.
   h. Where applicable, identify installed spares and other provisions for future work (e.g., reserved panel space, unused components, wiring, terminals).
2. As-installed, color-coded piping diagrams.

3. Charts of valve tag numbers, with the location and function of each valve.
4. Drawings:
    a. Supplement product data with Drawings as necessary to clearly illustrate:
        1) Format:
            a) Provide reinforced, punched, binder tab; bind in with text.
            b) Reduced to 8-1/2 inches by 11 inches, or 11 inches by 17 inches folded to 8-1/2 inches by 11 inches.
            c) Where reduction is impractical, fold and place in 8-1/2-inch by 11-inch envelopes bound in text.
            d) Identify Specification section and product on Drawings and envelopes.
    b. Relations of component parts of equipment and systems.
    c. Control and flow diagrams.
    d. Coordinate drawings with Project Record Documents to assure correct illustration of completed installation.
5. Instructions and Procedures: Within text, as required to supplement product data.
    a. Format:
        1) Organize in consistent format under separate heading for each different procedure.
        2) Provide logical sequence of instructions for each procedure.
        3) Provide information sheet for Owner’s personnel, including:
            a) Proper procedures in event of failure.
            b) Instances that might affect validity of guarantee or Bond.
    b. Installation Instructions: Including alignment, adjusting, calibrating, and checking.
    c. Operating Procedures:
        1) Startup, break-in, routine, and normal operating instructions.
        2) Test procedures and results of factory tests where required.
        3) Regulation, control, stopping, and emergency instructions.
        4) Description of operation sequence by control manufacturer.
        5) Shutdown instructions for both short and extended duration.
        6) Summer and winter operating instructions, as applicable.
        7) Safety precautions.
        8) Special operating instructions.
    d. Maintenance and Overhaul Procedures:
        1) Routine maintenance.
        2) Guide to troubleshooting.
        3) Disassembly, removal, repair, reinstallation, and re-assembly.

6. Guarantee, Bond, and Service Agreement: In accordance with Section 01 77 00, Closeout Procedures.

B. Content for Each Electric or Electronic Item or System:

1. Description of Unit and Component Parts:
   a. Function, normal operating characteristics, and limiting conditions.
   b. Performance curves, engineering data, nameplate data, and tests.
   c. Complete nomenclature and commercial number of replaceable parts.
   d. Interconnection wiring diagrams, including control and lighting systems.
2. Circuit Directories of Panelboards:
   a. Electrical service.
   b. Control requirements and interfaces.
   c. Communication requirements and interfaces.
   d. List of electrical relay settings, and control and alarm contact settings.
   e. Electrical interconnection wiring diagram, including as applicable, single-line, three-line, schematic and internal wiring, and external interconnection wiring.
   f. As-installed control diagrams by control manufacturer.
3. Operating Procedures:
   a. Routine and normal operating instructions.
   b. Startup and shutdown sequences, normal and emergency.
   c. Safety precautions.
   d. Special operating instructions.
4. Maintenance Procedures:
   a. Routine maintenance.
   b. Guide to troubleshooting.
   c. Adjustment and checking.
   d. List of relay settings, control and alarm contact settings.
5. Manufacturer’s printed operating and maintenance instructions.
6. List of original manufacturer’s spare parts, manufacturer’s current prices, and recommended quantities to be maintained in storage.

C. Maintenance Summary:

1. Compile individual Maintenance Summary for each applicable equipment item, respective unit or system, and for components or sub-units.

2. Format:
    a. Use Maintenance Summary Form bound with this section or electronic facsimile of such.
    b. Each Maintenance Summary may take as many pages as required.
    c. Use only 8-1/2 inch by 11-inch size paper.
    d. Complete using typewriter or electronic printing.
3. Include detailed lubrication instructions and diagrams showing points to be greased or oiled; recommend type, grade, and temperature range of lubricants and frequency of lubrication.
4. Recommended Spare Parts:
    a. Data to be consistent with manufacturer's Bill of Materials/Parts List furnished in O&M manuals.
    b. "Unit" is the unit of measure for ordering the part.
    c. "Quantity" is the number of units recommended.
    d. "Unit Cost" is the current purchase price.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 SUPPLEMENTS

A. The supplement listed below, following "End of Section", is part of this Specification.

1. Maintenance Summary Form.

END OF SECTION

MAINTENANCE SUMMARY FORM

PROJECT: Elkhorn Pumping Plant Replacement CONTRACT NO.:_____

1. EQUIPMENT ITEM _____
2. MANUFACTURER _____
3. EQUIPMENT/TAG NUMBER(S) _____
4. WEIGHT OF INDIVIDUAL COMPONENTS (OVER 100 POUNDS) _____
5. NAMEPLATE DATA (hp, voltage, speed, etc.) _____
6. MANUFACTURER'S LOCAL REPRESENTATIVE _____
    a. Name _____ Telephone No. _____
    b. Address _____
7. MAINTENANCE REQUIREMENTS

Maintenance Operation Comments	**Frequency**	**Lubricant (If Applicable)**
List briefly each maintenance operation required and refer to specific information in manufacturer's standard maintenance manual, if applicable. (Reference to manufacturer's catalog or sales literature is not acceptable.)	List required frequency of each maintenance operation.	Refer by symbol to lubricant required.

8. LUBRICANT LIST

Reference Symbol	Shell	Exxon Mobile	Chevron Texaco	BP Amoco	Or Equal
List symbols used in No. 7 above.	List equivalent lubricants, as distributed by each manufacturer for the specific use recommended.				

9. RECOMMENDED SPARE PARTS FOR OWNER'S INVENTORY

Part No.	Description	Unit	Quantity	Unit Cost
Note: Identify parts provided by this Contract with two asterisks.				

SECTION 01 88 15
ANCHORAGE AND BRACING

PART 1 GENERAL

1.01 SUMMARY

A. This section covers requirements for anchorage and bracing of equipment, distribution systems, and other nonstructural components required in accordance with the ICC 2022 California Building Code (CBC), for seismic, wind, gravity, soil, and operational loads.

1.02 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Institute of Steel Construction (AISC) 360, Specification for Structural Steel Buildings.
2. American Society of Civil Engineers (ASCE): ASCE 7-16, Minimum Design Loads for Buildings and Other Structures.
3. International Code Council (ICC): California Building Code (CBC).
4. State of California.

1.03 DEFINITIONS

A. Authority Having Jurisdiction (AHJ): Permitting building agency; may be a federal, state, local, or other regional department, or individual including building official, fire chief, fire marshal, chief of a fire prevention bureau, labor department, or health department, electrical inspector; or others having statutory authority. AHJ may be Owner when authorized to be self-permitting by governmental permitting agency or when no governmental agency has authority.

1.04 DESIGN AND PERFORMANCE REQUIREMENTS

A. General:

1. Anchorage and bracing systems shall be designed by a qualified professional engineer registered in the State of California.
2. Design anchorage into concrete including embedment in accordance with ACI 318-19; Chapter 17 (or other industry standard approved by Engineer), and Project Specifications.
   a. Unless otherwise noted, design for cracked concrete condition.

3. Design anchorage and bracing of mechanical and electrical components and systems in accordance with this section, unless a design is specifically provided within Contract Documents or where exempted hereinafter.
4. Design attachments, braces, and anchors for equipment, components, and distribution systems to structure for gravity, seismic, wind, and operational loading.
5. Anchor and brace piping and conduit, whether exempt or not exempt for this section, so that lateral or vertical displacement does not result in damage or failure to essential mechanical or electrical equipment.
6. Provide supplementary framing where required to transfer anchorage and bracing loads to structure.
7. Adjust equipment pad sizes or provide additional anchorage confinement reinforcing to provide required anchorage capacities.
8. Design Anchorage and Bracing for:
    a. Equipment and components that weigh more than 400 pounds and have center of mass located 4 feet or less above adjacent finished floor.
    b. Equipment weighing more than 20 pounds that has center of mass located more than 4 feet above adjacent finished floor.
    c. Mechanical and electrical components that are not provided with flexible connections between components and associated piping or conduit.
    d. Distribution systems that weigh more than 5 pounds per foot that have center of mass located more than 4 feet above adjacent finished floor.
9. For components exempted from design requirements of this section, provide bolted, welded, or otherwise positively fastened attachments to supporting structure.

B. Design Loads:

1. Gravity: Design anchorage and bracing for self-weight and superimposed loads on components and equipment.
2. Wind: Design anchorage and bracing for wind criteria provided on General Structural Notes on Drawings for wind-exposed mechanical and electrical equipment.
3. Operational:
    a. For loading supplied by equipment manufacturer for CBC required load cases.
    b. Loads may include equipment vibration, torque, thermal effects, effects of internal contents (weight and sloshing), water hammer, and other load-inducing conditions.
    c. Locate braces to minimize vibration to or movement of structure.

d. For vibrating loads, use anchors meeting requirements of Section 05 05 19, Post-Installed Anchors, and Section 05 50 00, Metal Fabrications, for anchors with designated capacities for vibratory loading per manufacturer's ICC-ES report.

4. Hydraulic: Design of anchorage for submerged mechanical equipment shall include hydrostatic and hydrodynamic loads.
5. Seismic:
   a. In accordance with 2022 CBC, Section 1613, and Chapter 13 of ASCE 7-16.
   b. Design anchorage and bracing for design criteria listed on General Structural Notes on Drawings.
   c. Design forces for anchors in concrete shall be in accordance with ASCE 7-16, Section 13.4.2 as applicable for Project Seismic Design Category.

1.05 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. List of mechanical and electrical equipment requiring Contractor-designed anchorage and bracing, unless specifically exempted.
   b. Manufacturers' engineered seismic and non-seismic hardware product data.
   c. Attachment assemblies' drawings including seismic attachments; include connection hardware, braces, supports, and anchors or anchor bolts for nonexempt components, equipment, and systems.
   d. Submittal will be rejected if proposed anchorage method would create excessive stress to supporting member. Revise anchorages and strengthen structural support to eliminate overstressed condition.
2. Anchorage and Bracing Calculations: For attachments, braces, and anchorages, include CBC and Project-specific criteria as noted on General Structural Notes on Drawings, in addition to manufacturer's specific criteria used for design; sealed and signed by a civil or structural engineer registered in the State of California.

B. Informational Submittals: Manufacturer's hardware installation requirements.

C. Deferred Submittals:

1. Submitted seismic anchorage drawings and calculations are identified as CBC deferred submittals and will be submitted to and must be accepted

by AHJ prior to installation of component, equipment, or distribution system.

2. Submit deferred Action Submittals such as Shop Drawings with supporting deferred informational submittals such as calculations no less than 4 weeks in advance of installation of component, equipment or distribution system to be anchored to structure.

1.06 SOURCE QUALITY CONTROL

A. Contractor and supplier responsibilities to accommodate Owner-furnished shop fabrication related special inspections and testing are provided in Project's Statement of Special Inspections on Drawings and Section 01 45 33, Special Inspection, Observation, and Testing.

B. Provide all other specified, regulatory required, or required repair verification inspection and testing that is not listed in Statement of Special Inspections in accordance with Section 01 45 16.13, Contractor Quality Control.

C. Provide Source Quality Control for welding and hot-dip galvanizing of anchors in accordance with Section 05 50 00, Metal Fabrications.

PART 2 PRODUCTS

2.01 GENERAL

A. Design and construct attachments and supports transferring seismic and non-seismic loads to structure of materials and products suitable for application and in accordance with design criteria shown on Drawings and nationally recognized standards.

B. Provide anchor bolts for anchorage of equipment to concrete or masonry in accordance with Section 05 50 00, Metal Fabrications. Provide anchor bolts of the size, minimum embedment, and spacing designated in calculations submitted by Contractor and accepted by Engineer.

C. Provide post-installed concrete and masonry anchors for anchorage of equipment to concrete or masonry in accordance with Section 05 05 19, Post-Installed Anchors. Provide post-installed anchors of the size, minimum embedment, and spacing designated in calculations submitted by Contractor and accepted by Engineer.

D. Do not use powder-actuated fasteners or sleeve anchors for seismic attachments and anchorage where resistance to tension loads is required. Do not use expansion anchors, other than undercut anchors, for nonvibration isolated mechanical equipment rated over 10 horsepower.

PART 3 EXECUTION

3.01 GENERAL

A. Make attachments, bracing, and anchorage in such a manner that component lateral force is transferred to lateral force resisting system of structure through a complete load path.

B. Design, provide, and install overall seismic anchorage system to provide restraint in all directions, including vertical, for each component or system so anchored.

C. Provide snubbers in each horizontal direction and vertical restraints for components mounted on vibration isolation systems where required to resist overturning.

D. Provide piping anchorage that maintains design flexibility and expansion capabilities at flexible connections and expansion joints.

1. Piping and conduit suspended more than 12 inches below supporting structure shall be braced for seismic effects to avoid significant bending of hangers and their attachments.

E. Anchor tall and narrow equipment such as motor control centers and telemetry equipment at base and within 12 inches from top of equipment, unless approved otherwise by Engineer.

F. Do not attach mechanical or electrical components to more than one element of a building structure at a single restraint location where such elements may respond differently during a seismic event. Do not make such attachments across building expansion and contraction joints.

3.02 INSTALLATION

A. Do not install components or their anchorages or restraints prior to review and acceptance by Engineer and AHJ.

B. Notify Engineer upon completion of installation of seismic restraints in accordance with Section 01 45 33, Special Inspection, Observation, and Testing.

3.03 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

A. In accordance with Section 05 05 19, Post-Installed Anchors, and Section 05 50 00, Metal Fabrications.

B. Owner-Furnished Quality Assurance, in accordance with CBC Chapter 17 requirements, is provided in Statement of Special Inspections Plan on Drawings. Contractor responsibilities and related information are included in Section 01 45 33, Special Inspection, Observation, and Testing.

C. Provide any other specified, regulatory required, or required repair verification inspection and testing that is not listed in Statement of Special Inspections in accordance with Section 01 45 16.13, Contractor Quality Control.

END OF SECTION

SECTION 01 91 14
EQUIPMENT TESTING AND FACILITY STARTUP

PART 1 GENERAL

1.01 DEFINITIONS

A. Facility: Entire Project, or an agreed-upon portion, including all of its unit processes.

B. Facility Performance Demonstration:

1. A demonstration, conducted by Contractor, with assistance of Owner, to demonstrate and document the performance of the entire operating facility, both manually and automatically (if required), based on criteria developed in conjunction with Owner and as accepted by Engineer.
2. Such demonstration is for the purposes of (i) verifying to Owner entire facility performs as a whole, and (ii) documenting performance characteristics of completed facility for Owner's records. Neither the demonstration nor the evaluation is intended in any way to make performance of a unit process or entire facility the responsibility of Contractor, unless such performance is otherwise specified.

C. Functional Test: Test or tests in presence of Engineer and Owner to demonstrate that installed equipment meets manufacturer's installation, calibration, and adjustment requirements and other requirements as specified.

D. Performance Test: Test or tests performed after any required functional test in presence of Engineer and Owner to demonstrate and confirm individual equipment meets performance requirements specified in individual sections.

E. Unit Process: As used in this section, a unit process is a portion of the facility that performs a specific process function, such as jib crane, fish screen and irrigation pump.

1.02 SUBMITTALS

A. Informational Submittals:

1. Facility Startup and Performance Demonstration Plan.
2. Functional and performance test results.
3. Completed Unit Process Startup Form for each unit process.
4. Completed Facility Performance Demonstration/Certification Form.

1.03 FACILITY STARTUP AND PERFORMANCE DEMONSTRATION PLAN

A. Develop a written plan, in conjunction with Owner's operations personnel; to include the following:

1. Step-by-step instructions for startup of each unit process and the complete facility.
2. Unit Process Startup Form (Sample attached), to minimally include the following:
   a. Description of the unit process, including equipment numbers/nomenclature of each item of equipment and all included devices.
   b. Detailed procedure for startup of the unit process, including valves to be opened/closed, order of equipment startup, etc.
   c. Startup requirements for each unit process, including water, power, chemicals, etc.
   d. Space for evaluation comments.
3. Facility Performance Demonstration/Certification Form (Sample attached), to minimally include the following:
   a. Description of unit processes included in the facility startup.
   b. Sequence of unit process startup to achieve facility startup.
   c. Description of computerized operations, if any, included in the facility.
   d. Contractor certification facility is capable of performing its intended function(s), including fully automatic operation.
   e. Signature spaces for Contractor and Engineer.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. Facility Startup Meetings: Schedule, in accordance with requirements of Section 01 31 19, Project Meetings, to discuss test schedule, test methods, materials, chemicals and liquids required, facilities operations interface, and Owner involvement.

B. Contractor's Testing and Startup Representative:

1. Designate and furnish one or more personnel to coordinate and expedite testing and facility startup.
2. Representative(s) shall be present during startup meetings and shall be available at all times during testing and startup.

C. Provide temporary valves, gauges, piping, test equipment and other materials and equipment required for testing and startup.

D. Provide Subcontractor and equipment manufacturers' staff adequate to prevent delays. Schedule ongoing work so as not to interfere with or delay testing and startup.

E. Owner will:

1. Provide water, power, and other items as required for startup, unless otherwise indicated.
2. Operate process units and facility with support of Contractor.

3.02 EQUIPMENT TESTING

A. Preparation:

1. Complete installation before testing.
2. Furnish qualified manufacturers' representatives, when required by individual Specification sections.
3. Obtain and submit from equipment manufacturer's representative Manufacturer's Certificate of Proper Installation Form, in accordance with Section 01 43 33, Manufacturers' Field Services, when required by individual Specification sections.
4. Equipment Test Report Form:
    a. Provide written test report for each item of equipment to be tested, to include the minimum information:
        1) Owner/Project Name.
        2) Equipment or item tested.
        3) Date and time of test.
        4) Type of test performed (Functional or Performance).
        5) Test method.
        6) Test conditions.
        7) Test results.
        8) Signature spaces for Contractor and Engineer as witness.
5. Cleaning and Checking:
    a. Prior to beginning functional testing:
        1) Calibrate testing equipment in accordance with manufacturer's instructions.
        2) Inspect and clean equipment, devices, connected piping, and structures to ensure they are free of foreign material.
        3) Lubricate equipment in accordance with manufacturer's instructions.

4) Turn rotating equipment by hand when possible to confirm that equipment is not bound.
5) Open and close valves by hand and operate other devices to check for binding, interference, or improper functioning.
6) Check power supply to electric-powered equipment for correct voltage.
7) Adjust clearances and torque.
8) Test piping for leaks.

6. Ready-to-test determination will be by Engineer based at least on the following:
   a. Acceptable Operation and Maintenance Data.
   b. Notification by Contractor of equipment readiness for testing.
   c. Receipt of Manufacturer's Certificate of Proper Installation, if so specified.
   d. Adequate completion of work adjacent to, or interfacing with, equipment to be tested.
   e. Availability and acceptability of manufacturer's representative, when specified, to assist in testing of respective equipment.
   f. Satisfactory fulfillment of other specified manufacturer's responsibilities.
   g. Equipment and electrical tagging complete.
   h. Delivery of all spare parts and special tools.

B. Functional Testing:

1. Conduct as specified in individual Specification sections.
2. Notify Owner and Engineer in writing at least 10 days prior to scheduled date of testing.
3. Prepare Equipment Test Report summarizing test method and results.
4. When, in Engineer's opinion, equipment meets functional requirements specified, such equipment will be accepted for purposes of advancing to performance testing phase, if so required by individual Specification sections. Such acceptance will be evidenced by Engineer/Owner's signature as witness on Equipment Test Report.

C. Performance Testing:

1. Conduct as specified in individual Specification sections.
2. Notify Engineer and Owner in writing at least 10 days prior to scheduled date of test.
3. Performance testing shall not commence until equipment has been accepted by Engineer as having satisfied functional test requirements specified.

4. Type of fluid, gas, or solid for testing shall be as specified.
5. Unless otherwise indicated, furnish labor, materials, and supplies for conducting the test and taking samples and performance measurements.
6. Prepare Equipment Test Report summarizing test method and results.
7. When, in Engineer's opinion, equipment meets performance requirements specified, such equipment will be accepted as to conforming to Contract requirements. Such acceptance will be evidenced by Engineer's signature on Equipment Test Report.

3.03 STARTUP OF UNIT PROCESSES

A. Prior to unit process startup, equipment within unit process shall be accepted by Engineer as having met functional and performance testing requirements specified.

B. Startup sequencing of unit processes shall be as chosen by Contractor to meet schedule requirements.

C. Make adjustments, repairs, and corrections necessary to complete unit process startup.

D. Startup shall be considered complete when, in opinion of Engineer, unit process has operated in manner intended for 5 continuous days without significant interruption. This period is in addition to functional or performance test periods specified elsewhere.

E. Significant Interruption:

1. May include any of the following events:
    a. Failure of Contractor to provide and maintain qualified onsite startup personnel as scheduled.
    b. Failure to meet specified functional operation for more than 2 consecutive hours.
    c. Failure of any critical equipment or unit process that is not satisfactorily corrected within 5 hours after failure.
    d. Failure of any noncritical equipment or unit process that is not satisfactorily corrected within 8 hours after failure.
    e. As determined by Engineer.

F. A significant interruption will require startup then in progress to be stopped. After corrections are made, startup test period to start from beginning again.

3.04 FACILITY PERFORMANCE DEMONSTRATION

A. When, in the opinion of Engineer, startup of all unit processes has been achieved, sequence each unit process to the point that facility is operational.

B. Demonstrate proper operation of required interfaces within and between individual unit processes.

C. After facility is operating, complete performance testing of equipment and systems not previously tested.

D. Document, as defined in Facility Startup and Performance Demonstration Plan, the performance of the facility including its computer system, until all unit processes are operable and under control of computer system.

E. Certify, on the Facility Performance Demonstration/Certification Form, that facility is capable of performing its intended function(s), including fully automatic and computerized operation.

3.05 SUPPLEMENTS

A. Supplements listed below, following “End of Section,” are a part of this Specification:

1. Unit Process Startup Form.
2. Facility Performance Demonstration/Certification Form.

END OF SECTION

UNIT PROCESS STARTUP FORM

OWNER: Natomas Mutual Water Company **PROJECT:** Elkhorn Pumping Plant Replacement

Unit Process Description: (Include description and equipment number of all equipment and devices):

Startup Procedure (Describe procedure for sequential startup and evaluation, including valves to be opened/closed, order of equipment startup, etc.):

Startup Requirements (Water, power, chemicals, etc.):

Evaluation Comments:

FACILITY PERFORMANCE DEMONSTRATION/CERTIFICATION FORM

OWNER: Natomas Mutual Water Company **PROJECT:** Elkhorn Pumping Plant Replacement

Unit Processes Description (List unit processes involved in facility startup):

_____

_____

_____

_____

Unit Processes Startup Sequence (Describe sequence for startup, including computerized operations, if any):

_____

_____

_____

_____

_____

Contractor Certification that Facility is capable of performing its intended function(s), including fully automatic operation:

Contractor: _____ Date: _____, 20____

Engineer: _____ Date: _____, 20____
(Authorized Signature)

SECTION 02 41 00
DEMOLITION

PART 1 GENERAL

1.01 DEFINITIONS

A. ACM: Asbestos-containing material.

B. Demolish/Demolition: Dismantling, razing, destroying, or wrecking of any fixed building or structure or any part thereof. Demolition also includes removal of pipes, manholes tanks, conduit, and other underground facilities, whether as a separate activity or in conjunction with construction of new facilities. Unless otherwise specified, title to items identified for demolition shall revert to Contractor.

C. Modify: Provide all necessary material and labor to modify an existing item to the condition indicated or specified.

D. Relocate: Remove, protect, clean and reinstall equipment, including electrical, instrumentation, and all ancillary components required to make the equipment fully functional, to the new location identified on Drawings.

E. Renovation: Altering a facility or one or more facility components in any way.

F. Salvage/Salvageable: Remove and deliver, to the specified location(s), the equipment, building materials, or other items so identified to be saved from destruction, damage, or waste; such property to remain that of Owner.

G. Universal Waste Lamp: In accordance with 40 CFR 273, the bulb or tube portion of an electric lighting device, examples of which include, but are not limited to, fluorescent, high-intensity discharge, neon, mercury vapor, high-pressure sodium, and metal halide lamps.

H. Universal Waste Thermostat: A temperature control device that contains metallic mercury in an ampule attached to a bimetal sensing element, and mercury-containing ampules that have been removed from these temperature control devices in compliance with the requirements of 40 CFR 273.

1.02 SUBMITTALS

A. Informational Submittals:

1. Submit proposed Demolition/Renovation Plan, in accordance with requirements specified herein, for approval before such Work is started.

2. Submit copies of any notifications, authorizations and permits required to perform the Work.
3. Copies of reports and other documentation required for abandoning wells.

1.03 REGULATORY AND SAFETY REQUIREMENTS

A. When applicable, demolition Work shall be accomplished in strict accordance with 29 CFR 1926-Subpart T.

B. Comply with federal, state, and local hauling and disposal regulations. In addition to the requirements of the General Conditions, Contractor's safety requirements shall conform to ANSI A10.6.

1.04 DEMOLITION/RENOVATION PLAN

A. Demolition/Renovation Plan shall provide for safe conduct of the Work and shall include:

1. Detailed description of methods and equipment to be used for each operation;
2. The Contractor's planned sequence of operations, including coordination with other work in progress;
3. Disconnection schedule of utility services.

1.05 SEQUENCING AND SCHEDULING

A. The Work of this Specification shall not commence until Contractor's Demolition/Renovation Plan has been approved by Engineer.

B. Include the Work of this Specification in the progress schedule, as specified in Section 01 32 00, Construction Progress Documentation.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 EXISTING FACILITIES TO BE DEMOLISHED OR RENOVATED

A. Buildings and adjacent designated areas scheduled for complete demolition are as shown on Drawings.

B. Structures:

1. Existing above-grade structures indicated shall be removed to 3 feet below grade.

2. Core drill concrete slabs and other concrete improvements scheduled to remain in place below ground, or break holes at the structure's lowest point to allow water to freely migrate through.
3. Sidewalks, curbs, gutters and street light bases shall be removed as indicated.

C. Substructure: Extract conflicting existing pilings prior to driving new piles.

D. Utilities and Related Equipment:

1. Notify Owner or appropriate utilities to turn off affected services at least 48 hours before starting demolition or renovation activities.
2. Remove existing utilities as indicated and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by Engineer.
3. When utility lines are encountered that are not indicated on Drawings, notify Engineer prior to further work in that area.
4. Remove meters, transformers, and related equipment and deliver to a location as determined by the Owner.
5. Excavate and remove utility lines serving buildings to be demolished to a distance of 10 feet beyond the outside perimeter of the demolition.
6. Provide a permanent leak-proof closure for water and gas lines.

E. Patching:

1. Where removals leave holes and damaged surfaces exposed in the finished Work, patch and repair to match adjacent finished surfaces as to texture and finish.
2. Where new Work is to be applied to existing surfaces, perform removals and patching in a manner to produce surfaces suitable for receiving new Work.
3. Patching shall be as specified and indicated, and shall include fill holes and depressions left as a result of removals in existing concrete walls with an approved patching material, applied in accordance with the manufacturer's printed instructions.

F. Electrical:

1. Cut off concealed or embedded conduit, boxes, or other materials a minimum of 3/4 inch below final finished surface.
2. When removing designated equipment, conduit and wiring may require rework to maintain service to other equipment.
3. Rework existing circuits, or provide temporary circuits as necessary during renovation to maintain service to existing lighting and equipment not scheduled to be renovated. Existing equipment and circuiting shown

are based upon limited field surveys. Verify existing conditions, make all necessary adjustments, and record the Work on the Record Drawings. This shall include, but is not limited to, swapping and other adjustments to branch circuits and relocation of branch circuit breakers within panelboards as required to accomplish the finished work.

4. Reuse of existing luminaires, devices, conduits, boxes, or equipment will be permitted only where specifically indicated.
5. Raceways and cabling not scheduled for reuse.
6. Inaccessibly Concealed: Cut off and abandon in place.
7. Exposed or Concealed Above Accessible Ceilings: Remove.
8. Raceways and Cabling Scheduled for Future Use: Cap/seal and tag.
9. Relocating Equipment: Extend existing wiring or run new wiring from the source.
10. Where the existing raceway is concealed, the outlet box shall be cleaned, and a blank cover plate installed.
11. Where the concealed raceway is uncovered remove raceway (or extended to new location if appropriate).
12. Provide new typewritten panelboard circuit directory cards.

G. Universal Waste Lamps and Thermostats: Manage, contain, package, and label in strict accordance with 40 CFR 273.

3.02 PROTECTION

A. Dust and Debris Control: Prevent the spread of dust and debris to avoid the creation of a nuisance or hazard in the surrounding area. Do not use water if it results in hazardous or objectionable conditions such as, but not limited to, ice, flooding, or pollution.

B. Traffic Control Signs: Where pedestrian and driver safety is endangered in the area of removal Work, use traffic barricades with flashing lights.

C. Existing Work:

1. Survey the Site and examine Drawings and Specifications to determine the extent of the Work before beginning any demolition or renovation.
2. Take necessary precautions to avoid damage to existing items scheduled to remain in place, to be reused, or to remain the property of Owner; any Contractor-damaged items shall be repaired or replaced as directed by Engineer.
3. Provide temporary weather protection during interval between removal of existing exterior surfaces and installation of new to ensure that no water leakage or damage occurs to structure or interior areas of existing building.

4. Ensure that structural elements are not overloaded as a result of or during performance of the Work. Responsibility for additional structural elements or increasing the strength of existing structural elements as may be required as a result of any Work performed under this Contract shall be that of the Contractor. Repairs, reinforcement, or structural replacement must have Engineer approval.
5. Do not overload pavements to remain.

D. Weather Protection: For portions of the building scheduled to remain, protect building interior and materials and equipment from weather at all times.

E. Trees: Protect trees within the Site that might be damaged during demolition and are indicated to be left in place, by a 6-foot-high fence. The fence shall be securely erected a minimum of 5 feet from the trunk of individual trees or follow the outer perimeter of branches or clumps of trees. Any tree designated to remain that is damaged during the Work shall be replaced in kind, as approved by the Engineer.

F. Facilities:

1. Protect electrical and mechanical services and utilities. Where removal of existing utilities and pavement is specified or indicated, provide approved barricades, temporary covering of exposed areas, and temporary services or connections for electrical and mechanical utilities.
2. Floors, roofs, walls, columns, pilasters, and other structural elements that are designed and constructed to stand without lateral support or shoring, and are determined by Contractor to be in stable condition, shall remain standing without additional bracing, shoring, or lateral support until demolished, unless directed otherwise by the Engineer.
3. Protect all facility elements not scheduled for demolition.
4. Provide interior shoring, bracing, or support to prevent movement, settlement, or collapse of structure or element to be demolished and adjacent facilities.

G. Protection of Personnel:

1. During demolition, continuously evaluate the condition of the structure being demolished and take immediate action to protect all personnel working in and around the demolition site.
2. Provide temporary barricades and other forms of protection to protect Owner’s personnel and the general public from injury due to demolition Work.

3. Provide protective measures as required to provide free and safe passage of Owner's personnel and the general public to occupied portions of the structure.

3.03 BURNING

A. The use of burning at the Site for the disposal of refuse and debris will not be permitted.

3.04 RELOCATIONS

A. Perform the removal and reinstallation of relocated items as indicated with workmen skilled in the trades involved. Clean all items to be relocated prior to reinstallation, to the satisfaction of Engineer. Repair items to be relocated which are damaged or replace damaged items with new undamaged items as approved by Engineer.

3.05 BACKFILL

A. Do not use demolition debris as backfill material.

B. Fill excavations, open basements and other hazardous openings to existing ground level or foundation level of new construction in accordance with Section 31 23 23, Fill and Backfill.

3.06 TITLE TO MATERIALS

A. All salvaged equipment and materials will remain the property of Owner.

B. Title to equipment and materials resulting from demolition is vested in the Contractor upon approval by Engineer of Contractor's Demolition/Renovation Plan, and the resulting authorization by Engineer to begin demolition.

3.07 DISPOSITION OF MATERIAL

A. Do not remove equipment and materials without approval of Contractor's Demolition/Renovation Plan by Engineer.

B. Materials and equipment that are specified to be salvaged to Owner shall be delivered to a storage site as directed within 8 miles of the Site.

C. Remove salvaged items in a manner to prevent damage, and pack or crate to protect the items from damage while in storage or during shipment. Properly identify containers as to contents. Repair or replace, at the discretion of Engineer, items damaged during removal or storage.

D. Owner will not be responsible for the condition or loss of, or damage to, property scheduled to become Contractor's property after Engineer's authorization to begin demolition. Materials and equipment shall not be viewed by prospective purchasers or sold on the Site.

3.08 CLEANUP

A. Debris and rubbish shall be removed from Site and transported in a manner that prevents spillage on streets or adjacent areas. Local regulations regarding hauling and disposal shall apply.

END OF SECTION

SECTION 03 10 00
CONCRETE FORMING AND ACCESSORIES

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Concrete Institute (ACI):
   a. 117, Specification for Tolerances for Concrete Construction and Materials.
   a. 301, Specifications for Structural Concrete.
   b. 318, Building Code Requirements for Structural Concrete.

1.02 DEFINITIONS

A. Defective Areas: See definition in Section 03 30 00, Cast-in-Place Concrete.

B. Exposed Concrete: See definition in Section 03 30 00, Cast-in-Place Concrete.

1.03 DESIGN REQUIREMENTS

A. Design formwork in accordance with ACI 301 and ACI 318 to provide concrete finishes specified in Section 03 30 00, Cast-in-Place Concrete.

B. Unless otherwise specified, limit deflection of facing materials for concrete surfaces to comply with ACI 301. Limit deflection of facing materials to comply with tolerance limits established by Contract Documents and with tolerances required by equipment manufacturers. Coordinate tolerance requirements with equipment manufacturers.

1.04 SUBMITTALS

A. Action Submittals:

1. Shop Drawings: Formwork drawings signed and sealed by a licensed professional engineer in the State of California.
2. Product Data:
   a. Form release agent.
   b. Form ties.
   c. Products to be used for sealing tie holes.

B. Informational Submittals: Statement of qualifications for formwork designer.

1.05 QUALITY ASSURANCE

A. Qualifications:

1. Formwork Designer: Formwork, falsework, and shoring design shall be designed by an engineer licensed in the State of California.

PART 2 PRODUCTS

2.01 FORM MATERIALS

A. Wall Forms and Underside of Slabs:

1. Materials: Plywood, hard plastic finished plywood, overlaid waterproof particle board, or steel in "new and undamaged" condition, of sufficient strength and surface smoothness to produce specified finish.
2. Where steel forms are used, treat steel surfaces to prevent rusting using products approved for use on steel forms.

B. Sandblasted Surface Forms: Medium-density overlay plywood for flat concrete surfaces to be sandblasted.

C. Painted Surface Forms: High-density overlay plywood for flat concrete surfaces to be painted.

D. All Other Forms: Materials as specified for wall forms.

2.02 ACCESSORIES

A. Form Release Agent:

1. Material:
   a. Shall not bond with, stain, or adversely affect concrete surfaces.
   b. Shall not impair subsequent treatments of concrete surfaces when applied to forms.
   c. Ready-to-use water based material formulated to reduce or eliminate surface imperfections.
   d. Contain no mineral oil or organic solvents.
2. Manufacturers and Products: Not for surfaces exposed to potable water.
   a. BASF, Shakopee, MN; MBT MasterFinish RL 211.
   b. Cresset Chemical Company; Crete-Lease 20-VOC-Xtra.

B. Half Round Drip Groove and Beveled Edge Corner Strips: Nonabsorbent material, compatible with form surface, fully sealed on all sides prohibiting loss of paste or water between the two surfaces.

C. Form Snap-Ties:

1. Material: Steel.
2. Spreader Inserts:
   a. Conical or spherical type.
   b. Design to maintain positive contact with forming material.
   c. Furnish units that will leave no metal closer than 1.5 inches to concrete surface when forms, inserts, and tie ends are removed.
3. Wire ties not permitted.
4. Flat bar ties for panel forms; furnish plastic or rubber inserts with minimum 1.5-inch depth and sufficient dimensions to permit patching of tie hole.

D. Through-Bolts:

1. At Contractor's option, may be used as alternate to form snap-tie.
2. Tapered minimum 1-inch diameter at smallest end.
3. Elastic Vinyl Plug for Through-Bolt Tie Holes:
   a. Design and size of plug to allow insertion with tool to enable plug to elongate and return to original length and diameter upon removal; forms watertight seal.
   b. Manufacturers and Products:
      1) Dayton Superior, Miamisburg, OH; A58 Sure Plug.
      2) Greenstreak Group, Inc., St Louis, MO; X-Plug.

PART 3 EXECUTION

3.01 FORM SURFACE PREPARATION

A. Prior to coating surface, thoroughly clean form surfaces that will be in contact with concrete or that have been in contact with previously cast concrete, dirt, and other surface contaminants.

B. Exposed Wood Forms in Contact with Concrete: Apply form release agent as recommended by manufacturer.

C. Steel Forms: Apply form release agent as soon as they are cleaned to prevent discoloration of concrete from rust.

3.02 ERECTION

A. General: In accordance with ACI 301, unless otherwise specified.

B. Beveled Edges (Chamfer):

1. Form 3/4-inch bevels at concrete edges, unless otherwise shown.
2. Where beveled edges on existing adjacent structures are other than 3/4 inch, obtain Engineer's approval of size prior to placement of beveled edge.

C. Wall Forms:

1. Do not reuse forms with damaged surfaces.
2. Locate form ties and joints in uninterrupted uniform pattern.
3. Inspect form surfaces prior to installation to ensure conformance with specified tolerances.

D. Form Tolerances:

1. Provide forms in accordance with ACI 117 and ACI 318, and the following tolerances for finishes specified:
    a. See the Schedule of Concrete Finishes in Section 03 30 00, Cast-in-Place Concrete, for beam, column, and wall types related to required form tolerances.
    b. Wall Tolerances:
        1) Straight Vertical or Horizontal Wall Surface: Flat planes within tolerance specified.
        2) Wall Type W-A:
            a) Plumb within 1/4 inch in 10 feet or within 1 inch from top to bottom for walls over 40 feet high.
            b) Depressions in Wall Surface: Maximum 5/16-inch when 10-foot straightedge is placed on high points in all directions.
        3) Wall Type W-B:
            a) Plumb within 1/8 inch in 10 feet or within 1/2 inch from top to bottom for walls over 40 feet high.
            b) Depressions in Wall Surface: Maximum 1/8-inch when 10-foot straightedge is placed on high points in all directions.
        4) Thickness: Maximum 1/4-inch minus or 1/2-inch plus from dimension shown.
        5) Form Offset: Between adjacent pieces of formwork, facing material shall not exceed 1/4 inch.

3.03 FORM REMOVAL

A. Nonsupporting forms, walls, and similar parts of Work, may be removed after cumulatively curing at not less than 50 degrees F for 24 hours from time of concrete placement if:

1. Concrete is sufficiently hard so as not to sustain damage by form removal operations.
2. Curing and protection operations are maintained.

B. Elevated Structural Slabs or Beams: In accordance with ACI 318, Chapter 6, and at such time as concrete has reached compressive strength equal to 90 percent of specified 28-day compressive strength as determined by field test cylinders.

C. Form Ties: Remove conical inserts or through bolts and plug holes as specified in Section 03 30 00, Cast-in-Place Concrete.

3.04 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

A. Owner-Furnished Quality Assurance, in accordance with CBC Chapter 17 requirements, is provided in Statement of Special Inspections Plan on Drawings. Contractor responsibilities and related information are included in Section 01 45 33, Special Inspection, Observation, and Testing.

B. Contractor-Furnished Quality Control: Inspection and testing as required in Section 01 45 16.13, Contractor Quality Control.

END OF SECTION

SECTION 03 15 00
CONCRETE JOINTS AND ACCESSORIES

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. A36/A36M, Specification for Carbon Structural Steel.
   b. A615/A615M, Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
   c. A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
   d. A767/A767M, Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.
   e. C920, Specification for Elastomeric Joint Sealants.
   f. D226, Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
   g. D227, Specification for Coal-Tar Saturated Organic Felt Used in Roofing and Waterproofing.
   h. D994, Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
   i. D1056, Specification for Flexible Cellular Materials—Sponge or Expanded Rubber.
   j. D1171, Standard Guide for Evaluating Nonwoven Fabrics.
   k. D1751, Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
   l. D1752, Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
   m. D2000, Standard Classification System for Rubber Products in Automotive Applications.
   n. D2240, Standard Test Method for Rubber Property – Durometer Hardness.

1.02 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Construction Joints, Expansion Joints and Control Joints: Layout and location for each type. Include joints locations shown on Drawings, additional required joint locations and any proposed alternate locations.
2. Product Data:
   a. Bond breaker.
   b. Premolded joint fillers.
   c. Rubber pad (bearing pad).
   d. Pourable joint fillers.
   e. Accessories not specified in other sections.

B. Informational Submittals:

1. Certification: Letter stating compatibility between liquids being contained and materials used for joint fillers.
2. Manufacturer's written instructions for product shipment, storage, handling, installation/application, and repair for:
   a. Bond breaker.
   b. Premolded joint fillers.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Acceptance at Site: Verify delivered materials are in accordance with Specifications, regulatory agencies, and Manufacturer's product data sheets prior to unloading and storing onsite.

B. Storage: Store materials under tarps to protect from oil, dirt, and sunlight or as required by Manufacturer.

PART 2 PRODUCTS

2.01 BOND BREAKER

A. Tape for Joints: Adhesive-backed glazed butyl or polyethylene tape. Same width as joint that will adhere to premolded joint material or concrete surface.

B. Use bond prevention material as specified in Section 03 30 00, Cast-in-Place Concrete, except where bond breaker tape is specifically called for on Drawings.

2.02 PREMOLDED JOINT FILLER

A. Bituminous Type: ASTM D994 or ASTM D1751.

B. Sponge Rubber:

1. Neoprene, closed-cell, expanded; ASTM D1056, Type 2C5, with compression deflection, 25 percent deflection (limits), 119 kPa to 168 kPa (17 psi to 24 psi) minimum. Use in joints for potable and nonpotable water containment structures.
2. Manufacturer and Product: Monmouth Rubber and Plastics, Corp, Long Branch, NJ; Durafoam DK5151.

2.03 RUBBER PAD (BEARING PAD)

A. Rubber Pad: Neoprene meeting ASTM D2000, Type M2 BC 414 A14C12C20F17.

B. Manufacturers:

1. Dacon Industries Co., Portland, OR.
2. West American Rubber Company, Inc., Orange, CA.

2.04 ACCESSORIES

A. Joint Sealant:

1. One-Part Polyurethane, Immersible:
   a. Polyurethane base, single-component, moisture curing; ASTM C920, Type S, Grade NS or P, Class 25 or 35.
   b. Capable of being continuously immersed in water.
   c. Manufacturers and Products for Nonsag:
      1) Sika Chemical Corp.; Sikaflex-1a.
      2) Tremco; Vulkem 116.
   d. Manufacturers and Products for Self-leveling:
      1) Tremco; Vulkem 45.
      2) Sika Chemical Corp.; Sikaflex 1c SL.

B. Backup Rod: Nongassing, extruded, closed-cell, round polyethylene foam rod.

C. Steel Reinforcement: As specified in Section 03 21 00, Steel Reinforcement.

D. Nails: Galvanized, as required for securing premolded joint filler.

PART 3 EXECUTION

3.01 GENERAL

A. Commence concrete placement after joint preparation is complete.

B. Time Between Concrete Pours: As specified in Section 03 30 00, Cast-in-Place Concrete.

3.02 SURFACE PREPARATION

A. Construction Joints: Prior to placement of abutting concrete, clean contact surface.

1. Remove laitance and spillage from steel reinforcement and dowels.
2. Roughen surface to minimum of 1/4-inch amplitude:
   a. Sandblast after concrete has fully cured.
   b. Water blast after concrete has partially cured.
   c. Green cut fresh concrete with high-pressure water and hand tools.
3. Perform cleaning so as not to damage waterstop, if one is present.

3.03 RUBBER PAD

A. Place as shown on Drawings.

B. Prior to cementing rubber pad in place, dry concrete surface and brush thoroughly to remove dirt and foreign material.

C. Use waterproof rubber cement or glue that will not damage pad to bond rubber to concrete surface.

3.04 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

A. Contractor-Furnished Quality Control: Inspection and testing as required in Section 01 45 16.13, Contractor Quality Control.

END OF SECTION

SECTION 03 21 00
STEEL REINFORCEMENT

PART 1 GENERAL

1.01 GENERAL

A. Steel reinforcement shall comply with ACI 301 and as modified in the following.

1.02 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Concrete Institute (ACI):
   a. 117, Specification for Tolerances for Concrete Construction and Materials.
   b. 301, Specifications for Structural Concrete.
   c. SP-66, Detailing Manual.
2. ASTM International (ASTM):
   a. A615/A615M, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
   b. A706/A706M, Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
   c. A767/767M, Standard Specification for Zinc-Coated (Galvanized) Steel bars for Concrete Reinforcement.
   d. A775/A775M, Standard Specification for Epoxy-Coated Steel Reinforcing Bars.
3. Concrete Reinforcing Steel Institute (CRSI):
   a. Placing Reinforcing Bars.
   b. Manual of Standard Practice.
4. International Code Council (ICC): Evaluation Services Report.

1.03 SUBMITTALS

A. Action Submittals:

1. Shop Drawings prepared in accordance with ACI 301 and ACI SP-66:
   a. Bending lists.
   b. Placing drawings.
2. Metallic sleeve splice and mechanical threaded connection.

B. Informational Submittals:

1. Lab test reports for steel reinforcement showing stress-strain curves and ultimate strengths.
2. Mechanical Threaded Connections:
   a. Current ICC Evaluation Services Report or equivalent code agency report listing findings to include acceptance, special inspection requirements, and restrictions.
   b. Verification device threads have been tested and meet requirements for thread quality, in accordance with manufacturer's published methods.
   c. Manufacturer's instructions.
3. Test results of field testing.

1.04 DELIVERY, STORAGE, AND HANDLING

A. In accordance with ACI 301 and recommendations of CRSI Placing Reinforcing Bars.

PART 2 PRODUCTS

2.01 MATERIALS

A. Reinforcing Bars:

1. Includes stirrups, ties, and spirals.
2. ASTM A615/A615M, Grade 60.
3. ASTM A767/767M, Grade 60, for galvanized bars.
4. ASTM A706/706M, Grade 60, for welded bars.

B. Mechanical Splices and Connections:

1. Metal Sleeve Splice:
   a. Furnish with cast filler metal, capable of developing, in tension or compression, 125 percent of minimum tensile strength of bar.
   b. Manufacturer and Product: Erico Products, Inc., Cleveland, OH; Cadweld T-Series.
2. Mechanical Threaded Connections:
   a. Furnish metal coupling sleeve with internal threads engaging threaded ends of bars developing in tension or compression 125 percent of yield strength of bar.
   b. Manufacturers and Products:
      1) Erico Products, Inc., Cleveland, OH; Lenton Reinforcing Steel Couplers.

2) Erico Products, Inc., Cleveland, OH; Lenton Lock Mechanical Rebar Splicing System.
3) Richmond Screw Anchor Co., Inc., Fort Worth, TX; Richmond DB-SAE Dowel Bar Splicers.

2.02 ACCESSORIES

A. Tie Wire:

1. Black, soft-annealed 16-gauge wire.
2. Nylon-, epoxy-, or plastic-coated wire.

B. Bar Supports and Spacers:

1. Use precast concrete bar supports or all-plastic bar supports and side form spacers, unless noted otherwise. Do not use other types of supports or spacers.
2. Bar supports shall have sufficient strength and stiffness to carry loads without failure, displacement, or significant deformation. Space bar supports so minimum concrete cover is maintained for reinforcing between supports.
3. Use only precast concrete bar supports where concrete surfaces are exposed to weather, earth, water, chloride intrusion, or corrosive chemicals. Bar supports shall be nonconductive and have geometry and bond characteristics that deter movement of moisture from the surface to the reinforcement.
4. Precast concrete supports shall have same minimum strength and shall be made from same materials as that of the concrete in which they are to be embedded. Precast concrete supports shall be cast and properly cured for at least 7 days before use and shall have a wire or other device cast into each block for the purpose of attaching them securely to steel reinforcement.
5. In Slabs Exposed to View after Form Removal: Use small precast concrete blocks made of same color as concrete in which they are embedded. All-plastic bar supports and side form spacers may be used, except where surface is exposed as described above.
6. Design and fabricate special bar supports for top reinforcing bars in slabs where standard bar supports do not possess necessary geometry, strength, or stiffness.
7. Plastic Bar Supports: Manufactured by Aztec Concrete Accessories, Bloomington, CA.
8. Precast Concrete Supports: Total bond precast, high-performance concrete bar supports as supplied by Dayton Superior, Miamisburg, OH, Dobies.

PART 3 EXECUTION

3.01 PREPARATION

A. Notify Engineer when reinforcing is ready for inspection and allow sufficient time for inspection prior to placing concrete.

B. Clean reinforcing bars of loose mill scale, oil, earth, and other contaminants.

3.02 INSTALLATION

A. Bundle or space bars, instead of field bending where construction access through reinforcing is necessary.

B. Splicing:

1. Minimum length of lap splices shall comply with table in Contract Documents.
2. Use lap splices, unless otherwise shown or permitted in writing by Engineer.
3. Stagger splices in adjacent bars where indicated.

C. Mechanical Splices and Connections:

1. Use only in areas specifically approved in writing by Engineer.
2. Install threaded rods as recommended by manufacturer with threads totally engaged into coupling sleeve and in accordance with ICC Evaluation Services Report or equivalent code agency report.
3. For metal sleeve splice, follow manufacturer’s installation recommendations.
4. Maintain minimum edge distance and concrete cover.

D. Tying Reinforcing Bars:

1. Tie every other intersection on mats made up of Nos. 3, 4, 5, and 6 bars to hold them firmly at required spacing.
2. Bend tie wire away from concrete surface to provide clearance of 1 inch from surface of concrete to tie wire.

E. Reinforcement Around Openings: On each side and above and below pipe or opening, place an equivalent area of steel bars to replace steel bars cut for opening. Extend steel reinforcing a standard lap length beyond opening at each end.

F. Welding Reinforcement: Only perform welding as allowed by Engineer.

G. Straightening and Rebending: Field bending of steel reinforcement bars is not permitted.

H. Unless permitted by Engineer, do not cut reinforcing bars in field.

3.03 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

A. Owner-Furnished Quality Assurance, in accordance with CBC Chapter 17 requirements, is provided in the Statement of Special Inspections Plan on Drawings. Contractor responsibilities and related information are included in Section 01 45 33, Special Inspection, Observation, and Testing.

B. Contractor-Furnished Quality Control: Inspection and testing as required in Section 01 45 16.13, Contractor Quality Control.

END OF SECTION

SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards that may be referenced in this section:

1. American Concrete Institute (ACI):
   a. 117, Specification for Tolerances for Concrete Construction and Materials.
   b. 301, Specifications for Structural Concrete.
   c. 305.1, Specification for Hot Weather Concreting.
   d. 306.1, Standard Specification for Cold Weather Concreting.
   e. 350.1, Specification for Tightness Testing of Environmental Engineering Concrete Containment Structures.
   f. CP-1, Technical Workbook for ACI Certification of Concrete Field Testing Technician – Grade 1.
2. ASTM International (ASTM):
   a. C31/C31M, Standard Practice for Making and Curing Concrete Test Specimens in the Field.
   b. C33/C33M, Standard Specification for Concrete Aggregates.
   c. C39/C39M, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
   d. C94/C94M, Standard Specification for Ready-Mixed Concrete.
   e. C109/C109M, Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens).
   f. C143/C143M, Standard Test Method for Slump of Hydraulic-Cement Concrete.
   g. C150/C150M, Standard Specification for Portland Cement.
   h. C157/C157M, Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete.
   i. C227, Standard Test Method for Potential Alkali Reactivity of Cement-Aggregate Combinations (Mortar-Bar Method).
   j. C231/C231M, Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
   k. C260/C260M, Standard Specification for Air-Entraining Admixtures for Concrete.
   l. C494/C494M, Standard Specification for Chemical Admixtures for Concrete.

m. C595/C595M, Standard Specification for Blended Hydraulic Cements.
n. C618, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
o. C881/C881M, Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
p. C979/C979M, Standard Specification for Pigments for Integrally Colored Concrete.
q. C989, Standard Specification for Slag Cement for Use in Concrete and Mortars.
r. C1012/C1012M, Standard Test Method for Length Change of Hydraulic-Cement Mortars Exposed to a Sulfate Solution.
s. C1017/C1017M, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
t. C1074, Standard Practice for Estimating Concrete Strength by the Maturity Method.
u. C1077, Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation.
v. C1218/C1218M, Standard Test Method for Water-Soluble Chloride in Mortar and Concrete.
w. C1240, Standard Specification for Silica Fume Used in Cementitious Mixtures.
x. C1260, Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method).
y. C1293, Standard Test Method for Determination of Length Change of Concrete Due to Alkali-Silica Reaction.
z. C1567, Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method).
aa. C1582/C1582M, Standard Specification for Admixtures to Inhibit Chloride-Induced Corrosion of Reinforcing Steel in Concrete.
bb. C1602/C1602M, Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete.
cc. D4580, Standard Practice for Measuring Delaminations in Concrete Bridge Decks by Sounding.
dd. E329, Standard Specification for Agencies Engaged in Construction Inspection, Special Inspection, or Testing Materials Used in Construction.

3. National Ready Mixed Concrete Association (NRMCA).

1.02 DEFINITIONS

A. Cold Weather: When ambient temperature is below 40 degrees F or is approaching 40 degrees F and falling.

B. Contractor's Licensed Design Engineer: Individual representing Contractor who is licensed to practice engineering as defined by statutory requirements of professional licensing laws in state or jurisdiction in which Project is to be constructed.

C. Defective Area: Surface defects that include honeycomb, rock pockets, indentations, and surface voids greater than 3/16-inch deep, surface voids greater than 3/4 inch in diameter, cracks in liquid containment structures and below grade habitable spaces that are 0.005-inch wide and wider, and cracks in other structures that are 0.010-inch wide and wider, spalls, chips, embedded debris, sand streaks, mortar leakage from form joints, deviations in formed surface that exceed specified tolerances and include but are not limited to fins, form pop-outs, and other projections. At exposed concrete, defective areas also include texture irregularities, stains, and other color variations that cannot be removed by cleaning.

D. Exposed Concrete: Concrete surface that can be seen inside or outside of structure regardless of whether concrete is above water, dry at all times, or can be seen when structure is drained.

E. Hot Weather: As defined in ACI 305.1.

F. New Concrete: Less than 60 days old.

1.03 SUBMITTALS

A. Action Submittals:

1. Mix Designs:
   a. Contain proportions of materials and admixtures to be used on Project, signed by mix designer.
   b. Documentation of average strength for each proposed mix design in accordance with ACI 301.
   c. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements, for the following:
      1) Portland cement.
      2) Supplementary cementitious materials.
      3) Aggregates, including specified class designation for coarse aggregate.

4) Admixtures.
5) Concrete producer has verified compatibility of constituent materials in design mix.

d. Test Reports:
1) Cement: Chemical analysis report.
2) Supplementary Cementitious Materials: Chemical analysis report and report of other specified test analyses.
3) Water-Soluble Chloride-Ion Content in Hardened Concrete: Unless otherwise permitted, in accordance with ASTM C1218/C1218M at an age between 28 days and 42 days.

e. Aggregates:
1) Coarse Aggregate Gradation: List gradings and percent passing through each sieve.
2) Fine Aggregate Gradation: List gradings and percent passing through each sieve.
3) Combined gradation for coarse and fine aggregates. List gradings and percent passing through each sieve.
4) Deleterious substances in fine aggregate per ASTM C33/C33M, Table 2.
5) Deleterious substances in coarse aggregate per ASTM C33/C33M, Table 4.
6) Test Reports:
a) Alkali Aggregate Reactivity: Aggregate shall be classified as nonpotentially reactive in accordance with Article Concrete Mix Design. Include documentation of test results per applicable standards.

f. Admixtures: Manufacturer’s catalog cut sheets and product data sheets for each admixture used in proposed mix designs.

2. Product Data: Specified ancillary materials.
3. Detailed plan for curing and protection of concrete placed and cured in cold weather. Details shall include, but not be limited to, the following:
a. Procedures for protecting subgrade from frost and accumulation of ice or snow on reinforcement, other metallic embeds, and forms prior to placement.
b. Procedures for measuring and recording temperatures of reinforcement and other embedded items prior to concrete placement.
c. Methods for temperature protection during placement.
d. Types of covering, insulation, housing, or heating to be provided.
e. Curing methods to be used during and following protection period.
f. Use of strength accelerating admixtures.
g. Methods for verification of in-place strength.

h. Procedures for measuring and recording concrete temperatures.
i. Procedures for preventing drying during dry, windy conditions.

4. Detailed plan for hot weather placements including curing and protection for concrete placed in ambient temperatures over 80 degrees F. Plan shall include, but not be limited to, the following:
   a. Procedures for measuring, and recording temperatures of reinforcement and other embedded items prior to concrete placement.
   b. Use of retarding admixture.
   c. Methods for controlling temperature of reinforcement and other embedded items and concrete materials before and during placement.
   d. Types of shading and wind protection to be provided.
   e. Curing methods, including use of evaporation retardant.
   f. Procedures for measuring and recording concrete temperatures.
   g. Procedures for preventing drying during dry, windy conditions.
5. Preinstallation Conference minutes.
6. Manufacturer’s application instructions for bonding agent and bond breaker.
7. Manufacturer’s Certificate of Compliance to specified standards:
   a. Bonding agent.
   b. Repair materials.
8. Statement of Qualification:
   a. Batch Plant: Certification as specified herein.
   b. Mix designer.
   c. Installer.
   d. Testing agency.
9. Field test reports.
10. Recorded temperature data from concrete placement where specified.
11. Concrete Delivery Tickets:
   a. For each batch of concrete before unloading at Site.
   b. In accordance with ASTM C94/C94M, including requirements 14.2.1 through 14.2.10.
   c. Indicate amount of mixing water withheld and maximum amount that may be permitted to be added at Site.

1.04 QUALITY ASSURANCE

A. Concrete construction shall conform to requirements of ACI 117 and ACI 301, except as modified herein.

B. Qualifications:

1. Batch Plant: NRMCA Program for Certification of Ready-Mixed Concrete Production Facilities or approved equivalent program.
2. Mix Designer: Person responsible for developing concrete mixture proportions certified as NRMCA Concrete Technologist Level 2 or DOT certified mix designer in jurisdiction of the Work. Requirement may be waived if individual is Contractor's Licensed Design Engineer.
3. Testing Agency: Unless otherwise permitted, an independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C1077 and ASTM E329 for testing indicated.
    a. Where field testing is required of Contractor, personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
    b. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

C. Preinstallation Conference:

1. Required Meeting Attendees:
    a. Contractor, including pumping, placing and finishing, and curing subcontractors.
    b. Ready-mix producer.
    c. Admixture representative.
    d. Testing and sampling personnel.
    e. Engineer who authored Statement of Special Inspection Plan or Engineer's designee.
2. Schedule and conduct prior to incorporation of respective products into Project. Notify Engineer of location and time.
3. Agenda shall include:
    a. Admixture types, dosage, performance, and redosing at Site.
    b. Mix designs, test of mixes, and Submittals.
    c. Placement methods, techniques, equipment, consolidation, and form pressures.
    d. Slump and placement time to maintain slump.
    e. Finish, curing, and water retention.
    f. Protection procedures for weather conditions.
    g. Other specified requirements requiring coordination.
4. Conference minutes as specified in Section 01 31 19, Project Meetings.

PART 2 PRODUCTS

2.01 MATERIALS

A. Cementitious Materials:

1. Cement:
   a. Portland Cement: Unless otherwise specified, conform to requirements of ASTM C150/C150M.
   b. Blended Hydraulic Cement:
      1) Unless otherwise specified, conform to requirements of ASTM C595/C595M.
      2) Portland cement used in blended hydraulic cement, conform to requirements of ASTM C150/C150M.
   c. Furnish from one source.
2. Supplementary Cementitious Materials (SCM):
   a. Fly Ash (Pozzolan): Class F fly ash in accordance with ASTM C618, except as modified herein:
      1) ASTM C618, Table 1, Loss on Ignition: Unless permitted otherwise, maximum 3 percent.
   b. Slag Cement: In accordance with ASTM C989, Grade 100 or Grade 120.
   c. Silica Fume: ASTM C1240.

B. Aggregates: Furnish from one source for each aggregate type used in a mix design.

1. Normal-Weight Aggregates:
   a. In accordance with ASTM C33/C33M, except as modified herein.
      1) Class Designation: 4S unless otherwise specified.
   b. Free of materials and aggregate types causing popouts, discoloration, staining, or other defects on surface of concrete.
   c. Alkali Silica Reactivity: See Article Concrete Mix Design.
2. Fine Aggregates:
   a. Clean, sharp, natural sand.
   b. ASTM C33/C33M.
   c. Limit deleterious substances in accordance with ASTM C33/C33M, Table 2 and as follows:
      1) Limit material finer than 75-µm (No. 200) sieve to 5 percent mass of total sample.
      2) Limit coal and lignite to 1.0 percent.
3. Coarse Aggregate:
   a. Natural gravels, combination of gravels and crushed gravels, crushed stone, or combination of these materials containing no

more than 15 percent flat or elongated particles (long dimension more than five times the short dimension).

b. Limit deleterious substances in accordance with ASTM C33/C33M, Table 4 for specified class designation.

C. Admixtures: Unless otherwise permitted, furnish from one manufacturer.

1. Characteristics:
   a. Compatible with other constituents in mix.
   b. Contain at most, only trace amount chlorides in solution.
   c. Do not use admixtures known to be toxic after concrete is 30 days.
   d. Furnish type of admixture as recommended by manufacturer for anticipated temperature ranges.
2. Air-Entraining Admixture: ASTM C260/C260M.
3. Water-Reducing Admixture: ASTM C494/C494M, Type A or Type D.
4. Retarding Admixture: ASTM C494/C494M, Type B.
5. Accelerating Admixture: ASTM C494/C494M, Type C.
6. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F or Type G.
7. Do not use calcium chloride as an admixture.
8. Admixtures with no standard, ASTM or other, designation may be used where permitted.

D. Water and Ice: Mixing water for concrete and water used to make ice shall be potable water, unless alternative sources of water are permitted.

1. Water from alternative sources shall comply with requirements of ASTM C1602/C1602M, and concentration of chemicals in combined mixing water shall be less than:
   a. Chloride Content: 1,000 ppm.
   b. Sulfate Content as SO_4: 3,000 ppm.
   c. Alkalis as (Na_2O + 0.658 K_2O): 600 ppm.
   d. Total Solids by Mass: Less than 50,000 ppm.

2.02 ANCILLARY MATERIALS

A. Repair Material:

1. Contain only trace amounts of chlorides and other chemicals that can potentially cause steel to oxidize.
2. Where repairs of exposed concrete are required, prepare mockup using proposed repair materials and methods, for confirmation of appearance compatibility prior to use.
3. Obtain Manufacturer’s Certificate of Compliance that products selected are appropriate for specific applications.

4. Repair mortar shall be site mixed.
5. Prepare concrete substrate and mix, place, and cure repair material in accordance with manufacturer's written recommendations.
6. Manufacturers and Products:
    a. BASF Building Systems Inc., Shakopee, MN; EMACO S-Series products.
    b. Sika Chemical Corp., Lyndhurst, NJ; SikaTop-Series.

2.03 CONCRETE MIX DESIGN

A. General:

1. See Supplement at the end of this section for mix design requirements for each class of concrete used on Project.
2. Prepare design mixtures for each type and strength of concrete, selecting and proportioning ingredients in accordance with requirements of ACI 301, unless otherwise specified.
3. Selection of constituent materials and products in mix design are optional, unless specified otherwise.
4. Unless otherwise permitted, use water-reducing admixture or water-reducing admixture and high-range, water-reducing admixture in pumped concrete, in concrete with a water-cementitious materials ratio below 0.50.
5. Unless otherwise permitted, use water-reducing admixture and high-range, water-reducing admixture in piers.
6. Use water-reducing admixture or high-range, water-reducing admixture to achieve fresh properties that facilitate handling, placing, and consolidating of concrete, and specified hardened properties.
7. Use water-reducing and retarding admixture when anticipated high temperatures, low humidity, or other adverse placement conditions can adversely affect fresh properties of concrete.
8. Unless otherwise specified, desired fresh properties of concrete shall be determined by Contractor, and coordinated with concrete producer. Fresh properties of concrete shall remain stable to satisfaction of Contractor, for duration of placement and consolidation, and shall remain in conformance with requirements of Contract Documents.
9. Contractor is encouraged to consider using environmentally sustainable concrete mix design technologies such as use of supplementary cementitious materials and aggregate packing.

B. Potential Alkali-Aggregate Reactivity of Concrete:

1. Do not use aggregates known to be susceptible to alkali-carbonate reaction (ACR).

2. Aggregates shall have been tested to determine potential alkali-aggregate reactivity in concrete in accordance with ASTM C1260 or ASTM C1567.
    a. Aggregates that indicate expansion greater than 0.10 percent at 16 days after casting shall not be used unless they have been shown to be nondeleteriously reactive in accordance with ASTM C227 or ASTM C1293, with less than 0.04 percent expansion at 1 year for cement-aggregate combinations or less than 0.04 percent expansion at 2 years for combinations with pozzolan or slag.
    b. Alkali content of cement used in proposed concrete mixture shall not be greater than alkali content of cement used in test for potential alkali-aggregate reactivity.
    c. Use low-alkali cement or incorporate pozzolans into concrete mixture as necessary to satisfy testing for potential alkali reactivity.

C. Proportions:

1. Design mix to meet aesthetic, durability, and strength requirements.
2. Where fly ash is included in mix, minimum fly ash content shall be a minimum of 20 percent of weight of total cementitious materials.

D. Slump Range at Site:

1. Prior to submitting mix design, consult with concrete producer and select a target slump value at point of delivery, for each application of each design mix. Unless otherwise permitted, target slump value will then be enforced for duration of Project.
2. Design mixes that include a high-range, water-reducing admixture shall have a minimum slump of 2 inches prior to addition of admixture. Unless otherwise permitted, slump shall be 8 inches maximum at point of delivery, for concrete with a high-range, water-reducing admixture.
3. Slump tolerance shall meet requirements of ACI 117.

E. Combined Aggregate Gradation:

1. Combined Gradation Limits: Fine aggregate shall be in range of 36 percent to 40 percent of total aggregate weight.

2.04 CONCRETE MIXING

A. General: In accordance with ACI 301, except as modified herein.

B. Truck Mixers:

1. For every truck, test slump of samples taken per ASTM C94/C94M, paragraph 12.5.1.
2. Where specified slump is more than 4 inches, and if slump tests differ by more than 2 inches, discontinue use of truck mixer, unless causing condition is corrected and satisfactory performance is verified by additional slump tests.

2.05 SOURCE QUALITY CONTROL

A. Source Quality Control Inspection: Engineer shall have access to and have right to inspect batch plants, cement mills, and supply facilities of suppliers, manufacturers, and Subcontractors, providing products included in this section.

PART 3 EXECUTION

3.01 PLACING CONCRETE

A. Preparation: Meet requirements ACI 301, except as modified herein.

B. Inspection: Notify Engineer and Special Inspector at least 1 full working day in advance before starting to place concrete.

C. Placement into Formwork:

1. Reinforcement: Secure in position before placing concrete.
2. Place concrete as soon as possible after leaving mixer, without segregation or loss of ingredients, without splashing forms or steel above, and in layers not over 1.5 feet deep, except for slabs which shall be placed full depth. Place and consolidate successive layers prior to initial set of first layer to prevent cold joints.
3. Placement frequency shall be such that lift lines will not be visible in exposed concrete finishes.
4. Use placement devices, for example chutes, pouring spouts, and pumps as required to prevent segregation.
5. Vertical Free Fall Drop to Final Placement:
   a. Forms 8 Inches or Less Wide: 5 feet.
   b. Forms Wider than 8 Inches: 8 feet, except as specified.
6. For placements where drops are greater than specified, use placement device such that free fall below placement device conforms to required value. Limit free fall to prevent segregation caused by aggregates hitting steel reinforcement.
7. Do not use aluminum conveying devices.

8. Provide sufficient illumination in the interior of forms so concrete deposition is visible, permitting confirmation of consolidation quality.
9. Trowel and round off top exposed edges of walls with 1/4-inch radius steel edging tool.
10. Cure concrete as specified in Section 03 39 00, Concrete Curing.

D. Chutes:

1. Design and arrange ends of chutes, hopper gates, and other points of concrete discharge throughout conveying, hoisting, and placing system for concrete to pass without becoming segregated.
2. Do not use chutes longer than 50 feet.
3. Minimum Slopes of Chutes: Angled to allow concrete to readily flow without segregation.

E. Retempering: Not permitted for concrete where cement has partially hydrated.

F. Pumping of Concrete:

1. Provide standby pump, conveyor system, crane and concrete bucket, or other system onsite during pumping, for adequate redundancy to ensure completion of concrete placement without cold joints in case of primary placing equipment breakdown.
2. Minimum Pump Hose (Conduit) Diameter: 4 inches.
3. Replace pumping equipment and hoses (conduits) that are not functioning properly.

G. Maximum Size of Concrete Placements:

1. Limit size of each placement to allow for strength gain and volume change as a result of shrinkage.
2. Locate expansion, control, and contraction joints where shown on Drawings.
3. Construction Joints:
   a. Unless otherwise shown or permitted, locate construction joints as follows:
      1) Locate construction joints as shown on Drawings or where approved in joint location submittal required in Section 03 15 00, Concrete Joints and Accessories.
      2) Uniformly space vertical construction joints within straight sections of walls and slabs, avoiding penetrations.
4. Consider beams, girders, brackets, column capitals, and haunches as part of floor or roof system and place monolithically with floor or roof system.

5. Should placement sequence result in cold joint located below finished water surface, install waterstop in joint.

H. Minimum Time between Adjacent Placements:

1. Construction or Control Joints: 7 days unless otherwise specified.
2. Construction joint between top of footing or slab, and column or wall, as soon as can safely be done without damaging previously cast concrete or interrupting curing thereof, but not less than 24 hours.
3. Expansion or Contraction Joints: 1 day.

I. Consolidation and Visual Observation:

1. Consolidation Equipment and Methods: ACI 301.
2. Provide at least one standby vibrator in operable condition at Site prior to placing concrete.
3. Provide sufficient windows in forms or limit form height to allow for concrete placement through windows and for visual observation of concrete.
4. Vibrate concrete in vicinity of joints to obtain impervious concrete.

J. Hot Weather:

1. Prepare ingredients, mix, place, cure, and protect in accordance with ACI 301, ACI 305.1, and as follows:
   a. Maintain concrete temperature below 90 degrees F at time of placement, or furnish test data or other proof that admixtures and mix ingredients do not produce flash set plastic shrinkage, or cracking as a result of heat of hydration. Cool ingredients before mixing to maintain fresh concrete temperatures as specified or less.
   b. Provide for windbreaks, shading, fog spraying, sprinkling, ice, wet cover, or other means as necessary to maintain concrete at or below specified temperature.
2. Concrete Curing: As specified in Section 03 39 00, Concrete Curing.

K. Cold Weather Placement:

1. Unless otherwise permitted, shall be in accordance with requirements of ACI 306.1 and as follows:
   a. Cold weather requirements shall apply when ambient temperature is below 40 degrees F or approaching 40 degrees F and falling.
   b. Do not place concrete over frozen earth or against surfaces with frost or ice present. Frozen earth shall be thawed to acceptance of Engineer.

c. Unless otherwise permitted, do not place concrete in contact with surfaces less than 35 degrees F; requirement is applicable to all surfaces including reinforcement and other embedded items.
d. Provide supplemental external heat as needed when other means of thermal protection are unable to maintain minimum surface temperature of concrete as specified in ACI 306.1.
e. Maintain minimum surface temperature of concrete as specified in ACI 306.1 for no less than 3 days during cold weather conditions.
f. Cure concrete as specified in Section 03 39 00, Concrete Curing. Protect concrete from freezing until end of curing period and until concrete has attained a compressive strength of 3,500 psi or design compressive strength if less than 3,500 psi.

2. External Heating Units: Do not exhaust heater flue gases directly into enclosed area as it causes concrete carbonation as a result of concentrated carbon dioxide.
3. Maintain curing conditions as specified in Section 03 39 00, Concrete Curing.

3.02 PLACING TREMIE CONCRETE SEALS

A. Place concrete when water level inside area to be filled with concrete is equal to groundwater elevation outside.

B. Maintain relation of water levels until concrete design strength is obtained.

3.03 CONCRETE BONDING

A. Construction Joints in New Concrete Members: Prepare surface of construction joint as specified in Section 03 15 00, Concrete Joints and Accessories.

B. Construction Joints at Existing Concrete:

1. Thoroughly clean and mechanically roughen existing concrete surfaces to roughness profile of 1/4 inch.
2. Saturate surface with water for 24 hours prior to placing new concrete.

3.04 REPAIRING CONCRETE

A. General:

1. Repair defective areas of concrete.
2. Repair concrete surfaces using specified materials. Select system, submit for review, and obtain approval from Engineer prior to use.

3. Develop repair techniques with material manufacturer on surface that will not be visible in final construction prior to starting actual repair work and show how finish color will blend with adjacent surfaces. Obtain approval from Engineer.
4. Obtain quantities of repair material and manufacturer's detailed instructions for use to provide repair with finish to match adjacent surface or apply sufficient repair material adjacent to repair to blend finish appearance.
5. Repair of concrete shall provide structurally sound surface finish, uniform in appearance or upgrade finish by other means until acceptable to Engineer.

B. Tie Holes: Unless otherwise specified, fill with specified repair material. Prepare substrate and mix, place, and cure repair material per manufacturer's written recommendations.

C. Alternate Form Ties, Through-Bolts:

1. Mechanically roughen entire interior surface of through hole.
2. Apply bonding agent to roughened surface and drive elastic vinyl plug to half depth.
3. Dry pack entire hole from both sides of plug with nonshrink grout, as specified in Section 03 62 00, Grouting.
4. Use only enough water to dry pack grout.
5. Dry pack while bonding agent is still tacky.
6. If bonding agent has dried, remove bonding agent by mechanical means and reapply new coat of bonding agent.
7. Compact grout using steel hammer and steel tool to drive grout to high density.
8. Cure grout with water.

D. Exposed Metal Objects:

1. Remove metal objects not intended to be exposed in as-built condition of structure including wire, nails, and bolts, by chipping back concrete to depth of 1 inch and then cutting or removing metal object.
2. Repair area of chipped-out concrete as specified for defective areas.

E. Blockouts at Pipes or Other Penetrations: Where shown install in accordance with requirements of Drawings.

3.05 CONCRETE WALL FINISHES

A. Type W-1 (Ordinary Wall Finish):

1. Patch tie holes.
2. Knock off projections.
3. Repair defective areas.

B. Type W-2 (Smooth Wall Finish):

1. Patch tie holes.
2. Grind off fins and other projections.
3. Repair defective areas to provide smooth uniform appearance.

3.06 CONCRETE SLAB FINISHES

A. General:

1. Use manual screeds, vibrating screeds, or roller compacting screeds to place concrete level and smooth.
2. Do not use “jitterbugs” or other special tools designed for purpose of forcing coarse aggregate away from surface and allowing layer of mortar, which will be weak and cause surface cracks or delamination, to accumulate.
3. Finish slab in accordance with specified slab finish.
4. Do not dust surfaces with dry materials nor add water to surfaces.
5. Cure concrete as specified in Section 03 39 00, Concrete Curing.

B. Type S-1 (Steel Troweled Finish):

1. Finish by screeding and floating with straightedges to bring surfaces to required finish elevation.
2. Wood float to true, even plane with no coarse aggregate visible.
3. Use sufficient pressure on wood floats to bring moisture to surface.
4. After surface moisture has disappeared, hand steel trowel concrete to produce smooth, smooth dense surface, free from trowel marks.
5. Provide light steel-troweled finish (two trowelings) at air-entrained slabs. Provide hard steel-troweled finish (ringing sound from the trowel) for nonair-entrained slabs.
6. Do not use dry cement or additional water during troweling, nor will excessive troweling be permitted.
7. Power Finishing:
    a. Approved power machine may be used in lieu of or in addition to hand finishing in accordance with directions of machine manufacturer.

b. Do not use power machine when concrete has not attained necessary set to allow finishing without introducing high and low spots in slab.
c. Do first steel troweling for slab S-1 finish by hand.

C. Type S-2 (Wood Float Finish):

1. Finish slab to receive fill and mortar setting bed by screeding with straightedges to bring surface to required finish plane.
2. Wood float finish to compact and seal surface.
3. Remove laitance and leave surface clean.
4. Coordinate with other finish procedures.

D. Type S-3 (Underside Elevated Slab Finish): When forming is removed, grind off projections on underside of slab and repair defective areas, including small shallow air pockets.

E. Type S-5 (Broomed Finish):

1. Finish as specified for Type S-1 floor finish, except use only a light-steel troweled finish, and then finish surface by drawing fine-hair broom lightly across surface.
2. Broom in same direction and parallel to expansion joints, or, in case of inclined slabs, perpendicular to slope, except for round roof slab, broom surface in radial direction.

F. Type S-6 (Sidewalk Finish):

1. Slope walks down 1/4 inch per foot away from structures, unless otherwise shown.
2. Strike off surface by means of strike board and float with wood or cork float to true plane, then flat steel trowel before brooming.
3. Broom surface at right angles to direction of traffic or as shown.
4. Lay out sidewalk surfaces in blocks, as shown or as directed by Engineer, with grooving tool.

G. Concrete Curbs:

1. Float top surface of curb smooth, and finish all discontinuous edges with steel edger.
2. After concrete has taken its initial set, remove front form and give exposed vertical surface an ordinary wall finish.

3.07 CONCRETE SLAB TOLERANCES

A. Slab Tolerances:

1. Exposed Slab Surfaces: Comprise of flat planes as required within tolerances specified.
2. Slab Finish Tolerances and Slope Tolerances: Crowns on floor surface not too high as to prevent 10-foot straightedge from resting on end blocks, nor low spots that allow block of twice the tolerance in thickness to pass under supported 10-foot straightedge.
3. Slab Type S-A: Steel gauge block 5/16-inch thick.
4. Slab Type S-B: Steel gauge block 1/8-inch thick.
5. Slab Type S-A and S-B:
   a. Finish Slab Elevation: Slope slabs to floor drain and gutter, and shall adequately drain regardless of tolerances.
6. Thickness: Maximum 1/4-inch minus or 1/2-inch plus from thickness shown. Where thickness tolerance will not affect slope, drainage, or slab elevation, thickness tolerance may exceed 1/2-inch plus.

B. Slab Elevation and Thickness:

1. Finish Slab Elevation: Slope slabs to floor drains and gutter. Slabs shall adequately drain regardless of tolerances.
2. Thickness: Maximum 1/4-inch minus or 1/2-inch plus from thickness shown. Where thickness tolerance will not affect slope, drainage, or slab elevation, thickness tolerance may exceed 1/2-inch plus.

3.08 FIELD QUALITY CONTROL

A. General:

1. Provide adequate facilities for safe storage and proper curing of concrete test specimens onsite for first 24 hours, and for additional time as may be required before transporting to test lab.
2. Unless otherwise specified, sample concrete for testing for making test specimens, from point of delivery.
3. When concrete is pumped, sample and test air content at point of delivery and at point of placement.
   a. For Each Concrete Mixture: Provided results of air content tests for first load of the day are within specified limits, testing need only be performed at point of delivery for subsequent loads of that concrete mixture except that testing should be performed at point of placement every 4 hours.
4. Evaluation will be in accordance with ACI 301 and Specifications.

5. Test specimens shall be made, cured, and tested in accordance with ASTM C31/C31M and ASTM C39/C39M.
6. Frequency of testing may be changed at discretion of Engineer.
7. Pumped Concrete: Take concrete samples for slump, ASTM C143/C143M, and test specimens, ASTM C31/C31M and ASTM C39/C39M,.
8. If measured air content at delivery is greater than specified limit, check test of air content will be performed immediately on a new sample from delivery unit. If check test fails, concrete has failed to meet requirements of Contract Documents. If measured air content is less than lower specified limit, adjustments will be permitted in accordance with ASTM C94/C94M, unless otherwise specified. If check test of adjusted mixture fails, concrete has failed to meet requirements of Contract Documents. Concrete that has failed to meet requirements of Contract Documents shall be rejected.

B. Concrete Strength Test:

1. Unless otherwise specified, one specimen at age of 7 days for information, and two 6-inch diameter or when permitted three 4-inch diameter test specimens at age of 28 days for acceptance.
2. If result of 7-day concrete strength test is less than 50 percent of specified 28-day strength, extend period of moist curing specified in Section 03 39 00, Concrete Curing, by 7 additional days.
3. Provide a minimum of one spare test specimen per sample. Test spare cylinder as directed by Engineer.

C. High-Range, Water-Reducer (Superplasticizer) Admixture Segregation Test: Test each truck prior to use on Project.

1. Segregation Test Objective: Concrete with 4-inch to 8-inch slump shall stay together when slumped. Segregation is assumed to cause mortar to flow out of mix even though aggregate may stay piled enough to meet slump test.
2. Test Procedure: Make slump test and check for excessive slump and observe to see if mortar or moisture flows from slumped concrete.
3. Reject concrete if mortar or moisture separates and flows out of mix.

D. Cold Weather Placement Tests:

1. During cold weather concreting, cast cylinders for field curing as follows. Use method that will produce greater number of specimens:
   a. Six extra test cylinders from last 100 cubic yards of concrete.

b. Minimum three specimens for each 2 hours of placing time or for each 100 cubic yards.

2. These specimens shall be in addition to those cast for lab testing.
3. Protect test cylinders from weather until they can be placed under same protection provided for concrete of structure that they represent.
4. Keep field test cylinders in same protective environment as parts of structure they represent to determine if specified strength has been obtained.
5. Test cylinders in accordance with applicable sections of ASTM C31/C31M and ASTM C39/C39M.
6. Use test results to determine specified strength gain prior to falsework removal or for prestressing.

E. Tolerances:

1. Slab Finish Tolerances and Slope Tolerances:
   a. Make floor flatness measurements day after floor is finished and before shoring is removed to eliminate effects of shrinkage, curing, and deflection.
   b. Support 10-foot long straightedge at each end with steel gauge blocks of thicknesses equal to specified tolerance.
   c. Compliance with designated limits in four of five consecutive measurements is satisfactory, unless defective conditions are observed.

3.09 MANUFACTURER'S SERVICES

A. Provide representative at Site in accordance with Section 01 43 33, Manufacturers' Field Services, for installation assistance, inspection, and certification of proper installation for concrete ingredients, mix design, mixing, and placement.

1. Concrete Producer Representative:
   a. Assist with concrete mix design, performance, placement, weather problems, and problems as may occur with concrete mix throughout Project, including instructions for redosing.
   b. Establish control limits on concrete mix designs.
   c. Provide equipment for control of concrete redosing for air entrainment or high-range, water-reducing admixture, superplasticizers, at Site to maintain proper slump and air content if needed.
2. Admixture Manufacturer's Representative: Available for consultations as required to ensure proper installation and performance of specified products.

3. Bonding Agent Manufacturer's Representative: Available for consultations as required to ensure proper installation and performance of specified products.

3.10 PROTECTION OF INSTALLED WORK

A. After curing as specified in Section 03 39 00, Concrete Curing, and after applying final floor finish, cover slabs with plywood or particle board or plastic sheeting or other material to keep floor clean and protect it from material and damage as a result of other construction work.

B. Repair areas damaged by construction, using specified repair materials and approved repair methods.

3.11 SCHEDULE OF CONCRETE FINISHES

A. Form Tolerances: As specified in Section 03 10 00, Concrete Forming and Accessories.

B. Provide concrete finishes as scheduled:

Area	Type of Finish	Required Form Tolerances
Exterior Wall Surfaces		
Above grade/exposed (above point 6" below finish grade)	W-2	W-B
Backfilled (below point 6" below finish grade)	W-1	W-A
Exterior Slabs		
Deck slab/exposed	S-5	S-B
Stairs and landings	S-5	S-B
Sidewalks	S-6	S-A
Other exterior slabs	S-5	S-A

3.12 SUPPLEMENTS

A. Requirements of concrete mix designs following “End of Section,” are a part of this Specification and supplement requirements of Part 1 through Part 3 of this section:

1. Concrete Mix Design, Class 4500F1S1P1C1.
2. Concrete Mix Design, Class 4000F0S1P0C0.
3. Concrete Mix Design, Class TC00F0S1P1C1.

END OF SECTION

CONCRETE MIX DESIGN, CLASS 4500F1S1P1C1

A. Mix Locations: All structural concrete unless specifically mentioned in CLASS 4000F0S1P0C0 or CLASS TC00F0S1P1C1.

B. Exposure Categories and Classifications: F1S1P1C1.

C. Mix Properties:

1. Limit water to cementitious materials ratio (W/Cm) in mix design to maximum value of 0.42.
2. Minimum concrete compressive strength (f'c) shall be 4,000 psi at 28 days and 4,500 psi at 56 days.
   a. Unless otherwise specified, provide air content based on nominal maximum size of aggregate as follows:

Nominal Maximum Aggregate Size in. ‡	**Air Content (%)***
3/4	5.0
1	4.5

‡See ASTM C33/C33M for tolerance on oversize for various nominal maximum size designations.

*Tolerance of air content is ±1-1/2 percent. Entrained air is not required for concrete placed in concrete filled steel pipe piles.

§Air contents apply to total mixture. When testing concretes, however, aggregate particles larger than 1-1/2 inches are to be removed by sieving and air content will be measured on sieved fraction (tolerance on air content as delivered applies to this value). Air content of total mixture is computed from value measured on sieved fraction passing 1-1/2 inch sieve in accordance with ASTM C231/C231M.

3. Provide cementitious materials in accordance with one of the following:
   a. ASTM C150/C150M Type II; inclusion of supplementary cementitious materials in design mix is optional.
   b. ASTM C150/C150M types other than Type II, plus supplementary cementitious materials in accordance with one of the following:
      1) Tricalcium Aluminate Content of Total Cementitious Materials: Maximum 8 percent by weight.
      2) Provide documentation of test results in accordance with ASTM C1012/C1012M, for combinations of cementitious

materials providing sulfate resistance with expansion less than 0.10 percent at 6 months.

3) ASTM C595/C595M Type IP or Type IS (less than 70), tested to comply with moderate sulfate resistance option (MS).

4. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent, unless otherwise specified.
   a. Limits are stated in terms of chloride ions in percent by weight of cement.
   b. Unless otherwise permitted, provide documentation from concrete tested in accordance with ASTM C1218/C1218M at an age between 28 days and 42 days.

D. Refer to PART 1 through PART 3 of this section for additional requirements.

CONCRETE MIX DESIGN, CLASS 4000F0S1P0C0

A. Mix Locations: Concrete fill, encasements, and sidewalks.

B. Exposure Categories and Classifications: F0S1P0C0.

C. Mix Properties:

1. Limit water to cementitious materials ratio (W/Cm) in mix design to maximum value of 0.50.
2. Minimum concrete compressive strength (f'c) shall be 3,000 psi at 28 days and 4,000 psi at 56 days.
3. There are no restrictions on air content.
4. Provide cementitious materials in accordance with one of the following:
    a. ASTM C150/C150M Type II.
    b. ASTM C150/C150M types other than Type II, plus supplementary cementitious materials in accordance with one of the following:
        1) Tricalcium Aluminate Content of Total Cementitious Materials: Maximum 8 percent by weight.
        2) Provide documentation of test results in accordance with ASTM C1012/C1012M, for combinations of cementitious materials providing sulfate resistance with expansion less than 0.10 percent at 6 months.
    c. ASTM C595/C595M Type IP or Type IS (less than 70), tested to comply with moderate sulfate resistance option (MS).
        1) Provide documentation of test results in accordance with ASTM C1012/C1012M, for combinations of cementitious materials providing sulfate resistance with expansion less than 0.10 percent at 6 months.
5. Limit water-soluble, chloride-ion content in hardened concrete to 1 percent, unless otherwise specified.
    a. Limits are stated in terms of chloride ions in percent by weight of cement.
    b. Unless otherwise permitted, provide documentation from concrete tested in accordance with ASTM C1218/C1218M at an age between 28 days and 42 days.

D. Refer to PART 1 through PART 3 of this section for additional requirements.

CONCRETE MIX DESIGN, CLASS TC00F0S1P1C1

A. Mix Locations: Tremie concrete as required at steel pipe piles.

B. Exposure Categories and Classifications: F0S1P1C1.

C. Mix Properties:

1. Limit water to cementitious materials ratio (W/Cm) in mix design to maximum value of 0.42.
2. Minimum concrete compressive strength (f'c) shall be 4,000 psi at 28 days and 4,500 psi at 56 days.
3. Use natural round gravel.
4. Fine Aggregate Range: 40 percent to 50 percent of total aggregates by weight.
5. There are no restrictions on air content.
6. Proportion mix for design strength and slump range of 6 inches to 9 inches with maximum water-cement ratio.
7. Use high-range, water-reducing admixture or plasticizing admixture.
8. Use antiwashout admixture in accordance with manufacturer's recommendations.
9. Provide cementitious materials in accordance with one of the following:
    a. ASTM C150/C150M Type II; inclusion of supplementary cementitious materials in design mix is optional.
    b. ASTM C150/C150M types other than Type II, plus supplementary cementitious materials in accordance with one of the following:
        1) Tricalcium Aluminate Content of Total Cementitious Materials: Maximum 8 percent by weight.
        2) Provide documentation of test results in accordance with ASTM C1012/C1012M, for combinations of cementitious materials providing sulfate resistance with expansion less than 0.10 percent at 6 months.
    c. ASTM C595/C595M Type IP or Type IS (less than 70), tested to comply with moderate sulfate resistance option (MS).
        1) Provide documentation of test results in accordance with ASTM C1012/C1012M, for combinations of cementitious materials providing sulfate resistance with expansion less than 0.10 percent at 6 months.
10. Unless otherwise permitted, minimum cementitious materials content in mix design shall be 600 pounds per cubic yard.

11. Limit water-soluble, chloride-ion content in hardened concrete to 0.10 percent, unless otherwise specified.
    a. Limits are stated in terms of chloride ions in percent by weight of cement.

D. Refer to PART 1 through PART 3 of this section for additional requirements.

SECTION 03 39 00
CONCRETE CURING

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Concrete Institute (ACI): 308.1, Specification for Curing Concrete.
2. ASTM International (ASTM):
   a. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
   b. C1315, Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.

1.02 SUBMITTALS

A. Action Submittals:

1. Manufacturers' data indicating compliance with the requirements specified herein for the following products:
   a. Evaporation retardant.
   b. Curing compound.
2. Curing methods proposed for each type of element such as slab, walls, beams, and columns in each facility.

B. Informational Submittals:

1. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements, for the following:
   a. Curing compound showing moisture retention requirements.
   b. Retardants for exposed aggregate finish.

PART 2 PRODUCTS

2.01 MATERIALS

A. Curing Compound:

1. Water-based, high-solids content, nonyellowing, curing compound meeting requirements of ASTM C1315 Type I, Class A.

2. Manufacturers and Products:
   a. Euclid Chemical Co., Cleveland, OH; Super Diamond Clear VOX.
   b. WR Meadows, Inc., Hampshire, IL; VOCOMP-30.
   c. Vexcon Chemical, Inc.; Philadelphia, PA; Starseal 1315.
   d. Dayton Superior; Safe Cure and Seal 1315 EF.

B. Evaporation Retardant:

1. Optional: Fluorescent fugitive dye color tint that disappears completely upon drying.
2. Manufacturers and Products:
   a. BASF Construction Chemicals, Shakopee, MN; MasterKure ER 50.
   b. Euclid Chemical Co., Cleveland, OH; Eucobar.

C. Water: Clean and potable, containing less than 500 ppm of chlorides.

PART 3 EXECUTION

3.01 CONCRETE CURING

A. General:

1. Cure all concrete in accordance with project specifications and ACI 308.1.
2. Use only water curing on potable water structures.
3. Where curing compound cannot be used, water curing as described below or special methods using moisture shall be agreed upon by Engineer prior to placing concrete.
4. As required in Section 03 30 00, Cast-in-Place Concrete, if result of 7-day concrete strength test is less than 50 percent of specified 28-day strength, extend period of moist curing specified below, by 7 additional days.

B. Use one of the following methods as approved by Engineer:

1. Vertical Surfaces:
   a. Method 1: Leave concrete forms in place and keep surfaces of forms and concrete wet for 7 days.
   b. Method 2: Continuously sprinkle with water 100 percent of exposed surfaces for 7 days starting immediately after removal of forms.
   c. Method 3: Apply curing compound, where allowed, immediately after removal of forms.

2. Horizontal Surfaces:
   a. Method 1: Protect surface by water ponding for 7 days.
   b. Method 2: Cover with burlap or cotton mats and keep continuously wet for 7 days.
   c. Method 3: Continuously sprinkle exposed surface for 7 days.
   d. Method 4: Apply curing compound, where allowed, immediately after final finishing when surface will no longer be damaged by traffic.

3.02 EVAPORATION RETARDANT APPLICATION

A. Use on flatwork when environmental conditions are anticipated to cause rapid drying of the concrete surface.

B. Spray onto surface of fresh flatwork concrete immediately after screeding to react with surface moisture.

C. Reapply as needed to ensure a continuous moist surface until final finishing is completed.

END OF SECTION

SECTION 03 62 00
GROUTING

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. C230, Standard Specification for Flow Table for Use in Tests of Hydraulic Cement.
   b. C307, Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacings.
   c. C531, Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes.
   d. C579, Standard Test Methods for Compressive Grout Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes.
   e. C882, Standard Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear.
   f. C939, Standard Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method).
   g. C940, Standard Test Method for Expansion and Bleeding of Freshly Mixed Grouts for Preplaced-Aggregate Concrete in the Laboratory.
   h. C1107/C1107M, Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
   i. C1181, Standard Test Methods for Compressive Creep of Chemical-Resistant Polymer Machinery Grouts.
   j. D4263, Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.

1.02 SUBMITTALS

A. Action Submittals:

1. Product data of grouts.
2. Proposed method for keeping existing concrete surfaces wet prior to placing nonshrink grout.
3. Forming method for fluid grout placements.
4. Curing method for grout.

B. Informational Submittals:

1. Manufacturer's Written Instructions:
   a. Adding fiber reinforcing to batching.
   b. Mixing of grout.
2. Manufacturer's proposed training schedule for grout work.
3. Manufacturer's Certificate of Compliance in accordance with Section 01 61 00, Common Product Requirements.
   a. Grout free from chlorides and other corrosion-causing chemicals.
   b. Nonshrink grout properties of Category II, verifying expansion at 3 days or 14 days will not exceed the 28-day expansion and nonshrink properties are not based on gas or gypsum expansion.
4. Manufacturer's Certificate of Proper Installation.
5. Statements of Qualification: Grout manufacturer's representative.
6. Test Reports:
   a. Test report for 24-hour evaluation of nonshrink grout.
   b. Test results and service report from demonstration and training session.
   c. Field test reports and laboratory test results for field-drawn Samples.
7. List of Contractor's equipment installation staff trained by grout manufacturer's representative in:
   a. Nonshrink grout installation and curing.
   b. Epoxy grout installation and curing.

1.03 QUALIFICATIONS

A. Grout Manufacturer's Representative: Authorized and trained representative of grout manufacturer. Minimum of 1-year experience that has resulted in successful installation of grouts similar to those for this Project.

PART 2 PRODUCTS

2.01 NONSHRINK GROUT AND EPOXY GROUT SCHEDULE

A. Furnish nonshrink grout (Category I and II) and epoxy grout for applications as indicated in the following schedule:

Application	Temperature Range	Max. Placing Time	
	40 deg F to 100 deg F	20 Min.	Greater Than 20 Min.
Column baseplates	I or II		II

Application	Temperature Range	Max. Placing Time	
	40 deg F to 100 deg F	20 Min.	Greater Than 20 Min.
Machine bases 25 hp or less	II	II	II
Form Tie-Through bolt openings	II	II	II
Machine bases 26 hp and up	Epoxy Grout	Epoxy Grout	Epoxy Grout
Anchor bolt selves, baseplates and/or soleplates with vibration, thermal movement, etc.	Epoxy Grout	Epoxy Grout	Epoxy Grout

2.02 NONSHRINK GROUT

A. Category I:

1. Nonmetallic and nongas-liberating.
2. Prepackaged natural aggregate grout requiring only the addition of water.
3. Test in accordance with ASTM C1107/C1107M:
   a. Grout shall have flowable consistency.
   b. Flowable for 15 minutes.
4. Grout shall not bleed at maximum allowed water.
5. Minimum strength of flowable grout, 3,000 psi at 3 days, 5,000 psi at 7 days, and 7,000 psi at 28 days.
6. Manufacturers and Products:
   a. Euclid Chemical Co., Cleveland, OH; NS Grout.
   b. Dayton Superior Corp., Miamisburg, OH; 1107 Advantage Grout.
   c. US MIX Co., Denver, CO; US SPEC GP Grout.
   d. Five Star Products Inc., Fairfield, CT; Five Star Grout.

B. Category II:

1. Nonmetallic, nongas-liberating.
2. Prepackaged natural aggregate grout requiring only the addition of water.
3. Aggregate shall show no segregation or settlement at fluid consistency at specified times or temperatures.

4. Test in accordance with ASTM C1107/C1107M:
   a. Fluid consistency 20 seconds to 30 seconds in accordance with ASTM C939.
   b. Temperatures of 40 degrees F, 80 degrees F, and 90 degrees F.
5. 1 hour after mixing, pass fluid grout through flow cone with continuous flow.
6. Minimum strength of fluid grout, 3,500 psi at 1 day, 4,500 psi at 3 days, and 7,500 psi at 28 days.
7. Maintain fluid consistency when mixed in 1-yard to 9-yard loads in ready-mix truck.
8. Manufacturers and Products:
   a. Five Star Products Inc., Fairfield, CT; Five Star Fluid Grout 100.
   b. Euclid Chemical Co., Cleveland, OH; Hi Flow Grout.
   c. Dayton Superior Corp., Miamisburg, OH; Sure Grip High Performance Grout.
   d. US MIX Co., Denver, CO; US SPEC MP Grout.

2.03 EPOXY GROUT

A. High-strength, nonshrink, high-temperature epoxy grouting material developed for the support of heavy equipment with vibratory loads.

B. Three-component mixture of a two-component epoxy resin system (100 percent solids) with a graded, precision aggregate blend.

C. Premeasured, prepackaged system.

D. Flowable.

E. Minimum compressive strength in accordance with ASTM C579 Method B, 9,500 psi at 75 degrees F at 7 days, 11,000 psi at post cure.

F. Maximum creep resistance in accordance with ASTM C1181 at 600 psi, 140 degrees F; 6.0 by 10^{-3} in/in.

G. Minimum bond strength in accordance with ASTM C882, 2,000 psi.

H. Minimum tensile strength in accordance with ASTM C307, 2,000 psi.

I. Maximum coefficient of thermal expansion in accordance with ASTM C531 at 73 degrees F to 210 degrees F, 23.0 by 10^{-6} in/in/degrees F.

J. Working Time: Minimum 2 hours at 50 degrees F; 1.5 hours at 70 degrees F; 50 minutes at 90 degrees F.

K. Good chemical resistance.

L. Good effective bearing area.

M. Noncorrosive.

N. Moisture insensitive.

O. Modify resin and aggregate content where recommended by epoxy grout manufacturer to provide desired epoxy grout flow properties.

P. Manufacturers and Products:

1. Euclid Chemical Co., Cleveland, OH; E^3-G.
2. Dayton Superior Corp., Miamisburg, OH; Pro-Poxy 2000 Normal Set.
3. Five Star Products Inc., Fairfield, CT; DP Epoxy Grout.

PART 3 EXECUTION

3.01 GROUT

A. General: Mix, place, and cure grout in accordance with grout manufacturer's representative's training instructions.

B. Epoxy Grout: Concrete slab shall be fully cured for 28 days to ensure excess water has evaporated. Test concrete surface for moisture in accordance with ASTM D4263 before epoxy grout is placed.

C. Form Tie-Through Bolt Holes: Provide nonshrink grout, Category II, fill space with dry pack dense grout hammered in with steel tool and hammer. Through-bolt holes; coordinate dry pack dense grout application with vinyl plug in Section 03 10 00, Concrete Forming and Accessories, and bonding agent in Section 03 30 00, Cast-in-Place Concrete.

D. Form Snap-Tie Hole: Fill tie hole in accordance with requirements of Section 03 30 00, Cast-in-Place Concrete.

3.02 GROUTING MACHINERY FOUNDATIONS

A. Block out original concrete or finish off at distance shown below bottom of machinery base with grout. Prepare concrete surface by sandblasting, chipping, or by mechanical means to remove any soft material. Surface roughness in accordance with manufacturer's written instructions.

B. Clean metal surfaces of all paint, oil, grease, loose rust, and other foreign material that will be in contact with grout.

C. Sandblast to bright metal all metal surfaces in contact with epoxy grout in accordance with manufacturer's written instructions.

D. Set machinery in position and wedge to elevation with steel wedges, or use cast-in leveling bolts. Remove wedges after grout is set and pack void with grout.

E. Form with watertight forms at least 2 inches higher than bottom of plate.

F. Fill space between bottom of machinery base and original concrete in accordance with manufacturer's representative's training instructions.

G. If grout cannot be placed from one edge and flowed to the opposite edge, air vents shall be provided through the plate to prevent air entrapment.

H. Radius all corners of grout pad.

I. Install expansion joints for epoxy grout placement in accordance with manufacturer's written instructions.

3.03 FIELD QUALITY CONTROL

A. General:

1. Performed by Project representative's inspection staff.
2. Perform the following quality control inspections. The grout manufacturer's representative shall accompany the Project representative's inspection staff on the first installation of each size and type of equipment.

B. Evaluation and Acceptance of Nonshrink Grout:

1. Inspect the surface preparation of concrete substrates onto which nonshrink grout materials are to be applied, for conformance to the specified application criteria including, but not limited to, substrate profile, degree of cleanliness, and moisture.
2. Inspect preparation and application of nonshrink grout form work for conformance to the manufacturer's recommendations.
3. Conduct a final review of completed nonshrink grout installation for conformance to these Specifications.
4. Consistency: As specified in Article Nonshrink Grout. Grout with consistencies outside range requirements shall be rejected.
5. Segregation: As specified in Article Nonshrink Grout. Grout when aggregate separates shall be rejected.

6. All grout, already placed, which fails to meet the requirements of these Specifications, is subject to removal and replacement at no additional cost to the Owner.

C. Evaluation and Acceptance of Epoxy Grout:

1. Inspect ambient conditions during various phases of epoxy grouting installation for conformance with the epoxy grout manufacturer's requirements.
2. Inspect the surface preparation of concrete substrates onto which epoxy grout materials are to be applied, for conformance to the specified application criteria including, but not limited to, substrate profile, degree of cleanliness, and moisture.
3. Inspect the surface preparation of the metallic substrates onto which the epoxy primer is to be applied.
4. Inspect the epoxy-primed metallic substrate for coverage and adhesion.
5. Inspect preparation and application of epoxy grout form work for conformance to the manufacturer's recommendation.
6. Verify consistency obtained is sufficient for the proper field placement at the installed temperatures.
7. Inspect and record that the "pot life" of epoxy grout materials is not exceeded during the installation.
8. Inspect epoxy grout for cure.
9. Inspect and record that localized repairs made to grout voids are in conformance with the specification requirements.
10. Conduct a final review of completed epoxy grout installation for conformance to these Specifications.
11. All grout, already placed, which fails to meet the requirements of these Specifications, is subject to removal and replacement at no additional cost to the Owner.

3.04 MANUFACTURER'S SERVICES

A. General:

1. Coordinate demonstrations, training sessions, and applicable Site visits with grout manufacturer's representative. Allow 2-week notice to grout manufacturer's representative for scheduling purposes.
2. Provide and conduct onsite, demonstration and training sessions for bleed tests, mixing, flow cone measurement, cube testing, application, and curing for each category and type of grout.
3. Necessary equipment and materials shall be available for demonstration.

4. Conduct training prior to equipment mount installation work on equipment pads.
5. Training for each type of grout shall be not less than 4 hours' duration.

B. Epoxy Grout Training:

1. Provide epoxy grout installation training by the qualified epoxy grout manufacturer's representative for Contractor's workers that will be installing epoxy grout for equipment mounts. Schedule training to allow Engineer's attendance.
2. Include training in:
   a. Performance testing such as compressive strength testing of the epoxy grout.
   b. All aspects of using the products, from mixing to application.
3. Transport test cubes to independent test laboratory and obtain test reports.
4. Training by manufacturer's representative does not relieve Contractor of overall responsibility for this portion of the work.
5. Submit a list of attendees that have been satisfactorily trained to perform epoxy grout installation for equipment mounting.

END OF SECTION

SECTION 05 05 19
POST-INSTALLED ANCHORS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Concrete Institute (ACI):
   a. 318, Building Code Requirements for Structural Concrete.
   b. 355.2, Qualification of Post-Installed Mechanical Anchors in Concrete.
   c. 355.4, Qualification of Post-Installed Adhesive Anchors in Concrete.
2. American Iron and Steel Institute (AISI): Stainless Steel Type 316.
3. American National Standards Institute (ANSI).
4. ASTM International (ASTM):
   a. A123/A123M, Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   b. A143, Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
   c. A153/A153M, Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   d. A193/A193M, Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.
   e. A194/A194M, Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both.
   f. A380, Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
   g. A385, Practice for Providing High-Quality Zinc Coatings (Hot-Dip).
   h. A563, Specification for Carbon and Alloy Steel Nuts.
   i. A780, Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
   j. A967, Specification for Chemical Passivation Treatments for Stainless Steel Parts.
   k. E488, Standard Test Methods for Strength of Anchors in Concrete Elements.
   l. F436, Specification for Hardened Steel Washers.
   m. F468, Specification for Nonferrous Bolts, Hex Cap Screws, and Studs for General Use.

n. F568M, Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners.
o. F593, Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
p. F594, Specification for Stainless Steel Nuts.
q. F1554, Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.

5. International Association of Plumbing and Mechanical Officials Uniform ES (IAPMO-UES): Evaluation Reports for Concrete and Masonry Anchors.
6. International Code Council Evaluation Service (ICC-ES):
   a. Evaluation Reports for Concrete and Masonry Anchors.
   b. AC01, Acceptance Criteria for Expansion Anchors in Masonry Elements.
   c. AC70, Acceptance Criteria for Fasteners Power-driven into Concrete, Steel and Masonry Elements.
   d. AC106, Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements.
   e. AC193, Acceptance Criteria for Mechanical Anchors in Concrete Elements.
   f. AC308, Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements. Evaluation Reports for Concrete and Masonry Anchors.
7. Specialty Steel Industry of North America (SSINA):
   a. Specifications for Stainless Steel.
   b. Design Guidelines for the Selection and Use of Stainless Steel.
   c. Stainless Steel Fabrication.
   d. Stainless Steel Fasteners.

1.02 DEFINITIONS

A. Corrosive Area: Containment area or area exposed to delivery, storage, transfer, or use of chemicals.

B. Exterior Area: Location not protected from weather by a building or other enclosed structure to include buried roof structures.

C. Interior Dry Area: Location inside building or structure where floor is not subject to liquid spills or wash down, and where wall or roof slab is not common to a water-holding or earth-retaining structure.

D. Interior Wet Area: Location inside building or structure where floor is sloped to floor drains or gutters and is subject to liquid spills or wash down, or where wall, floor, or roof slab is common to a water-holding or earth-retaining structure.

E. Submerged: Location at or below top of wall of open water-holding structure, such as a basin or channel, or wall, ceiling, or floor surface inside a covered water-holding structure, or exterior belowgrade wall or roof surface of water-holding structure, open or covered.

1.03 SUBMITTALS

A. Action Submittals:

1. Shop Drawings: Specific instructions for concrete anchor installation, including drilled hole size and depth, preparation, placement, procedures, and instructions for safe handling of anchoring systems.

B. Informational Submittals:

1. Concrete Anchors:
   a. Manufacturer’s product description and installation instructions.
   b. Current ICC-ES or IAPMO-UES Report for each type of post-installed anchor to be used.
   c. Adhesive Anchor Installer Certification.
2. Passivation method for stainless steel members.

1.04 QUALITY ASSURANCE

A. Qualifications:

1. Installers of adhesive anchors horizontally or upwardly inclined to support sustained tension loads shall be certified by an applicable certification program. Certification shall include written and performance tests in accordance with the ACI/CRSI Adhesive Installer Certification Program or equivalent.
2. Galvanized Coating Applicator: Company specializing in hot-dip galvanizing after fabrication and following procedures of Quality Assurance Manual of the American Galvanizers Association.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Package stainless steel items in a manner to provide protection from carbon impregnation.

B. Protect hot-dip galvanized finishes from damage as a result of metal banding and rough handling.

PART 2 PRODUCTS

2.01 GENERAL

A. Unless otherwise indicated, meet the following requirements:

Item	ASTM Reference
Stainless Steel:	
Threaded Rods	F593, AISI Type 316, Condition CW
Nuts*	F594, AISI Type 316, Condition CW
Carbon Steel:	
Threaded Rods	F1554, Grade 36 or F568M Class 5.8
Flat and Beveled Washers (Hardened)	F436
Nuts*	A194/A194M, Grade 2H
Galvanized Steel:	
All	A153/A153M
*Nuts of other grades and styles having specified proof load stresses greater than specified grade and style are also suitable. Nuts must have specified proof load stresses equal to or greater than minimum tensile strength of specified threaded rod.	

B. Bolts, Washers, and Nuts: Use stainless steel, hot-dip galvanized steel, and zinc-plated steel material types as indicated in Fastener Schedule at end of this section.

2.02 POST-INSTALLED CONCRETE ANCHORS

A. General:

1. AISI Type 316 stainless, hot-dip galvanized or zinc-plated steel, as shown in Fastener Schedule at end of this section.
2. Post-installed anchor systems used in concrete shall be approved by ICC Evaluation Services Report or equivalent for use in cracked concrete and for short-term and long-term loads including wind and earthquake.
3. Mechanical Anchors: Comply with the requirements of ICC-ES AC193 or ACI 355.2.
4. Adhesive Anchors: Comply with the requirements of ICC-ES AC308 or ACI 355.4.

B. Torque-Controlled Expansion Anchors (Wedge Anchors):

1. Manufacturers and Products:
   a. Hilti, Inc., Tulsa, OK; Kwik-Bolt –TZ2 (KB-TZ2) Anchors (ESR-4266).
   b. DeWalt/Powers Fasteners, Brewster, NY; Power-Stud +SD1, +SD2, +SD4, or +SD6 Anchors (ESR-2502 and ESR-2818).
   c. Simpson Strong-Tie Co., Inc., Pleasanton, CA; Strong-Bolt 2 Anchors (ESR-1771 and ESR-3037).

C. Adhesive Anchors:

1. Threaded Rod:
   a. Diameter as shown on Drawings.
   b. Length as required to provide minimum depth of embedment indicated and thread projection required.
   c. Clean and free of grease, oil, or other deleterious material.
2. Adhesive:
   a. Two-component, insensitive to moisture, designed to be used in adverse freeze/thaw environments.
   b. Cure Temperature, Pot Life, and Workability: Compatible for intended use and anticipated environmental conditions.
3. Packaging and Storage:
   a. Disposable, self-contained system capable of dispensing both components in proper mixing ratio and fitting into a manually or pneumatically operated caulking gun.
   b. Store adhesive on pallets or shelving in a covered storage area.
   c. Package Markings: Include manufacturer’s name, product name, batch number, product expiration date, ANSI hazard classification, and appropriate ANSI handling precautions.
   d. Dispose of When:
      1) Shelf life has expired.
      2) Stored other than in accordance with manufacturer’s instructions.
4. Manufacturers and Products:
   a. Hilti, Inc., Tulsa, OK; HIT Doweling Anchor System, HIT RE 500 V3 (ESR-3814), or HIT-HY 200 (ESR-3187).
   b. Simpson Strong-Tie Co., Inc., Pleasanton, CA; SET-XP Epoxy Adhesive Anchors (ESR-2508), or AT-XP Adhesive Anchors (IAPMO UES-263).
   c. DeWalt/Powers Fasteners, Brewster NY; Pure 110+ Epoxy adhesive anchor system (ESR-3298).

PART 3 EXECUTION

3.01 CONCRETE ANCHORS

A. Begin installation only after concrete to receive anchors has attained design strength.

B. Locate existing reinforcing with Ground Penetrating Radar or other method approved by Engineer prior to drilling. Coordinate with Engineer to adjust anchor locations where installation would result in hitting reinforcing.

C. Install in accordance with written manufacturer's instructions.

D. Provide minimum embedment, edge distance, and spacing as indicated on Drawings.

E. Use only drill type and bit type and diameter recommended by anchor manufacturer.

F. Clean hole of debris and dust per manufacturer's requirements.

G. When unidentified embedded steel, rebar, or other obstruction is encountered in drill path, slant drill to clear obstruction. If drill must be slanted more than indicated in manufacturer's installation instructions to clear obstruction, notify Engineer for direction on how to proceed.

H. Adhesive Anchors:

1. Unless otherwise approved by Engineer and adhesive manufacturer:
   a. Do not install adhesive anchors when temperature of concrete is below 40 degrees F or above 100 degrees F.
   b. Do not install prior to concrete attaining an age of 21 days.
   c. Remove any standing water from hole with oil-free compressed air. Inside surface of hole shall be dry.
   d. Do not disturb anchor during recommended curing time.
   e. Do not exceed maximum torque as specified in manufacturer's instructions.

3.02 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

A. Owner-Furnished Quality Assurance, in accordance with CBC Chapter 17 requirements, is provided in the Statement of Special Inspections Plan on Drawings. Contractor responsibilities and related information are included in Section 01 45 33, Special Inspection, Observation, and Testing.

B. Contractor-Furnished Quality Control: Inspection and testing as required in Section 01 45 16.13, Contractor Quality Control.

3.03 FASTENER SCHEDULE

A. Unless indicated otherwise on Drawings, provide fasteners as follows:

Service Use and Location	**Product**	**Remarks**
1. Post-Installed Anchors for Metal Components to Cast-in-Place Concrete (such as, Ladders, Handrail Posts, Electrical Panels, Platforms, and Equipment)		
Interior Dry Areas	Anchor material type to match material being anchored (for example, stainless steel anchors to anchor stainless steel equipment, zinc-plated anchors to anchor painted equipment, galvanized anchors to anchor galvanized equipment).	Verify product acceptability and manufacturer's requirements if anchor installation will occur in an overhead application
Submerged, Exterior, Interior Wet, and Corrosive Areas	Stainless steel anchors	Verify product acceptability and manufacturer's requirements if anchor installation will occur in an overhead application
2. All Others		
All service uses and locations	Stainless steel anchors	

B. Antiseizing Lubricant: Use on all stainless steel threads.

C. Do not use adhesive anchors to support fire-resistive construction or where ambient temperature will exceed 120 degrees F.

END OF SECTION

SECTION 05 05 23
WELDING

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards that may be referenced in this section:

1. American Society of Mechanical Engineers (ASME):
   a. BPVC SEC V, Nondestructive Examination.
   b. BPVC SEC IX, Welding and Brazing Qualifications.
2. American Society of Nondestructive Testing (ASNT): SNT-TC-1A, Personnel Qualification and Certification in Nondestructive Testing.
3. ASTM International (ASTM): A370, Standard Test Methods and Definitions for Mechanical Testing of Steel Products.
4. American Welding Society (AWS):
   a. A2.4, Standard Symbols for Welding, Brazing, and Nondestructive Examination.
   b. A3.0, Standard Welding Terms and Definitions.
   c. D1.1/D1.1M, Structural Welding Code - Steel.
   d. D1.8/D1.8M, Structural Welding Code - Seismic Supplement.
   e. D1.2/D1.2M, Structural Welding Code - Aluminum.
   f. D1.3/D1.3M, Structural Welding Code - Sheet Steel.
   g. D1.4/D1.4M, Structural Welding Code - Reinforcing Steel.
   h. D1.6/D1.6M, Structural Welding Code - Stainless Steel.
   i. QC1, Standard for AWS Certification of Welding Inspectors.

1.02 DEFINITIONS

A. CJP: Complete Joint Penetration.

B. CWI: Certified Welding Inspector.

1. Contractor’s Welding Inspector: Contractor’s CWI acts for, and on behalf of, the Contractor for all inspection and quality matters within the scope of the Contract Documents. Contractor is required to provide a welding inspector to oversee welding operations and be responsible for visual inspection and necessary correction of all deficiencies in materials and workmanship required to meet referenced welding codes. This type of Quality Control Inspection is not classified as Special Inspection.
2. Verification Inspector: CWI who acts on behalf of the Owner. This type of independent inspection and testing is the prerogative of the Owner,

who may perform this function, or waive independent verification inspection if it is not required by the building official and building code.

C. MT: Magnetic Particle Testing.

D. NDE: Nondestructive Examination.

E. NDT: Nondestructive Testing.

F. PJP: Partial Joint Penetration.

G. PQR: Procedure Qualification Record.

H. PT: Liquid Penetrant Testing.

I. RT: Radiographic Testing.

J. Special Inspection: Non-destructive examination exclusive of VT. Special inspection includes NDE such as MT, PT, UT, RT and Verification Inspection. Special Inspection personnel report to, and are retained by the Owner. See additional requirements in Section 01 45 33, Special Inspection, Observation, and Testing.

K. UT: Ultrasonic Testing.

L. VT: Visual Inspection/Testing.

M. WPQ: Welder/Welding Operator Performance Qualification Record.

N. WPS: Welding Procedure Specification.

1.03 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Shop and field WPSs and PQRs.
   b. NDT procedure specifications prepared in accordance with ASME BPVC SEC V.
   c. Welding Data (Shop and Field): Submit welding data together with Shop Drawings as a complete package.
      1) Show on Shop Drawings complete information regarding base metal specification designation, location, type, size, and extent of welds with reference called out for WPS and NDE numbers in tails of combined welding and NDE symbols as indicated in AWS A2.4.

2) Field Welds: Submit a weld map identifying location of each field weld. Maintain weld map during construction.
3) Clearly distinguish between shop and field welds.
4) Indicate, by welding symbols or sketches, details of welded joints and preparation of base metal. Provide complete joint welding details showing bevels, groove angles, and root openings for welds.
5) Welding and NDE Symbols: In accordance with AWS A2.4.
6) Welding Terms and Definitions: In accordance with AWS A3.0.

B. Informational Submittals:

1. WPQs.
2. CWI credentials.
3. Testing agency personnel credentials.
4. CWI visual inspection (VT) reports.
5. Welding Documentation: Submit on forms in referenced welding codes.

1.04 QUALIFICATIONS

A. WPSs: In accordance with AWS D1.1/D1.1M (Annex J Forms) for shop or field welding; or ASME BPVC SEC IX (Forms QW-482 and QW-483) for shop welding only.

B. WPQs: In accordance with AWS D1.1/D1.1M (Annex J Forms); or ASME BPVC SEC IX (Form QW-484).

C. CWI: Certified in accordance with AWS QC1, and having prior experience with specified welding codes. Alternate welding inspector qualifications require prior approval by Engineer.

D. Testing Agency: Personnel performing tests shall be NDT Level II certified in accordance with ASNT SNT-TC-1A.

1.05 SEQUENCING AND SCHEDULING

A. Unless otherwise specified, Submittals required in this section shall be submitted and approved prior to commencement of welding operations.

B. A pre-erection conference shall be held prior to the start of field welding. Mandatory attendance is required by all Contractor’s welding and inspection personnel. Include as items for discussion: responsibilities of various parties, WPSs and shop drawings, inspection requirements and procedures (VT and other types of NDE), storage of consumables, and welding schedule.

PART 2 PRODUCTS

2.01 SOURCE QUALITY CONTROL

A. CWI shall be present whenever shop welding is performed. CWI shall perform inspection at suitable intervals, prior to assembly, during assembly, during welding, and after welding. CWI shall perform inspections as required in AWS D1.1/D1.1M or referenced welding code and as follows:

1. Verifying conformance of specified job material and proper storage.
2. Monitoring conformance with approved WPS.
3. Monitoring conformance of WPQ.
4. Inspecting weld joint fit-up and performing in-process inspection.
5. Providing 100 percent visual inspection of welds.
6. Coordinating with nondestructive testing personnel and reviewing NDE test results.
7. Maintaining records and preparing reports documenting that results of CWI VT and subsequent NDE testing comply with the Work and referenced welding codes.

PART 3 EXECUTION

3.01 GENERAL

A. Welding and Fabrication by Welding: Conform to governing welding codes referenced in attached Welding and Nondestructive Testing Table.

B. Qualify welding procedure specifications for pipe welding for notch toughness by limiting heat input; conduct charpy testing of weld metal and heat-affected zone as part of the welding procedure qualification. Conduct charpy tests on full-size specimens in accordance with ASTM A370 at a test temperature of 30 degrees F. The minimum average energy of the test coupons shall not be less than 25 foot-pounds.

3.02 NONDESTRUCTIVE WELD TESTING REQUIREMENTS

A. Quality Control Inspection:

1. All Welds: 100 percent VT by Contractor’s CWI.
2. Acceptance Criteria:
   a. Structural Pipe and Tubing: AWS D1.1/D1.1M, Paragraph 10.24.
   b. All Other Structural Steel: AWS D1.1/D1.1M, Paragraph 8.9, Visual Inspection, Statically Loaded Nontubular Connections.
   c. Stud Connections: AWS D1.1/D1.1M, Paragraph 9.7.1.

B. Nondestructive Testing Requirements:

1. NDT frequency shall be as specified below, as required by referenced welding codes, or as specified in the attached table. In case there is a conflict, the higher frequency level of NDT shall apply.
   a. Nontubular Connections:
      1) CJP Butt Joint Groove Welds: 20 percent random RT. Use UT for CJP butt joint groove welds that cannot be readily radiographed.
      2) All Other CJP Groove Welds: 20 percent random UT.
      3) Fillet Welds and PJP Groove Welds: 20 percent random PT or MT.
   b. Tubular Connections:
      1) CJP butt joint groove welds made from one side without backing: 100 percent RT or UT in accordance with AWS D1.1/D1.1M, Paragraph 10.27 and 10.28 requirements.
      2) CJP Butt Joint Groove Welds made without backing or back-gouging: 20 percent random RT. Use UT for CJP butt joint groove welds that cannot be readily radiographed.
      3) All Other CJP Groove Welds: 20 percent random UT.
      4) Fillet Welds and PJP Groove Welds: 20 percent random PT or MT.
2. NDT Procedures and Acceptance Criteria:
   a. Nontubular Connections:
      1) RT: Perform in accordance with AWS D1.1/D1.1M, Clause 8, Part E. Acceptance criteria per AWS D1.1/D1.1M, Paragraph 8.12.1.
      2) UT: Perform in accordance with AWS D1.1/D1.1M, Clause 8, Part F. Acceptance criteria per AWS D1.1/D1.1M, Paragraph 8.13.1.
      3) PT and MT:
         a) Perform on fillet and PJP groove welds in accordance with AWS D1.1/D1.1M, Paragraph 8.14.4 and Paragraph 8.14.5.
         b) Acceptance criteria per AWS D1.1/D1.1M, Paragraph 8.9, Visual Inspection, Statically Loaded Nontubular Connections.
   b. Tubular Connections:
      1) RT: Comply with requirements for Nontubular Connections and additional requirements of AWS D1.1/D1.1M, Clause 10, Paragraphs 10.27 and 10.28.

2) UT: Comply with requirements for Nontubular Connections and additional requirements of AWS D1.1/D1.1M, Clause 10, Paragraph 10.26.
3) PT and MT:
   a) Perform on fillet and PJP groove welds in accordance with AWS D1.1/D1.1M, Paragraph 8.14.4 and Paragraph 8.14.5.
   b) Acceptance criteria per AWS D1.1/D1.1M, Paragraph 10.24.

3.03 FIELD QUALITY CONTROL

A. CWI shall be present whenever field welding is performed. CWI shall perform inspection, at suitable intervals, prior to assembly, during assembly, during welding, and after welding. CWI shall perform inspections as required in AWS D1.1/D1.1M or referenced welding code and as follows:

1. Verify conformance of specified job material and proper storage.
2. Monitor conformance with approved WPS.
3. Monitor conformance of WPQ.
4. Inspect weld joint fit-up and perform in-process inspection.
5. Provide 100 percent visual inspection of all welds in accordance with Paragraph Quality Control Inspection.
6. Supervise nondestructive testing personnel and evaluating test results.
7. Maintain records and prepare report confirming results of inspection and testing comply with the Work.

3.04 WELD DEFECT REPAIR

A. Repair and retest rejectable weld defects until sound weld metal has been deposited in accordance with appropriate welding codes.

B. The cost of weld repair and retesting shall be paid for by the Contractor. After a defect is thought to have been removed, and before re-welding, examine the area by suitable methods to ensure that the defect has been eliminated. Repaired welds must meet the inspection requirements of the original welds.

3.05 SUPPLEMENTS

A. The supplement listed below, following “End of Section,” is a part of this Specification.

1. Welding and Nondestructive Testing Table.

END OF SECTION

WELDING AND NONDESTRUCTIVE TESTING						
Specification Section	**Governing Welding Codes or Standards**	**Submit WPS**	**Submit WPQ**	**Onsite CWI Req'd**	**Submit Written NDT Procedure Specifications**	**NDT Requirements**
05 12 00 Structural Steel Framing	AWS D1.1/D1.1M, Structural Welding Code - Steel	Yes	Yes	Yes	Yes	100% VT and 10% UT or RT of all groove-and-butt joint welds; 10% MT of all fillet welds; also see Section 05 12 00
05 50 00 Metal Fabrications	AWS D1.1/D1.1M, Structural Welding Code–Steel or AWS D1.2/D1.2M, Structural Welding Code - Aluminum or AWS D1.6/D1.6M, Structural Welding Code - Stainless Steel	Yes	Yes	Yes	Yes	100% VT; also see Section 05 50 00
31 62 16 Steel Piles	AWS D1.1/D1.1M, Structural Welding Code - Steel	Yes	Yes	Yes	Yes	100% VT; also see Section 31 62 16
33 05 01.01 Welded Steel Pipe and Fittings	ASME BPV Code, Section IX; and AWS D1.1/D1.1M, Structural Welding Code - Steel	Yes	Yes	Yes	Yes	100% VT; also see Section 33 05 01.01

SECTION 05 12 00
STRUCTURAL STEEL FRAMING

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Galvanizers Association (AGA): Quality Assurance Manual.
2. American Institute of Steel Construction (AISC):
   a. 201, Certification Program for Structural Steel Fabricators.
   b. 206, Certification Program for Structural Steel Erectors—Standard for Structural Steel Erectors.
   c. 303, Code of Standard Practices for Steel Buildings and Bridges.
   d. 325, Steel Construction Manual.
   e. 326, Detailing for Steel Construction.
   f. 341, Seismic Provisions for Structural Steel Buildings.
   g. 360, Specification for Structural Steel Buildings.
   h. 420, Certification Standard for Shop Application of Complex Protective Coating Systems.
3. American Welding Society (AWS):
   a. D1.1/D1.1M, Structural Welding Code—Steel.
   b. D1.8/D1.8M, Structural Welding Code—Seismic Supplement.
4. ASTM International (ASTM):
   a. A6/A6M, Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.
   b. A36/A36M, Standard Specification for Carbon Structural Steel.
   c. A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
   d. A123/123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   e. A143/A143M, Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
   f. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   g. A325, Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
   h. A384/A384M, Standard Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies.

i. A385/A385M, Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip).
j. A490, Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength.
k. A500/A500M, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
l. A563, Standard Specification for Carbons and Alloy Steel Nuts.
m. A572/A572M, Standard Specification for High-Strength Low Alloy Columbium-Vanadium Structural Steel.
n. A780/A780M, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
o. A992/A992M, Standard Specification for Structural Steel Shapes.
p. B695, Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
q. A1085/A1085M, Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS).
r. F436, Standard Specification for Hardened Steel Washers.
s. F959, Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners.
t. F1136, Standard Specification for Zinc/Aluminum Corrosion Protective Coatings for Fasteners.
u. F1852, Standard Specification for “Twist Off” Type Tension Control Structural Bolt/Nut/Washer Assemblies, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
v. F2280, Standard Specification for “Twist Off” Type Tension Control Structural Bolt/Nut/Washer Assemblies, Steel, Heat Treated, 150 ksi Minimum Tensile Strength.
w. F3125, Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions.

5. Occupational Safety and Health Administration (OSHA).
6. Research Council on Structural Connections (RCSC): Specification for Structural Joints using High-Strength Bolts.

1.02 SUBMITTALS

A. Action Submittals:

1. Provide Shop Drawing details showing:
   a. Erection plans.
   b. Members, including piece numbers, sizes, grades, dimensions, cambers, and connection details.

c. Anchor bolt layouts.
d. Hardened washer details.
e. Connection material specifications.
f. Indicate type, size, and length of bolts.
g. Joint details for complete penetration welds.
h. Indicate welds by standard AWS symbols, distinguishing between shop and field welds and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.

2. Product specifications, including primer and other coatings.
3. Designation of the members and connections that are part of the seismic force resisting system (SFRS).
4. Weld access hole dimensions, surface profile, and finish requirements.
5. Location of demand critical shop welds.
6. Gusset plates drawn to scale when they are detailed to accommodate inelastic rotation.
7. Nondestructive testing (NDT) where performed by the fabricator.
8. Welding requirements as specified in AISC 341 or AWS D1.8/D1.8M.

B. Informational Submittals:

1. Name and address of manufacturer(s).
2. Mill Certificates of tests made in accordance with ASTM A6/A6M.
3. Manufacturers' testing procedures and standards.
4. Preparation and installation or application instructions, as appropriate.
5. Proposed method to resolve misalignment between anchor bolts and bolt holes in steel members.
6. High-Strength Bolts:
   a. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements, that products meet specified chemical and mechanical requirements.
   b. Manufacturer's inspection test report results for production lot(s) furnished to include:
      1) Tensile strength.
      2) Yield strength.
      3) Reduction of area.
      4) Elongation and hardness.
   c. Certified Mill Test Reports for Bolts and Nuts:
      1) Name and address of manufacturer.
      2) Bolts correctly marked.
      3) Marked bolts and nuts used in required mill tests and manufacturer's inspection tests.
7. Welding Procedures, Qualifications, and Inspection Reports: As specified in Section 05 05 23, Welding.

8. Hot-Dip Galvanizing: Certificate of compliance signed by galvanizer with description of material processed and ASTM standard used for coating.
9. Charpy V-notch test results.
10. Nondestructive Testing (NDT) report.

1.03 QUALITY ASSURANCE

A. Qualifications:

1. Welding qualifications as specified in Section 05 05 23, Welding.
2. Galvanized Coating Applicator: Company specializing in hot-dip galvanizing after fabrication and following procedures of AGA's Quality Assurance Manual.

B. Certifications:

1. Mill identification marks, heat number, size of section, and length in accordance with ASTM A6/A6M.
2. AISC Quality Certification for Fabricator: A fabricator who participates in the AISC Certification program and is designated an AISC certified plant, Category STD.
3. AISC Quality Certification for Erector: An installer who participates in the AISC Certification program and is designated an AISC Certified Erector, Category CSE, or documented experience in erection of at least five similar structural steel facilities over past 10 years in lieu of AISC certification.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Load structural members in such a manner that they will be transported and unloaded without damage to coatings and without being excessively stressed, deformed, or otherwise damaged.

B. Storage:

1. Store materials to permit easy access for inspection and identification. Store in a dry area and keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
   a. Do not store materials in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials as directed.

2. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
   a. Fasteners may be repackaged provided testing and inspecting agency observes repackaging and sealing of containers.
   b. Clean and lubricate bolts and nuts that become dry or rusty before use.
   c. Comply with manufacturer's written recommendations for cleaning and lubricating fasteners and for retesting fasteners after lubrication.

C. Handle materials to avoid distortion or damage to members or supporting structures.

PART 2 PRODUCTS

2.01 MATERIALS

A. Rolled Plates, Shapes except W-Shapes and Bars: ASTM A36/A36M or A572/A572M, Grade 50, unless indicated otherwise.

B. W-Shapes: ASTM A992/A992M, unless indicated otherwise on Drawings.

C. Steel Pipe: ASTM A53/A53M, Grade B.

D. Round Hollow Structural Sections (HSS): ASTM A500/A500M, Grade C (Fy equals 46 ksi).

E. Square and Rectangular Hollow Structural Sections (HSS): ASTM A500/A500M, Grade C (Fy equals 50 ksi).

F. For hot-dip galvanized steel that is exposed to view and does not receive paint, limit combined phosphorus and silicon content to 0.04 percent. For steels that require a minimum of 0.15 percent silicon, such as plates over 1.5 inches thick for ASTM A36/A36M and ASTM A572/A572M steels, limit maximum silicon content to 0.21 percent and phosphorous content to 0.03 percent.

2.02 FASTENERS

A. Anchor Bolts: As specified in Section 05 50 00, Metal Fabrications.

B. Post-Installed Anchors: As specified in Section 05 05 19, Post-Installed Anchors.

C. High-Strength Bolts:

1. ASTM F3125, Grade A325, Type 1, hot-dip galvanized.
2. Bolt Length and Thread Length: As required for connection type shown, with hardened washers as required.

D. Nuts: ASTM A563, type to match bolt type and finish.

E. Hardened Steel Flat and Beveled Washers: ASTM F436, type to match bolt finish.

F. Stud Shear Connectors: As specified in Section 05 50 00, Metal Fabrications.

2.03 ANCILLARY MATERIALS

A. Surface Preparation and Primer: As specified in Section 09 90 00, Painting and Coating.

B. Grout: As specified in Section 03 62 00, Grouting.

2.04 FABRICATION

A. General:

1. Fabricate as shown and in accordance with AISC 360 and AISC 303.
2. Columns: Full-length members without splices, unless shown otherwise or approved by Engineer.
3. Mark and match mark materials for field assembly.
4. Complete assembly, including bolting and welding of units, before start of finishing operations.
5. Fabricate to agree with field measurements.
6. Fabricate beams with rolling camber up.
7. Fillet re-entrant cuts and corners to radius of not less than 1/2 inch.
8. Sheared and flame-cut edges shall be free from rough corners and projections.

B. Connections:

1. Shop Connections: Weld or bolt as shown on Drawings.
2. Meet requirements of AISC 325 for bolted double-angle shear connections, unless indicated otherwise.
3. Meet OSHA requirements for one independent bolt at beams framing in to column web connections.

C. Welded Construction:

1. As specified in Section 05 05 23, Welding.
2. Groove and Butt Joint Welds: Complete penetration, unless otherwise indicated.

D. Interface with Other Work:

1. Holes:
   a. As necessary or as indicated for securing other Work to structural steel framing, and for passage of other Work through steel framing members shall be approved by Engineer.
   b. No flame-cut holes are permitted without prior approval of Engineer.
2. Weld threaded nuts to framing members, and other specialty items to receive other Work.

2.05 FINISHES

A. Shop Paint Primer:

1. Surface Preparation and painting as specified in Section 09 90 00, Painting and Coating.
2. Do not shop prime the following surfaces, unless indicated otherwise:
   a. Within 2 inches of field-welded connections.
   b. Steel members to be completely encased in reinforced concrete or coated with cementitious fireproofing.
3. Apply shop primer to top flange surfaces of composite steel beams, unless indicated otherwise.

B. Galvanizing:

1. Fabricate steel to be galvanized in accordance with ASTM A143/A143M, ASTM A384/A384M, and ASTM A385/A385M. Avoid fabrication techniques that could cause distortion or embrittlement of steel.
2. Remove welding slag, splatter, burrs, grease, oil, paint, lacquer, and other deleterious material prior to delivery for galvanizing.
3. Remove, by blast cleaning or other methods, surface contaminants and coatings not removable by normal chemical cleaning process in galvanizing operation.
4. Hot-dip galvanize steel members, fabrications, and assemblies after fabrication in accordance with ASTM A123/A123M.
5. Hot-dip galvanize ASTM A325 bolts, nuts, washers, and hardware components in accordance with ASTM A153/A153M. Oversize holes to

allow for zinc alloy growth. Shop-assemble bolts, nuts, and washers with special lubricant and test in accordance with ASTM A325 and ASTM A563.

6. Galvanize components of bolted assemblies separately before assembly.

2.06 SOURCE QUALITY CONTROL

A. Welding:

1. Contractor's Certified Welding Inspector (CWI): Inspect and test fabrication welds as specified in Section 05 05 23, Welding.
2. Visually inspect fabrication welds in accordance with AWS D1.1/D1.1M, Section 6 and Table 6.1, Visual Inspection Acceptance Criteria.
3. An independent testing agency will be retained by Owner to perform the inspection and testing of fabrication welds as specified in Section 05 05 23, Welding.
4. Repair and retest defective welds as specified in Section 05 05 23, Welding.

B. Special inspection of fabrication process and shop welding will be provided by Owner as indicated on Drawings.

C. Hot-Dip Galvanizing:

1. An independent testing agency shall be retained by Contractor and approved by Engineer to inspect and test hot-dip galvanized fabricated items in accordance with ASTM A123/A123M and ASTM A153/A153M.
2. Visually inspect and test for thickness and adhesion of zinc coating for minimum of three test samples from each lot in accordance with ASTM A123/A123M and ASTM A153/A153M.
3. Reject and retest nonconforming articles in accordance with ASTM A123/A123M and ASTM A153/A153M.

PART 3 EXECUTION

3.01 ERECTION

A. General:

1. Meet requirements of AISC 360 and AISC 303, with exceptions as specified.

2. Install Contractor-designed temporary construction bracing to provide necessary support until components are in place and construction is complete.
3. Provide additional field connection material as required by AISC 303.
4. Splice members only where indicated and accepted on Shop Drawings.

B. Field Assembly:

1. Clean bearing surfaces and other surfaces that will be in permanent contact before assembly.
2. Set structural frames accurately to lines and elevations shown.
3. Align and adjust various members forming a part of a complete frame or structure before permanently fastening.
4. Level and plumb individual members of structure within tolerances shown in AISC 303.
5. Establish required leveling and plumbing measurements on mean operating temperature of structure. Make allowances for difference between temperature at time of erection and mean temperature at which structure will be completed and in service.
6. Perform necessary adjustments to compensate for minor discrepancies in elevations and alignment.

C. Setting Baseplates and Bearing Plates:

1. Clean concrete and masonry bearing surfaces of bond reducing materials and roughen to improve bond to surfaces.
2. Clean bottom surface of baseplates and bearing plates.
3. Set loose and attached baseplates and bearing plates for structural members on wedges, shims, leveling nuts, or other adjustable devices. Use leveling plates where indicated.
4. Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims, but if protruding, cut off flush with edge of base or bearing plate prior to placing grout. Weld plate washer to baseplate where indicated.
5. Grout Under Baseplate: As specified in Section 03 62 00, Grouting, prior to placing loads on structure.

D. Anchor Bolts:

1. Coordinate installation of anchor bolts and other connectors required for securing structural steel to in-place work.
2. Provide templates and other devices for presetting bolts and other anchors to accurate locations.

3. Projection of anchor bolts beyond face of concrete and threaded length shall be adequate to allow for full engagement of threads of hold-down nuts, adjustment of leveling nuts, washer thicknesses, and construction tolerances, unless indicated otherwise.
4. Placement Tolerances:
    a. As required by AISC 303, unless indicated otherwise.
    b. Embedded anchor bolts shall not vary from dimensions shown on Drawings by more than the following:
        1) Center-to-Center of Any Two Bolts Within an Anchor Group: 1/8 inch.
        2) Center-to-Center of Adjacent Anchor Bolt Groups: 1/4 inch.
        3) Variation from Perpendicular to Theoretical Bearing Surface: 1:50.

E. Connections:

1. High-Strength Bolted:
    a. Tighten in accordance with RCSC Specification for Structural Joints Using High-Strength Bolts.
    b. Pretension all bolts unless noted otherwise on Drawings.
    c. Hardened Washers:
        1) Provide at locations required by Washer Requirements section of RCSC Specification for Structural Joints Using High Strength Bolts, to include pretensioned and slip critical connections using slotted or oversized holes or ASTM A490 bolts.
        2) Use beveled style and extra thickness where required by RCSC Specification.
        3) Use square or rectangular beveled washers at inner flange surfaces of American Standard beams and channels.
        4) Do not substitute DTIs for hardened flat washers required at slotted and oversize holes.
    d. For snug-tightened connections (N, X), tighten to snug tight condition. Use hardened washer over slotted or oversize holes in outer plies.
2. Welded:
    a. As specified in Section 05 05 23, Welding.
    b. Groove and Butt Joint Welds: Complete penetration, unless otherwise indicated.

3.02 MISFITS

A. At Bolted Connections:

1. Immediately notify Engineer for approval of one of the following methods of correction:
   a. Ream holes that must be enlarged to admit bolts and use oversized bolts.
   b. Plug weld misaligned holes and redrill holes to admit standard size bolts.
   c. Drill additional holes in connection, conforming to AISC for bolt spacing and end and edge distances, and add additional bolts.
   d. Reject member containing misfit, incorrect sized, or misaligned holes and fabricate new member to ensure proper fit.
2. Do not enlarge incorrectly sized or misaligned holes in members by burning or by use of drift pins.

B. At Anchor Bolts:

1. Resolve misalignments between anchor bolts and bolt holes in steel members in accordance with approved Shop Drawing.
2. Do not flame cut to enlarge holes without prior approval of Engineer.

C. Gas Cutting:

1. Do not use gas cutting torches in field for correcting fabrication errors in structural framing.
2. Secondary members not under stress and concealed in finished structure may be corrected by gas cutting torches, if approved by Engineer.
3. Finish flame-cut sections equivalent to sheared and punched appearance.

3.03 REPAIR AND CLEANING

A. Clean shop primer from field welds, bolted connections, and abraded areas immediately after erection.

B. Remove and grind smooth tack welds, fit-up-lugs, and weld runoff tabs.

C. Remove weld back-up bars and grind smooth where indicated on Drawings.

D. Apply touchup paint primer by brush or spray of same thickness and material as that used in shop application and as specified in Section 09 90 00, Painting and Coating.

E. Hot-Dip Galvanized Coating Repair:

1. Conform to ASTM A780/A780M.
2. For minor repairs at abraded areas, use sprayed zinc conforming to ASTM A780/A780M.
3. For flame cut or welded areas, use zinc-based solder, or zinc sticks, conforming to ASTM A780/A780M.
4. Use magnetic gauge to determine thickness is equal to or greater than base galvanized coating.

3.04 FIELD FINISH

A. Field finish in accordance with Section 09 90 00, Painting and Coating.

3.05 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

A. Owner-Furnished Quality Assurance, in accordance with CBC Chapter 17 requirements, is provided in Statement of Special Inspections Plan on Drawings. Contractor responsibilities and related information are included in Section 01 45 33, Special Inspection, Observation, and Testing.

B. Contractor-Furnished Quality Control: Inspect and test as required in Section 01 45 16.13, Contractor Quality Control.

C. High-Strength Bolted Connections:

1. An independent testing agency will be retained by Owner to perform the following inspection and testing in accordance with the RCSC Specification for Structural Joints Using High-Strength Bolts:
   a. Marking identification and conformance to ASTM standards.
   b. Alignment of bolt holes.
   c. Placement, type, and thickness of hardened washers.
   d. Tightening of bolts.
2. Snug-Tightened Connections (N, X): Snug tight condition with plies of joint in firm contact.
3. Pretensioned Bearing and Slip Critical (SC) Connections:
   a. Conduct preinstallation test.
   b. Monitor installation and tightening of DTIs or TC bolts.
   c. Monitor condition of faying surfaces for slip critical connections.
4. Preinstallation Test:
   a. Conduct test in accordance with Specification for Structural Joints Using ASTM A325 or ASTM A490 bolts prior to using bolt tension measuring device.
   b. Select representative sample of not less than three bolts of each diameter, length, and grade.

c. Include DTIs and flat hardened washers as required to match actual connection assembly.

5. Nondestructive Testing (NDT): Inspect bolted connections and perform corrections as required to meet code acceptance criteria per RCSC Specification for Structural Joints Using ASTM A325 or ASTM A490 Bolts.
6. Defective Connections: Correct and reinspect defective and improperly tightened high-strength bolted connections. Retest pretensioned bolts as necessary to demonstrate compliance of completed work.

D. Welding:

1. Certified Welding Inspector (CWI): Inspect and test field welds as specified in Section 05 05 23, Welding.
2. Visually inspect field welds in accordance with AWS D1.1/D1.1M as specified in Section 05 05 23, Welding.
3. An independent testing agency will be retained by Owner to perform inspection and testing of field welds as specified in Section 05 05 23, Welding.
4. Repair and retest defective welds as specified in Section 05 05 23, Welding.

E. Special inspection will be provided by Owner as indicated on Drawings.

F. Stud Shear Connectors: Inspect and test stud shear connectors as specified in Section 05 50 00, Metal Fabrications.

END OF SECTION

SECTION 05 50 00
METAL FABRICATIONS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. The Aluminum Association, Inc. (AA): The Aluminum Design Manual.
2. American Galvanizers Association (AGA):
   a. Inspection of Hot-Dip Galvanized Steel Products.
   b. Quality Assurance Manual.
3. American Iron and Steel Institute (AISI): Stainless Steel Types.
4. American National Standards Institute (ANSI).
5. American Society of Safety Engineers (ASSE): A10.11, Safety Requirements for Personnel and Debris Nets.
6. American Welding Society (AWS):
   a. D1.1/D1.1M, Structural Welding Code - Steel.
   b. D1.2/D1.2M, Structural Welding Code - Aluminum.
   c. D1.6/D1.6M, Structural Welding Code - Stainless Steel.
7. ASTM International (ASTM):
   a. A36/A36M, Standard Specification for Carbon Structural Steel.
   b. A48/A48M, Specification for Gray Iron Castings.
   c. A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
   d. A108, Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
   e. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   f. A143/A143M, Standard for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
   g. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   h. A193/A193M, Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
   i. A194/A194M, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.

j. A240/A240M, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
k. A276, Standard Specification for Stainless Steel Bars and Shapes.
l. A283/A283M, Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.
m. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
n. A325, Standard Specification for Structural Bolts, Steel, Heat Treated 120/105 ksi Minimum Tensile Strength.
o. A380, Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
p. A384/A384M, Standard Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies.
q. A385/A385M, Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip).
r. A489, Standard Specification for Carbon Steel Lifting Eyes.
s. A500/A500M, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
t. A501, Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
u. A563, Standard Specification for Carbon and Alloy Steel Nuts.
v. A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
w. A780/A780, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
x. A786/A786M, Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates.
y. A793, Standard Specification for Rolled Floor Plate, Stainless Steel.
z. A967, Standard Specification for Chemical Passivation Treatments for Stainless Steel Parts.
aa. A992/A992M, Standard Specification for Structural Steel Shapes.
bb. A1085, Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS).
cc. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
dd. B308/B308M, Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.

ee. B429/B429M, Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
ff. B632/B632M, Standard Specification for Aluminum-Alloy Rolled Tread Plate.
gg. C881/C881M, Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
hh. D1056, Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber.
ii. F436, Standard Specification for Hardened Steel Washers.
jj. F468, Standard Specification for Nonferrous Bolts, Hex Cap Screws, and Studs for General Use.
kk. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
ll. F594, Standard Specification for Stainless Steel Nuts.
mm. F844, Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use.
nn. F1554, Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.

8. Occupational Safety and Health Administration (OSHA):
29 CFR 1926.502, Fall Protection Systems Criteria and Practices.
9. Specialty Steel Industry of North America (SSINA):
a. Specifications for Stainless Steel.
b. Design Guidelines for the Selection and Use of Stainless Steel.
c. Stainless Steel Fabrication.
d. Stainless Steel Fasteners.

1.02 DEFINITIONS

A. Anchor Bolt: Cast-in-place concrete anchor.

B. Exterior Area: Location not protected from weather by building or other enclosed structure.

C. Interior Dry Area: Location inside building or structure where floor is not subject to liquid spills or washdown, nor where wall or roof slab is common to a water-holding or earth-retaining structure.

D. Interior Wet Area: Location inside structure where floor is sloped to floor drains or is subject to liquid spills or washdown, or where wall, floor, or roof slab is common to a water-holding or earth-retaining structure.

E. Submerged: Location at or below top of wall of open water-holding structure, such as basin or channel, or wall, ceiling or floor surface inside a covered

water-holding structure, or exterior belowgrade wall or roof surface of water-holding structure, open or covered.

1.03 SUBMITTALS

A. Action Submittals:

1. Shop Drawings: Metal fabrications, including members, connections, welding and fastener information.
2. Samples: Color samples of abrasive stair nosings.

B. Informational Submittals:

1. Name and address of manufacturer(s).
2. Mill certificates of tests made in accordance with ASTM A6.
3. Welding Procedures, Qualification, and Inspection Reports: As specified in Section 05 05 23, Welding.
4. Passivation method for stainless steel members.
5. Galvanized coating applicator qualifications.
6. Hot-Dip Galvanizing: Certificate of compliance signed by galvanizer, with description of material processed and ASTM standard used for coating.

1.04 QUALITY ASSURANCE

A. Qualifications:

1. Welding qualifications as specified in Section 05 05 23, Welding.
2. Galvanized Coating Applicator: Company specializing in hot-dip galvanizing after fabrication and following procedures of Quality Assurance Manual of the American Galvanizers Association.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Insofar as practical, factory assemble specified items. Package assemblies, which have to be shipped unassembled to protect materials from damage and tag to facilitate identification and field assembly.

B. Package stainless steel items to provide protection from carbon impregnation.

C. Protect painted coatings and hot-dip galvanized finishes from damage as a result of metal banding and rough handling. Use padded slings and straps.

D. Store fabricated items in dry area, not in direct contact with ground.

PART 2 PRODUCTS

2.01 GENERAL

A. For hot-dip galvanized steel that is exposed to view and does not receive paint, limit the combined phosphorus and silicon content to 0.04 percent. For steels that require a minimum of 0.15 percent silicon (such as plates over 1.5 inches thick for ASTM A36/A36M steel), limit maximum silicon content to 0.21 percent and phosphorous content to 0.03 percent.

B. Unless otherwise indicated, meet the following requirements:

Item	ASTM Reference
Steel Wide Flange Shapes	A992/992M
Other Steel Shapes and Plates	A36/A36M or A572/A572M, Grade 50 or A992/A992M for other steel shapes
Steel Pipe	A53, Grade B
Hollow Structural Sections (HSS)	A500/A500M, Grade C
Aluminum:	
Aluminum Plates	B209, Alloy 6061-T6
Aluminum Structural Shapes	B308/B308M, Alloy 6061-T6
Stainless Steel:	
Bars and Angles	A276, AISI Type 316 (316L for welded connections)
Shapes	A276, AISI Type 304 (304L for welded connections)
Steel Plate, Sheet, and Strip	A240/A240M, AISI Type 316 (316L for welded connections)
Bolts, Threaded Rods, Anchor Bolts, and Anchor Studs	F593, AISI Type 316, Group 2, Condition SH
Nuts	F594, AISI Type 316, Condition CW

Item	ASTM Reference
Steel Bolts and Nuts:	
Carbon Steel	A307 bolts, with A563 nuts
High-Strength	F3125 Grade A325, Type 1 bolts, with A563 nuts
Anchor Bolts and Rods	F1554 Grade 36, with weldability supplement S1.
Eyebolts	A489
Threaded Rods	A36/A36M
Flat Washers (Unhardened)	F844
Flat and Beveled Washers (Hardened)	F436
Thrust Ties for Steel Pipe:	
Threaded Rods	A193/A193M, Grade B7
Nuts	A194/A194M, Grade 2H
Plate	A283/A283M, Grade D
Welded Anchor Studs	A108, Grades C-1010 through C-1020
Aluminum Bolts and Nuts	F468, Alloy 2024-T4
Cast Iron	A48/A48M, Class 35

C. Bolts, Washers, and Nuts: Use stainless steel, hot-dip galvanized steel, zinc-plated steel, and aluminum material types as indicated in Fastener Schedule at end of this section.

2.02 ANCHOR BOLTS AND ANCHOR BOLT SLEEVES

A. Cast-In-Place Anchor Bolts:

1. Headed type, unless otherwise shown on Drawings.
2. Material type and protective coating as shown in Fastener Schedule at end of this section.

B. Anchor Bolt Sleeves:

1. Plastic:
   a. Single unit construction with corrugated sleeve.
   b. Top of sleeve shall be self-threading to provide adjustment of threaded anchor bolt projection.
   c. Material: High-density polyethylene.
2. Fabricated Steel: ASTM A36/A36M.

2.03 POST-INSTALLED CONCRETE ANCHORS

A. See Section 05 05 19, Post-Installed Anchors.

2.04 STUD SHEAR CONNECTORS

A. Headed anchor studs (HAS), or threaded anchor studs (TAS),or stud shear connectors, as indicated on Drawings.

1. Carbon Steel: ASTM A108, Standard Quality Grades 1010 through 1020, inclusive either semikilled or killed aluminum or silicon dioxidation, unless indicated otherwise.
2. Stainless Steel: ASTM F593, AISI Type 316, Condition CW, where indicated.

B. Manufacturers:

1. Nelson Stud Welding, FabriSteel Co., Elyria, OH.
2. Stud Welding Associates, Inc., Elyria, OH.

2.05 EMBEDDED STEEL SUPPORT FRAMES FOR FLOOR PLATE AND GRATING

A. Steel angle support frames to be embedded in concrete shall be stainless steel, ASTM A276, AISI Type 316, unless indicated otherwise.

B. Welded anchors for stainless steel support frames shall also be stainless steel.

2.06 FLOOR PLATE

A. Material:

1. Aluminum: ASTM B632/B632M, Alloy 6061-T6.

B. Minimum Thickness:

1. Aluminum: 3/8 inch, unless shown otherwise on Drawings.

C. Surface: Raised-lug pattern or diamond tread, unless shown otherwise on Drawings.

D. Slip-Resistant Surface:

1. Provide on all floor plate.
2. Manufacturers and Products:
   a. IKG/Borden, Clark, NJ; MEBAC 2.
   b. W.S. Molnar Co., Detroit, MI; SLIPNOT Grade 2–Medium.

2.07 ACCESSORIES

A. Antiseizing Lubricant for Stainless Steel Threaded Connections:

1. Suitable for potable water supply.
2. Resists washout.
3. Manufacturers and Products:
   a. Bostik, Middleton, MA; Neverseez.
   b. Saf-T-Eze Div., STL Corp., Lombard, IL; Anti-Seize.

B. Neoprene Gasket:

1. ASTM D1056, 2C1, soft, closed-cell neoprene gasket material, suitable for exposure to sewage and sewage gases, unless otherwise shown on Drawings.
2. Thickness: Minimum 1/4 inch.
3. Furnish without skin coat.
4. Manufacturer and Product: Monmouth Rubber and Plastics Corporation, Long Branch, NJ; Durafoam DK1111LD.

2.08 FABRICATION

A. General:

1. Finish exposed surfaces smooth, sharp, and to well-defined lines.
2. Furnish necessary rabbets, lugs, and brackets so work can be assembled in neat, substantial manner.
3. Conceal fastenings where practical; where exposed, flush countersink.
4. Drill metalwork and countersink holes as required for attaching hardware or other materials.
5. Grind cut edges smooth and straight. Round sharp edges to small uniform radius. Grind burrs, jagged edges, and surface defects smooth.
6. Fit and assemble in largest practical sections for delivery to Site.

B. Materials:

1. Use steel shapes, unless otherwise noted.
2. Steel to be Hot-dip Galvanized: Limit silicon content to less than 0.04 percent or to between 0.15 percent and 0.25 percent.
3. Fabricate aluminum in accordance with AA Specifications for Aluminum Structures–Allowable Stress Design.

C. Welding:

1. As specified in Section 05 05 23, Welding.
2. Groove and Butt Joint Welds: Complete penetration, unless otherwise indicated.
3. Weld connections and grind exposed welds smooth. When required to be watertight, make welds continuous.
4. Welded fabrications shall be free from twisting or distortion caused by improper welding techniques.
5. Steel: Meet fabrication requirements of AWS D1.1/D1.1M, Section 7.
6. Aluminum: Meet requirements of AWS D1.2/D1.2M.
7. Stainless Steel: Meet requirements of AWS D1.6/D1.6M.
8. Complete welding before applying finish.

D. Painting:

1. Shop prime with rust-inhibitive primer as specified in Section 09 90 00, Painting and Coating, unless otherwise indicated.
2. Coat surfaces of galvanized steel and aluminum fabricated items to be in direct contact with concrete, grout, masonry, or dissimilar metals, as specified in Section 09 90 00, Painting and Coating, unless indicated otherwise.
3. Do not apply protective coating to galvanized steel anchor bolts or galvanized steel welded anchor studs, unless indicated otherwise.

E. Galvanizing:

1. Fabricate steel to be galvanized in accordance with ASTM A143/A143M, ASTM A384/A384M, and ASTM A385/A385M. Avoid fabrication techniques that could cause distortion or embrittlement of the steel.
2. Provide venting and drain holes for tubular members and fabricated assemblies in accordance with ASTM A385/A385M.
3. Remove welding slag, splatter, burrs, grease, oil, paint, lacquer, and other deleterious material prior to delivery for galvanizing.

4. Remove by blast cleaning or other methods surface contaminants and coatings not removable by normal chemical cleaning process in the galvanizing operation.
5. Hot-dip galvanize steel members, fabrications, and assemblies after fabrication in accordance with ASTM A123/A123M.
6. Hot-dip galvanize bolts, nuts, washers, and hardware components in accordance with ASTM A153/A153M. Oversize holes to allow for zinc alloy growth. Shop assemble bolts and nuts.
7. Galvanized steel sheets in accordance with ASTM A653/A653M.
8. Galvanize components of bolted assemblies separately before assembly. Galvanizing of tapped holes is not required.

F. Electrolytic Protection: Coat surfaces of galvanized steel and aluminum fabricated items to be in direct contact with concrete, grout, masonry, or dissimilar metals, as specified in Section 09 90 00, Painting and Coating, unless indicated otherwise.

G. Watertight Seal: Where required or shown, furnish neoprene gasket of a type that is satisfactory. Cover full bearing surfaces.

H. Fitting: Where movement of fabrications is required or shown, cut, fit, and align items for smooth operation. Make corners square and opposite sides parallel.

I. Accessories: Furnish as required for a complete installation. Fasten by welding or with stainless steel bolts or screws.

2.09 SOURCE QUALITY CONTROL

A. Visually inspect all fabrication welds and correct deficiencies.

1. Steel: AWS D1.1/D1.1M.
2. Aluminum: AWS D1.2/D1.2M.
3. Stainless Steel: AWS D1.6/D1.6M.

B. Hot-Dip Galvanizing:

1. Visually inspect and test for thickness and adhesion of zinc coating for minimum of three test samples from each lot in accordance with ASTM A123/A123M and ASTM A153/A153M.
2. Reject and retest nonconforming articles in accordance with ASTM A123/A123M and ASTM A153/A153M.

PART 3 EXECUTION

3.01 INSTALLATION OF METAL FABRICATIONS

A. General:

1. Meet requirements of AISC 360 and AISC 303, with exceptions as specified.
2. Install metal fabrications plumb and level, accurately fitted, free from distortion or defects.
3. Install rigid, substantial, and neat in appearance.
4. Install manufactured products in accordance with manufacturer's recommendations.
5. Obtain Engineer approval prior to field cutting steel members or making adjustments not scheduled.

B. Aluminum:

1. Do not remove mill markings from concealed surfaces.
2. Remove inked or painted identification marks on exposed surfaces not otherwise coated after installed material has been inspected and approved.
3. Fabrication, mechanical connections, and welded construction shall be in accordance with the AA Aluminum Design Manual.

C. Pipe Sleeves:

1. Provide where pipes pass through concrete or masonry.
2. Holes drilled with a rotary drill may be provided in lieu of sleeves in existing walls.
3. Provide center flange for water stoppage on sleeves in exterior or water-bearing walls.
4. Provide rubber caulking sealant or a modular mechanical unit to form watertight seal in annular space between pipes and sleeves.

D. Steel Lintels and Shelf Angles: Provide as required for support of masonry and other construction not attached to structural steel framing, unless otherwise shown on Drawings.

3.02 CAST-IN-PLACE ANCHOR BOLTS

A. Locate and hold anchor bolts in place with templates at time concrete is placed.

B. Use anchor bolt sleeves for location adjustment and provide two nuts and one washer per bolt of same material as bolt.

C. Minimum Bolt Size: 1/2-inch diameter by 12 inches long, unless otherwise shown.

3.03 MISFITS

A. At Bolted Connections:

1. Immediately notify Engineer for approval of one of the following methods of correction:
   a. Ream holes that must be enlarged to admit bolts and use oversized bolts.
   b. Plug weld misaligned holes and redrill holes to admit standard size bolts.
   c. Drill additional holes in connection, conforming to AISC for bolt spacing and end and edge distances, and add additional bolts.
   d. Reject member containing misfit, incorrect sized, or misaligned holes and fabricate new member to ensure proper fit.
2. Do not enlarge incorrectly sized or misaligned holes in members by burning or by use of drift pins.

B. At Anchor Bolts:

1. Resolve misalignments between anchor bolts and bolt holes in steel members in accordance with approved Shop Drawing.
2. Do not flame cut to enlarge holes without prior approval of Engineer.

C. Gas Cutting:

1. Do not use gas cutting torches in field for correcting fabrication errors in structural framing.
2. Secondary members not under stress and concealed in finished structure may be corrected by gas cutting torches, if approved by Engineer.
3. Finish flame-cut sections equivalent to sheared and punched appearance.

3.04 ELECTROLYTIC PROTECTION

A. Aluminum and Galvanized Steel:

1. Coat surfaces of galvanized steel and aluminum fabricated items to be in direct contact with concrete, grout, masonry, or dissimilar metals, as

specified in Section 09 90 00, Painting and Coating, unless indicated otherwise.
2. Do not apply protective coating to galvanized steel anchor bolts or galvanized steel welded anchor studs, unless indicated otherwise.
3. Allow coating to dry before installation of the material.
4. Protect coated surfaces during installation.
5. Should coating become marred, prepare and touch up in accordance with paint manufacturer's written instructions.

B. Titanium: Where titanium equipment is in contact with concrete or dissimilar metal, provide full-face neoprene insulation gasket, 3/32-inch minimum thickness and 70-durometer hardness.

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 using cleaning and passivation methods in accordance with requirements of ASTM A380 and ASTM A967.
4. Brushes used to remove foreign substances shall utilize only stainless steel or nonmetallic bristles.
5. After treatment, visually inspect surfaces for compliance.

3.05 PAINTING

A. Painted Galvanized Surfaces: Prepare as specified in Section 09 90 00, Painting and Coating.

B. Repair of Damaged Hot-Dip Galvanized Coating:

1. Conform to ASTM A780/A780M.
2. For minor repairs at abraded areas, use sprayed zinc conforming to ASTM A780/A780M.
3. For flame cut or welded areas, use zinc-based solder, or zinc sticks, conforming to ASTM A780/A780M.
4. Use magnetic gauge to determine thickness is equal to or greater than base galvanized coating.

C. Field Painting of Shop Primed Surfaces: Prepare surfaces and field finish in accordance with Section 09 90 00, Painting and Coating.

3.06 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

A. Owner-Furnished Quality Assurance:

1. In accordance with CBC Chapter 17 requirements, is provided in the Statement of Special Inspections Plan on Drawings.
2. Contractor responsibilities and related information on special inspection, observation, and testing are included in Section 01 45 33, Special Inspection, Observation, and Testing.

B. Contractor-Furnished Quality Control:

1. Inspection and testing required in Section 01 45 16.13, Contractor Quality Control.
2. Manufacturer's Certificate of Compliance per Section 01 61 00, Common Product Requirements, for test results, or calculations, or drawings that ensure material and equipment design and design criteria meet requirements of Section 01 61 00, Common Product Requirements, and Section 01 88 15, Anchorage and Bracing.

C. Stud Shear Connectors:

1. At start of each production period, conduct the following test to determine proper generator, control unit, and stud welding gun settings, in accordance with AWS D1.1/D1.1M, Chapter 9:
   a. Weld two test studs and visually inspect for full 360-degree flash.
   b. Bend test studs 30 degrees from vertical for headed anchor studs (HAS). Torque test threaded anchor studs (TAS) studs per AWS D1.1/D1.1M.
   c. Test studs will be acceptable if there is no failure of welds.
   d. If weld fails, repeat test until two consecutive test studs test to be satisfactory.
2. During production, if visual inspection reveals weld does not exhibit full 360-degree flash or that stud has been repaired by welding, conduct the following test in accordance with AWS D1.1/D1.1M, Chapter 9:
   a. Bend HAS studs or stud shear connectors approximately 15 degrees from vertical, away from missing portion of flash. For TAS studs, torque test per AWS D1.1/D1.1M.
   b. Studs meeting this test without exhibiting cracks in weld will be considered acceptable and left in bent position.
3. Replace studs failing test.
4. Special inspection shall be provided by Owner where indicated in Statement of Special Inspections Plan on Drawings.

3.07 FASTENER SCHEDULE

A. Unless indicated otherwise on Drawings, provide fasteners as follows:

Service Use and Location	Product	Remarks
1. Anchor Bolts Cast Into Concrete for Structural Steel, Metal Fabrications and Castings		
Interior Dry Areas	Anchor material type to match material being anchored (for example, stainless steel anchors to anchor stainless steel equipment, zinc-plated anchors to anchor painted equipment, galvanized anchors to anchor galvanized equipment).	
Exterior and Interior Wet Areas	Hot-dip galvanized steel headed anchor bolts	
Submerged and Corrosive Areas	Stainless steel headed anchor bolts with fusion bonded coating	See Section 09 90 00, Painting and Coating
2. Anchor Bolts Cast Into Concrete for Equipment Bases		
Interior Dry Areas	Anchor material type to match material being anchored (for example, stainless steel anchors to anchor stainless steel equipment, zinc-plated anchors to anchor painted equipment, galvanized anchors to anchor galvanized equipment).	

Service Use and Location	Product	Remarks
Submerged, Exterior, Interior Wet, and Corrosive Areas	Stainless steel headed anchor bolts with fusion bonded coating, unless otherwise specified with equipment	See Section 09 90 00, Painting and Coating
3. Post-Installed Anchors: See Section 05 05 19, Post-Installed Anchors		
4. Connections for Structural Steel Framing		
Exterior and Interior Wet and Dry Areas	High-strength steel bolted connections, ASTM A325, Type 1	Use hot-dipped galvanized high-strength bolted connections for galvanized steel framing members.
5. Connections of Aluminum Components		
Submerged, Exterior and Interior Wet and Dry Areas	Stainless steel bolted connections, unless otherwise specified with equipment	
6. All Others		
Exterior and Interior Wet and Dry Areas	Stainless steel fasteners	

B. Antiseizing Lubricant: Use on stainless steel threads.

END OF SECTION

SECTION 05 52 16
ALUMINUM RAILINGS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Aluminum Association, Incorporated (AA): DAF45, Designation System for Aluminum Finishes.
2. American Concrete Institute (ACI) 318, Building Code Requirements for Structural Concrete.
3. American Iron and Steel Institute (AISI).
4. ASTM International (ASTM):
   a. A193/A193M, Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
   b. A194/A194M, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
   c. E894, Standard Test Method for Anchorage of Permanent Metal Railing Systems and Rails for Buildings.
   d. E935, Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings.
   e. E985, Standard Specification for Permanent Metal Railing Systems and Rails for Buildings.
5. International Code Council (ICC): California Building Code (CBC).
6. Occupational Safety and Health Act (OSHA): 29 CFR 1910, Code of Federal Regulations.

1.02 DEFINITIONS

A. ICC Evaluation Services Report: ICC report on evaluation of manufactured concrete anchor systems.

B. Railings: This term includes guardrail systems, handrail systems, platform railing systems, ramp-rail systems, and stair-rail systems. Railings may be comprised of a framework of vertical, horizontal, or inclined members, grillwork or panels, accessories, or combination thereof.

C. Special Inspection: As defined by the ICC CBC.

D. Toeboards: Vertical barrier at floor level usually erected on railings along exposed edges of floor or wall openings, platforms, or ramps to prevent miscellaneous items from falling through.

1.03 DESIGN REQUIREMENTS

A. Structural Performance of Railing Systems: Design, test, fabricate, and install railings to withstand the following structural loads without exceeding allowable design working stress or allowable deflection. Apply each load to produce maximum stress and deflection in railing system components.

1. Top Rail:
   a. Capable of withstanding the following load cases applied:
      1) Concentrated load of 200 pounds applied at any point and in any direction in accordance with ICC CBC and OSHA.
      2) Uniform load of 50 pounds per linear foot applied in any direction in accordance with ICC CBC.
      3) Concentrated load need not be assumed to act concurrently with uniform loads in accordance with ICC CBC.
2. Calculated lateral deflection at top of posts shall not exceed 1 inch.

1.04 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Project-specific scaled plans and elevations of railings and detail drawings. Include railing profiles, sizes, connections, anchorage, size and type of fasteners, and accessories.
   b. Manufacturer’s literature and catalog data of railing and components.
   c. Design Data:
      1) Calculations or test data using specified design performance loads and including the following:
         a) Bending stress in, and deflection of, posts in accordance with ASTM E985 as modified herein.
         b) Design of post base connection.
         c) Documentation that concrete anchors have been designed in accordance with one of the following:
            (1) ACI 318, Chapter 17.
            (2) ICC Evaluation Services Report for selected anchor.

B. Informational Submittals:

1. Manufacturer’s assembly and installation instructions.
2. Special Inspection: Manufacturer’s instructions for Special Inspection of post-installed anchors.
3. Test Reports:
    a. Test data may supplement load calculations providing data covers complete railing system, including anchorage:
        1) Test data for railing and components showing load and deflection as a result of load, in enough detail to prove railing is strong enough and satisfies national, state, local standards, regulations, code requirements, and OSHA 29 CFR 1910, using design loads specified. Include test data for the following:
            a) Railing and post connections.
            b) Railing wall connections.
            c) Railing expansion joint connections.
        2) Testing of anchorages shall be in accordance with ASTM E894 and ASTM E935 using applied loads in accordance with ICC CBC.
        3) Deflection Criteria:
            a) In accordance with ASTM E985 and design loads specified, except as follows:
                (1) Maximum calculated lateral deflection at top of posts shall not exceed 1 inch.
        4) Aluminum Rail Piping: Test data showing yield strength of pipe as delivered equals or exceeds specified values.
4. Manufacturer’s written recommendations describing procedures for maintaining railings including cleaning materials, application methods, and precautions to be taken in use of cleaning materials.

1.05 QUALITY ASSURANCE

A. Qualifications: Calculations and drawings required for design data shall be stamped and signed by a registered civil or structural engineer licensed in California.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Package and wrap railings to prevent scratching and denting during shipment, storage, and installation. Maintain protective wrapping to the extent possible until railing is completely installed.

B. Delivery:

1. Shop assemble into practical modules of lengths for shipment.
2. Deliver toeboards loose for field assembly.
3. Deliver clear anodized railing pipe and posts with protective plastic wrap.

1.07 ENVIRONMENTAL REQUIREMENTS

A. Thermal Movements: Allow for thermal movement resulting from the following maximum range in ambient temperature in design, fabrication, and installation of railings to prevent buckling, opening up of joints, over stressing of components, connections and other detrimental effects. Base design calculation on actual surface temperature of material as a result of both solar heat gain and night time sky heat loss. Temperature change is difference between high or low temperature and installation temperature.

1. Temperature Change Range: 70 degrees F, ambient; 100 degrees F, material surfaces.

PART 2 PRODUCTS

2.01 ALUMINUM RAILINGS

A. General:

1. Furnish pre-engineered and prefabricated railing systems as shown on Drawings.
2. Railing systems using pop rivets or glued railing construction are not permitted.
3. Sand cast accessories and components are not permitted.
4. Fasteners shall be AISI Type 316 stainless steel, unless otherwise noted.

B. Rails, Posts, and Formed Elbows:

1. Extruded Alloy 6105-T5, 6061-T6, or equivalent.
2. Tensile Strength: 38,000 psi, minimum.
3. Yield Strength: 35,000 psi, minimum.
4. Wall Thickness: 0.145 inch, minimum.
5. Posts and railings shall be nominal 1-1/2 inch diameter (1.90-inch outside diameter).

C. Accessories:

1. Fittings and Accessories:
   a. Extruded, machined bar stock, permanent mold castings, or die castings of sufficient strength to meet load requirements.
   b. Gauge metal components are not acceptable for load-resisting components.
   c. Fittings shall match color of pipe in railings.
2. Miscellaneous Extruded Aluminum Parts: Alloys 6063-T6, 6061-T6, or 6105 T5 aluminum, or equivalent, and of adequate strength for all loads.
3. Castings for Railings:
   a. Cast Al-mag with sufficient strength to meet load and test requirements.
   b. Anodizable grade finish with excellent resistance to corrosion when subjected to exposure of sodium chloride solution intermittent spray and immersion.
4. Post Anchorages:
   a. Refer to standard details for types of post anchorages and minimum requirements.
   b. Bolts at anchorages shall be minimum 1/2-inch diameter.
5. Rail Terminals: Aluminum wall fitting with provision for three 3/8-inch Type 316 fasteners.
6. Toeboards:
   a. Molded or extruded Alloy 6063-T6 or 6061-T6 aluminum.
   b. Provide slotted holes for expansion and contraction where required.
7. Fasteners: Stainless steel.

D. Finishes:

1. Pipe and Post: In accordance with AA DAF45, designation AA-M32-C22-A41.
2. Cast Fittings and Toeboards: In accordance with AA DAF45, designation AA-M10-C22-A41.

2.02 ANCHOR BOLTS, FASTENERS, AND CONCRETE ANCHORS

A. Locknuts, Washers, and Screws:

1. Elastic Locknuts, Steel Flat Washers, Round Head Machine Screws (RHMS): AISI Type 316 stainless steel.
2. Flat Washers: Molded nylon.

B. Bolts and Nuts for Bolting Railing to Metal Beams: ASTM A193/A193M and ASTM A194/A194M, Type 316 stainless steel.

C. Concrete Anchors:

1. Stainless steel, AISI Type 316.
2. Post-installed anchors in accordance with Section 05 05 19, Post-Installed Anchors, unless otherwise specified herein.
3. Bolt Diameter: 1/2-inch, minimum.

2.03 FABRICATION

A. Shop Assembly:

1. Post Spacing: Maximum 6-foot horizontal spacing.
2. Railing Posts Bolted to Metal or Concrete:
   a. In lieu of field cutting, provide approved fitting with sufficient post overlap, containing provisions for vertical adjustment.
   b. Field fit-up is required.
3. Free of burrs, nicks, and sharp edges when fabrication is complete.
4. Welding is not permitted.

B. Shop/Factory Finishing:

1. Use same alloy for uniform appearance throughout fabrication for railings.
2. Railing and Post Fittings: Match fittings with color of pipe in railing.

C. Shop Assembly:

1. Shop assemble rails, posts, and formed elbows with a close tolerance for tight fit.
2. Fit dowels tightly inside posts.

D. Repair of Defective Work: Remove stains and replace defective Work.

PART 3 EXECUTION

3.01 GENERAL

A. Field fabrication of aluminum railing systems is not permitted.

B. Where required, provide railing posts longer than needed and field cut to exact dimensions required in order to satisfy vertical variations on actual structure.

C. Install railing with base that provides plus or minus 1/4-inch vertical adjustment inside base fitting. If adjustment is required in field and exceeds plus or minus 1/4-inch, reduce post length not to exceed beyond bottom of lowest set-screw or bolt in base fitting.

D. Modification to supporting structure is not permitted where railing is to be attached.

E. Protection from Entrapped Water:

1. Make provisions in exterior and interior installations subject to high humidity to drain water from railing system.
2. For posts mounted in concrete, bends, and elbows occurring at low points, drill weep holes of 1/4-inch diameter at lowest possible elevations, one hole per post or rail. Drill hole in plane of rail.

3.02 RAILING INSTALLATION

A. Assembly and Installation: Perform in accordance with manufacturer's written recommendations for installation.

B. Expansion Joints:

1. Maximum intervals of 54 feet on center and at structural joints.
2. Slip joint with internal sleeve extending 2 inches beyond each side of joint. Provide 1/2-inch slip joint gap to allow for expansion.
3. Fasten to one side using 3/8-inch diameter set-screw. Place set-screw at bottom of pipe.
4. Locate joints within 12 inches of posts. Locate expansion joints in rails that span expansion joints in structural walls and floors supporting the posts.

C. Posts and Rails:

1. Surface Mounted Posts:
   a. Bolt post baseplate connectors firmly in place.
   b. Shims, wedges, grout, and similar devices for railing post alignment not permitted.
2. Set posts plumb and aligned to within 1/8 inch in 12 feet.
3. Set rails horizontal or parallel to slope of steps to within 1/8 inch in 12 feet.
4. Install posts and rails in same plane.
5. Remove projections or irregularities and provide a smooth surface for sliding hands continuously along top rail.
6. Use offset rail for use on stairs and platforms if post is attached to web of stringers or structural platform supports.
7. Support 1-1/2 inch rails directly above stairway stringers with offset fittings.

D. Toeboard:

1. Provide at railings, except where 4-inch or higher concrete curbs are installed, at gates, or at stairways unless shown otherwise.
2. Accurately measure in field for correct length; after railing post installation cut and secure to posts.
3. Dimension between bottom of toeboard and walking surface not to exceed 1/4 inch.
4. Install plumb and aligned to within 1/8 inch in 12 feet.

3.03 FIELD FINISHING

A. Corrosion Protection: Prevent galvanic action and other forms of corrosion caused from direct contact with concrete and dissimilar metals by coating metal surfaces as specified in Section 09 90 00, Painting and Coating.

3.04 FIELD QUALITY CONTROL

A. Post-installed anchors supporting railing systems require special inspection.

B. Owner-Furnished Quality Assurance, in accordance with ICC CBC Chapter 17 requirements, is provided in the Statement of Special Inspections Plan on Drawings. Contractor responsibilities and related information are included in Section 01 45 33, Special Inspection and Testing.

C. Contractor-Furnished Quality Control: Inspection and testing as required in Section 01 45 16.13, Contractor Quality Control.

3.05 CLEANING

A. Wash railing system thoroughly using clean water and soap. Rinse with clean water.

B. Do not use acid solution, steel wool, or other harsh abrasive.

C. If stain remains after washing, restore in accordance with railing manufacturer’s recommendations or replace stained railings.

END OF SECTION

SECTION 05 53 00
METAL GRATINGS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Association of State Highway and Transportation Officials (AASHTO): Standard Specifications for Highway Bridges.
2. ASTM International (ASTM):
   a. A36/A36M, Standard Specification for Carbon Structural Steel.
   b. A666, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
   c. A1011/A1011M, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
   d. B221, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
3. National Association of Architectural Metal Manufacturers (NAAMM):
   a. MBG 531, Metal Bar Grating Manual.
   b. MBG 532, Heavy-Duty Metal Bar Grating Manual.

1.02 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Grating: Show dimensions, weight, size, and location of connections to adjacent grating, supports, and other Work.
   b. Grating Anchorage: Show details of anchorage to supports to prevent displacement from traffic impact.
   c. Product data for grating, grating clips, anchors, accessories, and other manufactured products specified herein.
   d. Manufacturer’s specifications, including coatings, surface treatment, and finishes.

B. Informational Submittals:

1. Special handling and storage requirements.
2. Installation instructions.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Insofar as is practical, factory assemble items.

B. Package and clearly tag parts and assemblies that are, due to necessity, shipped unassembled.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Materials, equipment, and accessories specified in this section shall be products of:

1. Alabama Metal Industries Corporation (AMICO), Birmingham, AL.
2. HARSCO Industrial IKG, Houston, TX.
3. Ohio Gratings, Inc., Canton, OH.

2.02 GRATING MATERIALS

A. Carbon Steel:

1. Bearing Bars, Banding, and Rectangular Cross Bars: ASTM A1011/A1011M commercial steel Type II for hot rolled carbon steel sheet and strip, or ASTM A36/A36M.
2. Cross Bars made from Wire Rods: Not permitted.
3. Finish: Galvanized after fabrication.

2.03 LIGHT DUTY METAL BAR GRATING (TYPE ‘A’)

A. General Requirements:

1. Maximum Service Load:
   a. Light Duty (Type A): 100 psf uniformly distributed load.
2. Maximum Deflection: Span/240 or 1/4 inch, whichever is less.
3. Bearing Bar Spacing:
   a. Light Duty: 1-3/16 inch maximum, center-to-center.
4. Cross Bar Spacing: 4 inches maximum, center-to-center.
5. Bearing Bars, Cross Bars and Banding: Minimum thickness as specified in NAAMM MBG 531 or as shown on Drawings.

B. Grating Materials: Galvanized steel welded, rectangular bar grating fabricated by electro-forging cross bars to bearing bars.

C. Surface:

1. Serrated.
2. When surface of bars is serrated provide 1/4-inch deeper bearing bars than shown on Drawings to maintain specified load carrying capacity of grating.

D. Stair Treads:

1. Material and Type: Same as grating material and grating type as furnished for connecting walkway or work surface.
2. Nosings: Integral ribbing and serrated edge on one long axis of tread, or nonslip abrasive on each tread along one long edge.
3. Carrier Plate or Angle: Furnish at each end for connection to stair stringers.

2.04 HEAVY-DUTY METAL BAR GRATING (TYPE ‘C’)

A. General Requirements:

1. Service Load: AASHTO Design Truck and Design Tandem (H 20 wheel load).
2. Bearing Bar Spacing: 1-7/8 inch maximum center-to-center.
3. Cross Bar Spacing: 4 inches maximum center-to-center.
4. Bearing Bars, Cross Bars, and Banding: Minimum thickness as specified in NAAMM MBG 532 or as shown on Drawings.

B. Grating Type: Galvanized steel, heavy-duty, rectangular bar grating fabricated by welding crossbars between rectangular bearing bars.

C. Surface: Plain.

2.05 ACCESSORIES

A. Embedded Frames: As indicated on Drawings and as specified in Section 05 50 00, Metal Fabrications.

B. Grating Clamps:

1. Use at flanged beam and bolted angle frame supports.
2. Removable from above grating walkway surface.
3. Provide hat bracket, recessed bolt, and bottom clamp of same material as grating.

4. Manufacturers and Products:
   a. Direct Metals Company, LLC, Kennesaw, GA; Grating Clamp.
   b. Grating Fasteners, Inc., Harvey, LA; G-Clip.

C. Anchor Stud and Saddle Clip:

1. Use at embedded angle frame supports with stud anchor and nut recessed below top of grating surface.
2. Removable from above grating walkway surface.
3. Provide Type 316 stainless steel welded threaded stud anchor, nut, washer, and saddle clip.
4. Manufacturers and Products:
   a. Welded Stud Anchor:
      1) Nelson Stud Welding, Inc., Elyria, OH.
      2) Stud Welding Associates, Inc. Elyria, OH.
   b. Saddle Clip:
      1) Direct Metals Company, LLC, Kennesaw, GA; Saddle Clip.
      2) Grating Fasteners, Inc., Harvey, LA; Saddle Clip.
      3) Struct-Fast, Inc., Baltimore, MD; Gratefast.

2.06 FABRICATION

A. General:

1. In accordance with NAAMM MBG 531 or NAAMM MBG 532.
2. Conceal fastenings where practical.
3. Drill metalwork and countersink holes as required for attaching hardware or other materials.
4. Cutouts:
   a. Fabricate in grating sections for penetrations indicated.
   b. Arrange to permit grating removal without disturbing items penetrating grating.
   c. Edge band openings in grating that interrupt four or more bearing bars with bars of same size and material as bearing bars.
5. Do not notch bearing bars at supports to maintain elevation.
6. Field measure areas to receive grating. Verify dimensions of new fabricated supports, and fabricate to dimension required for specified clearances.
7. Section Length: Sufficient to prevent section from falling through clear opening when oriented in the span direction and one end is touching either the concrete or the vertical leg of grating support.
8. Minimum Bearing: 1 inch for grating depth up to 2-1/4 inches and 2 inches for grating depth greater than 2-1/4 inches.

9. Banding and Toe Plates: Same material as grating and welded to bearing bars in accordance with requirements of NAAMM MBG 531 and NAAMM MBG 532.

B. Light-Duty (Type A) Metal Bar Grating: A single grating section shall be not less than 1.5 feet or greater than 3 feet in width, or weigh more than 150 pounds.

C. Heavy-Duty Metal Bar Grating: Minimum width of grating sections shall be 2 feet regardless of length and weight.

D. Supports:

1. Same material as grating, except that supports which are to be embedded in concrete shall be Type 316 stainless steel, unless part of an extruded aluminum system.
2. Coordinate dimensions and fabrication with grating to be supported.
3. Coordinate dimensions with increased depth due to serrations.

PART 3 EXECUTION

3.01 INSTALLATION

A. Until grating sections are securely fastened in place, area shall be appropriately barricaded or flagged to alert people working in the area of potential fall hazard.

B. Install manufactured products in accordance with manufacturer’s recommendations.

C. Install supports such that grating sections have a solid bearing on both ends, and that grating sections will not rock or wobble under design loads.

D. Install grating supports plumb and level as applicable.

E. Install sections of welded frames with anchors to straight plane without offsets.

F. Field locate and install fasteners to fit grating layout.

G. Anchor grating securely to supports using minimum of four fastener clips and bolts per grating section.

H. Each grating or plank section shall be easily removable and replaceable.

I. Completed installation shall be rigid and neat in appearance.

J. Protect painted and galvanized surfaces during installation.

K. Repair damaged coatings as specified in Section 09 90 00, Painting and Coating.

END OF SECTION

SECTION 07 92 01
SEALANTS AND CAULKING

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards that may be referenced in this section:

1. ASTM International (ASTM): C920, Standard Specification for Elastomeric Joint Sealants.

1.02 ENVIRONMENTAL REQUIREMENTS

A. Ambient Temperature: Between 40 degrees F and 80 degrees F when sealant is applied. Consult manufacturer when sealant cannot be applied within these temperature ranges.

PART 2 PRODUCTS

2.01 MATERIALS

A. Sealant Type 6: One-part polyurethane; ASTM C920, Type S, Grade NS or P, Class 25 or 35.

1. Nonsag: Sikaflex 1A or Tremco Vulkem 116.
2. Self-leveling: Sikaflex 1c SL or Tremco Vulkem 45.

B. Backup Rod: Nongassing, extruded, closed-cell, round polyethylene foam rod.

PART 3 EXECUTION

3.01 PREPARATION

A. Verify conditions are acceptable for sealants; clean, dry, sound, and free of dust and other foreign matter.

B. Mask adjacent surfaces.

3.02 INSTALLATION

A. Conform to ASTM C962.

B. Backup Rod: Install in joints wider than 3/16 inch.

C. Apply materials in accordance with manufacturer's recommendations and instructions.

D. Fill joints completely from back to face, without voids.

E. Tool joints concave.

3.03 CLEANING

A. Clean smears and other soiling caused by sealant.

B. Replace or repair to Owner's satisfaction damaged surfaces resulting from sealing or cleaning.

3.04 APPLICATION SCHEDULE

A. Type 6: Exterior joints.

END OF SECTION

SECTION 09 90 00
PAINTING AND COATING

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Water Works Association (AWWA):
   a. C203, Coal-Tar Protective Coatings and Linings for Steel Water Pipelines—Enamel and Tape—Hot-Applied.
   b. C209, Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines.
   c. C213, Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines.
   d. C214, Tape Coating Systems for the Exterior of Steel Water Pipelines.
2. Environmental Protection Agency (EPA).
3. NACE International (NACE): SP0188, Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates.
4. Occupational Safety and Health Act (OSHA).
5. Research Council on Structural Connections (RCSC): Specification for Structural Joints using High-Strength Bolts.
6. The Society for Protective Coatings (SSPC):
   a. PA 2, Procedure for Determining Conformance to Dry Coating Thickness Requirements.
   b. PA 10, Guide to Safety and Health Requirements for Industrial Painting Projects.
   c. SP 1, Solvent Cleaning.
   d. SP 2, Hand Tool Cleaning.
   e. SP 3, Power Tool Cleaning.
   f. SP 5, White Metal Blast Cleaning.
   g. SP 6, Commercial Blast Cleaning.
   h. SP 7, Joint Surface Preparation Standard Brush-Off Blast Cleaning.
   i. SP 10, Near-White Blast Cleaning.
   j. SP 11, Power Tool Cleaning to Bare Metal.
   k. SP 16, Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals.
   l. SP 13, Surface Preparation of Concrete.
   m. SP WJ-1, Waterjet Cleaning of Metals—Clean to Bare Substrate.
   n. SP WJ-2, Waterjet Cleaning of Metals—Very Thorough Cleaning.

o. SP WJ-3, Waterjet Cleaning of Metals—Thorough Cleaning.
p. SP WJ-4, Waterjet Cleaning of Metals—Light Cleaning.
q. Guide 15, Field Methods for Retrieval and Analysis of Soluble Salts on Steel and Other Nonporous Substrates.

1.02 DEFINITIONS

A. Terms used in this section:

1. Coverage: Total minimum dry film thickness in mils or square feet per gallon.
2. FRP: Fiberglass Reinforced Plastic.
3. HCl: Hydrochloric Acid.
4. MDFT: Minimum Dry Film Thickness, mils.
5. MDFTPC: Minimum Dry Film Thickness per Coat, mils.
6. Mil: Thousandth of an inch.
7. PPDS: Paint Product Data Sheet.
8. PSDS: Paint System Data Sheet.
9. PVC: Polyvinyl Chloride.
10. SFPG: Square Feet per Gallon.
11. SFPGPC: Square Feet per Gallon per Coat.
12. SP: Surface Preparation.

1.03 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Data Sheets:
      1) For each product, furnish a Paint Product Data Sheet (PPDS), the manufacturer’s technical data sheets, and paint colors available (where applicable). The PPDS form is appended to the end of this section.
      2) For each paint system, furnish a Paint System Data Sheet (PSDS). The PSDS form is appended to the end of this section.
      3) Manufacturer’s written verification that submitted material is suitable for the intended use.
      4) Technical and performance information that demonstrates compliance with specification.
      5) Furnish copies of paint system submittals to the coating applicator.
      6) Indiscriminate submittal of only manufacturer’s literature is not acceptable.

b. Detailed chemical and gradation analysis for each proposed abrasive material.
c. Applicator's Qualification: List of references substantiating experience.
d. Applicator's Quality Control Program:
    1) Verifying conforming work through inspection, process control, or a combination thereof.
    2) Producing documentation of conforming work (objective conformance).
    3) Identifying and addressing all nonconformities through Corrective Action.
e. Factory Applied Coatings: Manufacturer's certification stating factory applied coating system meets or exceeds requirements specified.

2. Samples:
    a. Reference Panel:
        1) Surface Preparation:
            a) Prior to start of surface preparation, furnish a 4-inch by 4-inch steel panel for each grade of sandblast specified herein, prepared to specified requirements.
            b) Provide panel representative of the steel used; prevent deterioration of surface quality.
            c) Panel to be reference source for inspection upon approval by Engineer.
        2) Paint:
            a) Unless otherwise specified, before painting work is started, prepare minimum 8-inch by 10-inch sample with type of paint and application specified on similar substrate to which paint is to be applied.
            b) Furnish additional samples as required until colors, finishes, and textures are approved.
            c) Approved samples to be the quality standard for final finishes.

B. Informational Submittals:

1. Applicator's Qualification: List of references substantiating experience.
2. Coating Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements.
3. Factory Applied Coatings: Manufacturer's certification stating factory applied coating system meets or exceeds requirements specified.
4. Manufacturer's written verification that submitted material is suitable for the intended use.

5. If the manufacturer of finish coating differs from that of shop primer, provide finish coating manufacturer's written confirmation that materials are compatible.
6. Manufacturer's written instructions and special details for applying each type of paint.
7. Completed Applicator's Quality Control Program forms as specified herein, but not limited to:
    a. Environmental conditions.
    b. Surface preparation.
    c. Surface contamination testing.
    d. Thickness testing.
    e. Holiday testing.

1.04 QUALITY ASSURANCE

A. Applicator Qualifications: Minimum 5 years' experience in application of specified products.

B. Regulatory Requirements:

1. Meet federal, state, and local requirements limiting the emission of volatile organic compounds.
2. Perform surface preparation and painting in accordance with recommendations of the following:
    a. Paint manufacturer's instructions.
    b. SSPC PA 10.
    c. Federal, state, and local agencies having jurisdiction.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Shipping:

1. Where precoated items are to be shipped to the Site, protect coating from damage. Batten coated items to prevent abrasion.
2. Protect shop painted surfaces during shipment and handling by suitable provisions including padding, blocking, and use of canvas or nylon slings.
3. Protect the pickled surface of stainless steel during shipment and handling by suitable provisions including padding, blocking, and use of canvas or nylon slings.

B. Storage:

1. Store products in a protected area that is heated or cooled to maintain temperatures within the range recommended by paint manufacturer.
2. Primed surfaces shall not be exposed to weather for more than 2 months before being topcoated, or less time if recommended by coating manufacturer.

1.06 PROJECT CONDITIONS

A. Environmental Requirements:

1. Do not apply paint in temperatures or moisture conditions outside of manufacturer's recommended maximum or minimum allowable.
2. Do not perform final abrasive blast cleaning whenever relative humidity exceeds 85 percent, or whenever surface temperature is less than 5 degrees F above dew point of ambient air.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Nationally recognized manufacturers of paints and protective coatings who are regularly engaged in the production of such materials for essentially identical service conditions.

B. Minimum of 5 years' verifiable experience in manufacture of specified product.

C. Each of the following manufacturers is capable of supplying most of the products specified herein:

1. Akzo Nobel (Devoe; International).
2. Carboline.
3. PPG.
4. Sherwin-Williams.
5. Tnemec.

2.02 ABRASIVE MATERIALS

A. Select abrasive type and size to produce surface profile that meets coating manufacturer's recommendations for specific primer and coating system to be applied.

2.03 PAINT MATERIALS

A. General:

1. Manufacturer's highest quality products suitable for intended service.
2. Compatibility: Only compatible materials from a single manufacturer shall be used in the Work. Particular attention shall be directed to compatibility of primers and finish coats.
3. Thinners, Cleaners, Driers, and Other Additives: As recommended by coating manufacturer.

B. Products:

Product	Definition
Acrylic Latex	Single-component, finish as required
Acrylic Latex (Flat)	Flat latex
Bituminous Paint	Single-component, coal-tar pitch based
Coal-Tar Epoxy	Amine, polyamide, or phenolic epoxy type 70% volume solids minimum, suitable for immersion service
Epoxy Primer—Ferrous Metal	Anticorrosive, converted epoxy primer containing rust-inhibitive pigments
High Build Epoxy	Polyamidoamine epoxy, minimum 69% volume solids, capability of 4 to 8 MDFT per coat
Polyurethane Enamel	Two-component, aliphatic or acrylic based polyurethane; high gloss finish

2.04 MIXING

A. Multiple-Component Coatings:

1. Prepare using each component as packaged by paint manufacturer.
2. No partial batches will be permitted.
3. Do not use multiple-component coatings that have been mixed beyond their pot life.
4. Furnish small quantity kits for touchup painting and for painting other small areas.
5. Mix only components specified and furnished by paint manufacturer.
6. Do not intermix additional components for reasons of color or otherwise, even within the same generic type of coating.

B. Colors: Formulate paints with colorants free of lead, lead compounds, or other materials that might be affected by presence of hydrogen sulfide or other gas likely to be present at Site.

2.05 SHOP FINISHES

A. Shop Blast Cleaning: Reference Paragraph Shop Coating Requirements.

B. Surface Preparation: Provide Engineer minimum 7 days' advance notice to start of shop surface preparation work and coating application work.

C. Shop Coating Requirements:

1. When required by equipment specifications, such equipment shall be primed and finish coated in shop by manufacturer and touched up in field with identical material after installation.
2. Where manufacturer's standard coating is not suitable for intended service condition, Engineer may approve use of a tie-coat to be used between manufacturer's standard coating and specified field finish. In such cases, tie-coat shall be surface tolerant epoxy as recommended by manufacturer of specified field finish coat. Coordinate details of equipment manufacturer's standard coating with field coating manufacturer.

D. Pipe:

1. Steel Pipe:
   a. Surface preparation and application of primer shall be performed by pipe manufacturer.
   b. For pipe with epoxy lining, do not place end cap seals until pipe lining material has sufficiently dried.

PART 3 EXECUTION

3.01 GENERAL

A. Provide Engineer minimum 7 days' advance notice to start of field surface preparation work and coating application work.

B. Perform the Work only in presence of Engineer, unless Engineer grants prior approval to perform the Work in Engineer's absence.

C. Schedule inspection of cleaned surfaces and all coats prior to succeeding coat in advance with Engineer.

3.02 EXAMINATION

A. Factory Finished Items:

1. Schedule inspection with Engineer before repairing damaged factory-finished items delivered to Site.
2. Repair abraded or otherwise damaged areas on factory-finished items as recommended by coating manufacturer. Carefully blend repaired areas into original finish. If required to match colors, provide full finish coat in field.

B. Surface Preparation Verification: Inspect and provide substrate surfaces prepared in accordance with these Specifications and printed directions and recommendations of paint manufacturer whose product is to be applied. The more stringent requirements shall apply.

3.03 PROTECTION OF ITEMS NOT TO BE PAINTED

A. Remove, mask, or otherwise protect hardware, lighting fixtures, switchplates, aluminum surfaces, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not specified elsewhere to be painted.

B. Provide drop cloths to prevent paint materials from falling on or marring adjacent surfaces.

C. Protect working parts of mechanical and electrical equipment from damage during surface preparation and painting process.

D. Mask openings in motors to prevent paint and other materials from entering.

E. Protect surfaces adjacent to or downwind of Work area from overspray.

3.04 SURFACE PREPARATION

A. Field Abrasive Blasting:

1. Perform blasting for items and equipment where specified and as required to restore damaged surfaces previously shop or field blasted and primed or coated.
2. Refer to coating systems for degree of abrasive blasting required.
3. Where the specified degree of surface preparation differs from manufacturer’s recommendations, the more stringent shall apply.

B. Surface Contamination Testing:

1. A surface contamination analysis test shall be performed every 500 square feet by means of a Chlor Test CSN Salts, or approved equivalent.
2. Surface with chloride levels exceeding 3 µg/square centimeter for submerged surfaces and 5 µg/square centimeter for exposed surfaces shall be treated with a liquid soluble salt remover equivalent to CHLOR*RID (CHLOR*RID International, Chandler, AZ).
3. Follow manufacturer's recommendations and procedures for the use of this product to remove the surface contamination.

C. Metal Surface Preparation:

1. Where indicated, meet requirements of SSPC Specifications summarized below:
   a. SP 1, Solvent Cleaning: Removal of visible oil, grease, soil, drawing and cutting compounds, and other soluble contaminants by cleaning with solvent.
   b. SP 5, White Metal Blast Cleaning: Removal of visible oil, grease, dust, dirt, mill scale, rust, coatings, oxides, corrosion products, and other foreign matter by blast cleaning.
   c. SP 6, Commercial Blast Cleaning: Removal of visible oil, grease, dust, dirt, mill scale, rust, coatings, oxides, corrosion products, and other foreign matter, except for random staining limited to no more than 33 percent of each unit area of surface which may consist of light shadows, slight streaks, or minor discolorations caused by stains of rust, stains of mill scale, or stains of previously applied coatings.
   d. SP 7, Brush-Off Blast Cleaning: Removal of visible rust, oil, grease, soil, dust, loose mill scale, loose rust, and loose coatings. Tightly adherent mill scale, rust, and coating may remain on surface.
   e. SP 10, Near-White Blast Cleaning: Removal of visible oil, grease, dust, dirt, mill scale, rust, coatings, oxides, corrosion products, and other foreign matter, except for random staining limited to no more than 5 percent of each unit area of surface which may consist of light shadows, slight streaks, or minor discolorations caused by stains of rust, stains of mill scale, or stains of previously applied coatings.
   f. SP 16, Brush Blasting of Non-Ferrous Metals: A brush-off blast cleaned non-ferrous metal surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, metal oxides (corrosion products), and other foreign matter. Intact,

tightly adherent coating is permitted to remain. A coating is considered tightly adherent if it cannot be removed by lifting with a dull putty knife. Bare metal substrates shall have a minimum profile of 19 micrometers (0.75 mil).

2. The words “solvent cleaning”, “hand tool cleaning”, “wire brushing”, and “blast cleaning”, or similar words of equal intent in these Specifications or in paint manufacturer’s specification refer to the applicable SSPC Specification.
3. Where OSHA or EPA regulations preclude standard abrasive blast cleaning, wet or vacu-blast methods may be required. Coating manufacturers’ recommendations for wet blast additives and first coat application shall apply.
4. Ductile Iron Pipe Supplied with Asphaltic Varnish Finish: Remove asphaltic varnish finish prior to performing specified surface preparation.
5. Hand tool clean areas that cannot be cleaned by power tool cleaning.
6. Round or chamfer sharp edges and grind smooth burrs, jagged edges, and surface defects.
7. Welds and Adjacent Areas:
    a. Prepare such that there is:
        1) No undercutting or reverse ridges on weld bead.
        2) No weld spatter on or adjacent to weld or any area to be painted.
        3) No sharp peaks or ridges along weld bead.
    b. Grind embedded pieces of electrode or wire flush with adjacent surface of weld bead.
8. Preblast Cleaning Requirements:
    a. Remove oil, grease, welding fluxes, and other surface contaminants prior to blast cleaning.
    b. Cleaning Methods: Steam, open flame, hot water, or cold water with appropriate detergent additives followed with clean water rinsing.
    c. Clean small isolated areas as above or solvent clean with suitable solvent and clean cloth.
9. Blast Cleaning Requirements:
    a. Type of Equipment and Speed of Travel: Design to obtain specified degree of cleanliness. Minimum surface preparation is as specified herein and takes precedence over coating manufacturer’s recommendations.
    b. Select type and size of abrasive to produce surface profile that meets coating manufacturer’s recommendations for particular primer to be used.
    c. Use only dry blast cleaning methods.
    d. Do not reuse abrasive, except for designed recyclable systems.

e. Meet applicable federal, state, and local air pollution and environmental control regulations for blast cleaning, confined space entry (if required), and disposition of spent aggregate and debris.

10. Post-Blast Cleaning and Other Cleaning Requirements:
    a. Clean surfaces of dust and residual particles from cleaning operations by dry (no oil or water vapor) air blast cleaning or other method prior to painting. Vacuum clean enclosed areas and other areas where dust settling is a problem and wipe with a tack cloth.
    b. Paint surfaces the same day they are blasted. Reblast surfaces that have started to rust before they are painted.

D. Galvanized Metal, Copper, and Nonferrous Metal Alloy Surface Preparation:

1. Remove soil, cement spatter, and other surface dirt with appropriate hand or power tools.
2. Brush blast in accordance with SSPC SP 16.
3. Obtain and follow coating manufacturer's recommendations for additional preparation that may be required.

E. Stainless Steel Items that will not Receive a Coating:

1. Check surface for scuffs or damage to ensure pickling remains intact. If any of the following are observed on the surface of pickled stainless steel, then that area must be repaired:
    a. Rough surface.
    b. Smut or discoloration.
2. If the pickled surface is not fully intact, then the damaged areas shall be repaired using the following procedures:
    a. Inspect the repair area to ensure that all surfaces not being repaired have been protected.
    b. Preclean surface by removing all oil and grease using a hot water pressure washer or a mild detergent cleaner. Rinse with a pressure washer using cold water.
    c. If the repair area is large, consider using a spray applied pickling agent (typically nitric or hydrofluoric acid). If the repair area is small, then consider the use of a brush applied pickling paste.
    d. Spread pickling chemical evenly over the repair zone.
    e. Typical pickling time for Type 304L and Type 316L stainless steel varies from 40 minutes at 68 degrees F to 30 minutes at 86 degrees F.

f. The Pickling Spray must not be allowed to dry. Drying may cause discoloration of the steel surface and deposition of smut. If drying occurs, clean surface and re-apply as necessary.
g. After an appropriate amount of time has passed, remove any remaining pickling agents from the surface of the stainless steel by first prewashing at tap water pressure to reduce acid splashing before thoroughly rinsing the surface using high pressure cold water.

F. Plastic and FRP Surface Preparation:

1. Hand sand plastic surfaces to be coated with medium grit sandpaper to provide tooth for coating system.
2. Large areas may be power sanded or brush-off blasted, provided sufficient controls are employed so surface is roughened without removing excess material.

3.05 SURFACE CLEANING

A. Brush-off Blast Cleaning:

1. Equipment, procedure, and degree of cleaning shall meet requirements of SSPC SP 7.
2. Abrasive: Either wet or dry blasting sand, grit, or nutshell.
3. Select various surface preparation parameters, such as size and hardness of abrasive, nozzle size, air pressure, and nozzle distance from surface such that surface is cleaned without pitting, chipping, or other damage.
4. Verify parameter selection by blast cleaning a trial area that will not be exposed to view.
5. Engineer will review acceptable trial blast cleaned area and use area as a representative sample of surface preparation.
6. Repair or replace surface damaged by blast cleaning.

B. Solvent Cleaning:

1. Consists of removal of foreign matter such as oil, grease, soil, drawing and cutting compounds, and any other surface contaminants by using solvents, emulsions, cleaning compounds, steam cleaning, or similar materials and methods that involve a solvent or cleaning action.
2. Meet requirements of SSPC SP 1.

3.06 APPLICATION

A. General:

1. The intention of these Specifications is for new, exterior metal, and submerged metal surfaces to be painted, whether specifically mentioned or not, except as specified otherwise. Do not paint exterior concrete surfaces, unless specifically indicated.
2. Extent of Coating (Immersion): Coatings shall be applied to internal vessel and pipe surfaces, nozzle bores, flange gasket sealing surfaces, carbon steel internals, and stainless steel internals, unless otherwise specified.
3. For coatings subject to immersion, obtain full cure for completed system. Consult coatings manufacturer's written instructions for these requirements. Do not immerse coating until completion of curing cycle.
4. Apply coatings in accordance with these Specifications and paint manufacturers' printed recommendations and special details. The more stringent requirements shall apply. Allow sufficient time between coats to assure thorough drying of previously applied paint.
5. Sand wood lightly between coats to achieve required finish.
6. Vacuum clean surfaces free of loose particles. Use tack cloth just prior to applying next coat.
7. Fusion Bonded Coatings Method Application: Electrostatic, fluidized bed, or flocking.
8. Coat units or surfaces to be bolted together or joined closely to structures or to one another prior to assembly or installation.
9. On pipelines, terminate coatings along pipe runs to 1 inch inside pipe penetrations.
10. Keep paint materials sealed when not in use.
11. Where more than one coat is applied within a given system, alternate colors to provide a visual reference showing required number of coats have been applied.

B. Stripe Coating:

1. Stripe coat all field welds, edges, angles, fasteners, and other irregular surfaces in immersion service.
2. Stripe coat shall consist of one coat, brush applied, to the coating thickness specified.
3. Apply stripe coat between intermediate and final coats.
4. Stripe coat color shall contrast intermediate coat to allow visual verification of application.

C. Galvanized Metal, Copper, and Nonferrous Metal Alloys:

1. Concealed galvanized, copper, and nonferrous metal alloy surfaces (behind building panels or walls) do not require painting, unless specifically indicated herein.
2. Prepare surface and apply primer in accordance with System No. 10 specification.
3. Apply intermediate and finish coats of the coating system appropriate for the exposure.

D. Film Thickness and Coverage:

1. Number of Coats:
   a. Minimum required without regard to coating thickness.
   b. Additional coats may be required to obtain minimum required paint thickness, depending on method of application, differences in manufacturers' products, and atmospheric conditions.
2. Application Thickness:
   a. Do not exceed coating manufacturer's recommendations.
   b. Measure using a wet film thickness gauge to ensure proper coating thickness during application.
3. Film Thickness Measurements and Electrical Inspection of Coated Surfaces:
   a. Perform with properly calibrated instruments.
   b. Recoat and repair as necessary for compliance with specification.
   c. Coats are subject to inspection by Engineer and coating manufacturer's representative.
4. Visually inspect concrete, masonry, nonferrous metal, plastic, and wood surfaces to ensure proper and complete coverage has been attained.
5. Give particular attention to edges, angles, flanges, and other similar areas, where insufficient film thicknesses are likely to be present, and ensure proper millage in these areas.
6. Apply additional coats as required to achieve complete hiding of underlying coats. Hiding shall be so complete that additional coats would not increase the hiding.

3.07 PROTECTIVE COATINGS SYSTEMS AND APPLICATION SCHEDULE

A. Unless otherwise shown or specified, paint surfaces in accordance with the following application schedule. In the event of discrepancies or omissions in the following, request clarification from Engineer before starting work in question.

B. System No. 1 Submerged Metal:

Surface Prep.	Paint Material	Min. Coats, Cover
SP 5, White Metal Blast Cleaning	High Build Epoxy	3 coats, 4 MDFTPC, Stripe coat (4 MDFT), between second and third coats, all edges, welds, and irregular surfaces.

1. Use on the following items or areas:
   a. Metal surfaces new below a plane 1-foot above the maximum liquid surface; metal surfaces above the maximum liquid surface that are a part of the immersed equipment; surfaces of metallic items, such as wall pipes, pipes, pipe sleeves, access manholes, gate guides and thimbles, and structural steel that are embedded in concrete; and the following specific surfaces:
      1) Interior surfaces of steel piping noted in the Piping Schedule.
      2) Structural steel, including piles, below elevation 32.00. System No. 1 can be used for structural steel above elevation 32.00.
      3) Surfaces as specified in Section 44 42 56.23, Mixed Flow Irrigation Pumps.
      4) Weir troughs.

C. System No. 4 Exposed Metal—Highly Corrosive:

Surface Prep.	Paint Material	Min. Coats, Cover
SP 10, Near-White Blast Cleaning	Epoxy Primer—Ferrous Metal	1 coat, 2.5 MDFT
	High Build Epoxy	1 coat, 4 MDFT
	Polyurethane Enamel	1 coat, 3 MDFT

1. Use on the following items or areas:
   a. Exposed non-galvanized metal surfaces, new and located inside or outside of structures and exposed to weather and the following specific surfaces:
      1) Structural steel above elevation 32.00.
      2) Exposed portions of steel pipe.
      3) Steel pipe posts.
      4) As indicated on Drawings.

D. System No. 7 Concrete Encased Metal:

Surface Prep.	Paint Material	Min. Coats, Cover
SP 6, Commercial Blast Cleaning	Coal-Tar Epoxy	2 coats, 16 MDFT

1. Use on the following items or areas:
   a. Use on concrete encased ferrous and non-ferrous metals including wall pipes, pipe sleeves, access manholes, gate guides, and thimbles.

E. System No. 8 Buried Metal—General:

Surface Prep.	Paint Material	Min. Coats, Cover
SP 10, Near-White Blast Cleaning	High Build Epoxy	2 coats, 16 MDFT

1. Use on the following items or areas:
   a. Buried, below grade portions of steel items, except buried stainless steel or ductile iron.

F. System No. 10 Galvanized Metal, Copper, and Nonferrous Metal Alloy Conditioning:

Surface Prep.	Paint Material	Min. Coats, Cover
In accordance with Paragraph Galvanized Metal, Copper, and Nonferrous Metal Alloy Surface Preparation	Epoxy Primer—Other Finish Coat with System No. 1, No. 4, No. 7, or No. 8 as required based on exposure	As recommended by coating manufacturer Remaining coats as required for exposure

1. Use on the following items or areas:
   a. Galvanized surfaces requiring painting, and the following specific surfaces:
      1) As specified in Section 05 50 00, Metal Fabrications.
      2) Galvanized surfaces buried or in contact with concrete.
   b. After application of System No. 10, apply finish coats as required for exposure.

G. System No. 25 Exposed FRP, PVC:

Surface Prep.	Paint Material	Min. Coats, Cover
In accordance with Paragraph Plastic and FRP Surface Preparation	Acrylic Latex Semigloss, Gloss, or Flat	2 coats, 320 SFPGPC

1. Use on the following items or areas:
   a. All exposed-to-view PVC and CPVC surfaces, and FRP surfaces without integral UV-resistant gel coat.

H. System No. 27 Aluminum and Dissimilar Metal Insulation:

Surface Prep.	Paint Material	Min. Coats, Cover
Solvent Clean (SP 1)	Prime in accordance with manufacturer's recommendations	
	Bituminous Paint	1 coat, 10 MDFT

1. Use between contact surfaces of dissimilar metals, and on aluminum surfaces embedded or in contact with concrete.

I. System No. 29 Fusion Bonded Coating:

Surface Prep.	Paint Material	Min. Coats, Cover
SP 10, Near-White Blast Cleaning	Fusion Bonded Coating 100% Solids Epoxy	1 or 2 coats, 7 MDFT

1. For steel pipe and fittings, meet all requirements of AWWA C213.
2. Use on the following items:
   a. Stainless steel headed anchor bolts as indicated in Section 05 50 00, Metal Fabrications.

3.08 COLORS

A. Owner requires that all topcoats have a black color. Please provide all coating topcoats with a black color unless explicit approval is given by the Owner.

3.09 FIELD QUALITY CONTROL

A. Thickness Testing:

1. Measure coating thickness specified in mils with a magnetic type, dry film thickness gauge, in accordance with SSPC PA 2.
2. Acceptable gauges available from Defelsko, Nordson.
3. Check each coat for correct millage. Do not make measurement before a minimum of 8 hours after application of coating.

B. Holiday Testing:

1. Holiday detect coatings subject to immersion service on 100 percent of the surfaces.
    a. Thin Film Coatings:
        1) Holiday detect coatings 20 mils thick or less, except zinc primer and galvanizing, with low voltage wet sponge electrical holiday detector in accordance with NACE SP0188.
        2) Equipment: Tinker and Rasor Model M-1, TQC Low-Voltage Pinhole Detector.
    b. Thick Film Coatings:
        1) Holiday detect coatings in excess of 20 mils dry film thickness with high voltage spark tester as recommended by coating manufacturer and in accordance with NACE SP0188.
        2) Equipment: As recommended by the coating manufacturer.
2. Coatings with pinholes/holidays are subject to rejection and require repair/recoat.

C. Inspection: Leave staging and lighting in place until Engineer has inspected surface or coating. Replace staging removed prior to approval by Engineer. Provide additional staging and lighting as requested by Engineer.

D. Unsatisfactory Application:

1. If item has an improper finish color or insufficient film thickness, clean surface and topcoat with specified paint material to obtain specified color and coverage. Obtain specific surface preparation information from coating manufacturer.
2. Evidence of runs, bridges, shiners, laps, or other imperfections is cause for rejection.
3. Repair defects in accordance with written recommendations of coating manufacturer.

E. Damaged Coatings, Pinholes, and Holidays:

1. Hand or power sand visible areas of chipped, peeled, or abraded paint, and feather edges. Follow with primer and finish coat. Depending on extent of repair and appearance, a finish sanding and topcoat may be required.
2. Remove rust and contaminants from metal surface. Provide surface cleanliness and profile in accordance with surface preparation requirements for specified paint system.
3. Feather edges and repair in accordance with recommendations of paint manufacturer.
4. Apply finish coats, including touchup and damage-repair coats in a manner that will present a uniform texture and color-matched appearance.

3.10 MANUFACTURER'S SERVICES

A. In accordance with Section 01 43 33, Manufacturers' Field Services, coating manufacturer's representative shall be present at Site as follows:

1. On first day of application of any coating system.
2. A minimum of two additional Site inspection visits, each for a minimum of 4 hours, in order to provide Manufacturer's Certificate of Proper Installation.
3. As required to resolve field problems attributable to or associated with manufacturer's product.
4. To verify full cure of coating prior to coated surfaces being placed into immersion service.

3.11 CLEANUP

A. Place cloths and waste that might constitute a fire hazard in closed metal containers or destroy at end of each day.

B. Upon completion of the Work, remove staging, scaffolding, and containers from Site or destroy in a legal manner.

C. Remove paint spots, oil, or stains upon adjacent surfaces and floors and leave entire job clean.

3.12 SUPPLEMENTS

A. The supplements listed below, following “End of Section,” are a part of this Specification:

1. Paint System Data Sheet (PSDS).
2. Paint Product Data Sheet (PPDS).

END OF SECTION

PAINT SYSTEM DATA SHEET (PSDS)

Complete this PSDS for each coating system, include all components of the system (surface preparation, primer, intermediate coats, and finish coats). Include all components of a given coating system on a single PSDS.

Paint System Number (from Spec.):		
Paint System Title (from Spec.):		
Coating Supplier:		
Representative:		
Surface Preparation:		
Paint Material (Generic)	**Product Name/Number (Proprietary)**	**Min. Coats, Coverage**

PAINT PRODUCT DATA SHEET (PPDS)

Complete and attach manufacturer's Technical Data Sheet to this PPDS for each product submitted. Provide manufacturer's recommendations for the following parameters at temperature (F)/relative humidity:

Temperature/RH	50/50	70/30	90/25
Induction Time			
Pot Life			
Shelf Life			
Drying Time			
Curing Time			
Min. Recoat Time			
Max. Recoat Time			

Provide manufacturer's recommendations for the following:

Mixing Ratio: _____

Maximum Permissible Thinning: _____

Ambient Temperature Limitations: min.: _____ max.: _____

Surface Temperature Limitations: min.: _____ max.: _____

Surface Profile Requirements: min.: _____ max.: _____

Attach additional sheets detailing manufacturer's recommended storage requirements and holiday testing procedures.

SECTION 09 97 13.01
PIPELINE TAPE COATING

PART 1 GENERAL

1.01 REQUIREMENTS

A. Provide shop-applied, multi-layer tape coating system for the exterior of buried steel pipelines.

B. Except as described in this section, conform to ANSI/AWWA C214 for straight pipe sections and ANSI/AWWA C209 for fittings and specials.

1.02 REFERENCES

A. The following is a list of standards that may be referenced in this section.

1. American Water Works Association (AWWA):
   a. C205, Cement-Mortar Protective Lining and Coating for Steel Water Pipe 4 In. (100 mm) and Larger—Shop Applied.
   b. C209, Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines.
   c. C214, Tape Coating Systems for the Exterior of Steel Water Pipelines.
2. ASTM International (ASTM): D1000, Methods of Testing Pressure-Sensitive Adhesive Coated Tapes Used for Electrical Insulation.
3. NACE International (NACE): SP0274, High Voltage Electrical Inspection of Pipeline Coatings Prior to Installation.
4. NSF International (NSF):
   a. 61, Drinking Water System Components - Health Effects.
   b. 372, Drinking Water System Components - Lead Content.
5. Society for Protective Coatings (SSPC) Surface Preparation Standards:
   a. SP-1, Solvent Cleaning Surface Preparation.
   b. SP-2, Hand Tool Cleaning Surface Preparation.
   c. SP-3, Power Tool Cleaning Surface Preparation.
   d. SP-6, Commercial Abrasive Blast Surface Preparation.
   e. SP-5, White Metal Abrasive Blast Surface Preparation.
   f. SP-10, Near White Metal Abrasive Blast Surface Preparation.
   g. SSPC Paint Application Guides: PA 2, Measurement of Dry Coating Thickness with Magnetic Gages.

1.03 DEFINITIONS

A. Manufacturer’s Representative: Employee of manufacturer who is factory trained and knowledgeable in technical aspects of their products and systems.

1.04 SUBMITTALS

A. Action Submittals:

1. Coating Materials List: Tape coating materials indicating manufacturer, products, and thickness.
2. Materials Information: Technical data sheets with technical and performance information indicating compliance with requirements of this section and reference standards.

B. Informational Submittals:

1. Samples of tape materials. Identify each sample with catalog number, size, color, and other information.
2. Shop and Field Applicator’s Quality Control Program: Submit Quality Control Plan in accordance with Section 01 45 16.13, Contractor Quality Control.

1.05 QUALITY ASSURANCE

A. Perform coating work in the presence of Engineer, unless otherwise approved by Owner.

B. Coating Applicator's Experience and Certification: Certified by the coating manufacturer as an approved applicator and having a minimum of 5 years’ experience installing the submitted coating system.

C. Provide a qualified technical representative, employed by the coating manufacturer, in the shop and the field for 1 day, minimum, at the start of coating application. During this visit, the manufacturer’s representative will conduct observations and tests as required to ensure that coating application is in conformance with their recommended methods and conditions.

D. Provide additional visits by the manufacturer’s representative at sufficient intervals during surface preparation and coating application as may be required for product application quality assurance, and to determine compliance with manufacturer’s instructions, and as may be necessary to resolve problems attributable to, or associated with, manufacturer’s products furnished for this Project.

E. Applicator's Quality Control Program:

1. Quality Control Test Frequency: In accordance with coating manufacturer's recommended quality control program parameters and these Specifications.
2. Minimum Test Documentation:
   a. Environmental conditions including, but not limited to, date and time, weather conditions, precipitation, ambient temperature, relative humidity, and dew point.
   b. Steel temperature at time of surface preparation.
   c. Visual observations of prepared surface.
   d. Surface profile of prepared steel using Surface Profile Comparator Reference Disks and 10 power magnifier, Testex Press-O-Film, or approved equal.
   e. Equipment Tests, Including, but Not Limited To: Moisture and oil contamination in compressed air.
   f. Materials stored and used at site including manufacturer, products, expiration date, and batch numbers.
   g. Abrasive Used, Including, but Not Limited To:
      1) Product and gradation (particle size).
      2) Percentage of shot/grit for recycled abrasive.
      3) Tests for cleanliness of recycled abrasive.
   h. Wet film coating thickness.
   i. Dry film coating thickness.
   j. Results of final coating inspection, including holiday and adhesion tests.
   k. Record of type and number of coating repairs.
3. Furnish calibrated inspection devices in good working condition for measurement of environmental conditions, surface profile, film thickness, adhesion and holiday detection.
4. Provide trained technicians to test the coating system and prepare reports.
5. Record quality control test data on approved forms. Maintain forms readily accessible to either the coating manufacturer or Owner's representative.

1.06 OBSERVATION OF WORK

A. Provide written advance notice to Engineer a minimum of 7 days prior to the start of any shop coating work.

B. Make provisions to allow Engineer full access to the Work and documentation regarding coating application.

C. Engineer may elect to observe materials for suitability prior to or during incorporation into the Work, including compliance with proper storage of materials and material expiration dates.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle coated pipe in accordance with reference standards and protect coating from damage.

B. Allow coatings to develop sufficient strength for stability before handling and pipe installation.

C. Lift pipe with web slings of width and type compatible with the coating. Pad coating whenever chain, cable, tongs, forklifts, or other equipment are used to handle pipe.

D. Transport coated pipe square-stacked on padded supports or racks with padding under load ties.

E. Inspect coating for damage upon arrival at the Site. Repair damage if permitted by Engineer; otherwise replace pipe.

F. When stringing pipe along the trench, support pipe on padded blocks or mounds of finely graded material. Do not place coated pipe on rocks or pavement without padding.

PART 2 PRODUCTS

2.01 POLYETHYLENE TAPE COATING SYSTEM

A. Tape Coating Suppliers:

1. Factory and Field Tape Coating Systems:
   a. Polyken Tape Technology as manufactured by Seal For Life, Tapes and Coatings Division, Franklin, MA.
   b. TapeCoat as manufactured by Chase Corporation, Westwood, MA.
2. Product numbers are listed for first named manufacturer.
3. Supply coating materials from a single manufacturer.

B. Provide straight pipe sections with a four-layer polyethylene tape system, ANSI/AWWA C214 compliant, such as Polyken YGIII:

1. Primer: Liquid adhesive, Polyken 1019 or Polyken 1039.
2. Filler Tape: Extruded butyl rubber compound, Polyken 939.

3. Inner Layer: Corrosion protection tape (20 mils), Polyken 989-20.
4. Middle Layer: Mechanical protection tape (30 mils), Polyken 955-30 Gray.
5. Outer Layer: Mechanical protection tape (30 mils) with ultraviolet light stabilizers for 12-month protection, Polyken 956-30 White.
6. Total System Thickness: 80 mils minimum.

C. Provide fittings and specials with a three-layer polyethylene tape system, ANSI/AWWA C209 Type II compliant:

1. Primer: Liquid adhesive, Polyken 1019 or Polyken 1039.
2. Filler Tape: Extruded butyl rubber compound, Polyken 939.
3. Inner Layer: Corrosion protection tape (50 mils), Polyken 930-50 Black.
4. Outer Layer: Mechanical protection tape (30 mils), Polyken 955 Gray.
5. Total System Thickness: 80 mils, minimum.
6. Supply the coating material by the same manufacturer as the materials for straight pipe.

2.02 CEMENT MORTAR OVERCOAT

A. Provide cement mortar and reinforcing materials in accordance with ANSI/AWWA C205.

PART 3 EXECUTION

3.01 GENERAL

A. Apply coating materials in accordance with this section, tape manufacturer’s product application instructions, and coating manufacturer’s field technical support instructions. The requirements of the applicable ANSI/AWWA standard shall apply in the absence of more stringent or more specific requirements of the coating manufacturer.

B. Apply coatings for atmospherically exposed pipe and fittings in accordance with Section 09 90 00, Painting and Coating.

C. Provide coatings for pipe exposed inside vaults and structures in accordance with Section 09 90 00, Painting and Coating.

D. Coat buried coated pipe and fittings passing through a concrete structure wall or floor a minimum of 2 inches beyond the interior wall or floor surface.

3.02 WELD PREPARATION

A. Grind welds higher than 1/32 inch above pipe surface to less than 1/32 inch above the surface.

B. Grind welds on pipe ends used with sleeve-type couplings flush with pipe surface within 18 inches of pipe ends.

C. Use care when grinding welds to avoid gouging adjacent steel. Damage to pipe wall will be cause for rejection of the pipe.

3.03 SURFACE PREPARATION

A. Remove burrs, sharp edges, and weld spatter prior to abrasive blasting.

B. The words “solvent cleaning”, “hand tool cleaning”, “wire brushing”, and “blast cleaning”, or similar words of equal intent, in these Specifications or in paint manufacturer’s specifications refer to the applicable SSPC Specifications.

C. Detergent clean surfaces in accordance with SSPC-SP1 prior to abrasive blasting.

D. Immediately before primer application, perform abrasive blasting using media suitable to produce a surface in conformance with SSPC-SP6 or better. Provide a surface profile between 1-1/2 mils and 3 mils or as recommended in writing by coating manufacturer.

E. Comply with applicable federal, state, and local air pollution and environmental control regulations for surface preparation, blast cleaning, disposition of spent aggregate and debris, and coating application.

F. Do not perform abrasive blast cleaning when relative humidity exceeds 85 percent, or when surface temperature is less than 5 degrees F above the ambient air dew point.

G. Do Not Apply Coatings When:

1. Surface and ambient temperatures are outside the maximum and minimum temperatures recommended by the paint manufacturer or these Specifications.
2. In dust- or smoke-laden atmosphere, blowing dust or debris, damp or humid weather, or under conditions that could cause icing on the metal surface.

H. When weather conditions or Project requirements dictate, provide and operate heaters and dehumidification equipment to allow pipe surfaces to be abrasive blasted and coated as specified and in accordance with the manufacturer's written coating application recommendations.

3.04 PIPE END PREPARATION

A. Welded Pipe Joints: Hold back tape coating at pipe ends 6 inches or as required for the specific joint. Holdbacks shall be uniform and parallel to the pipe ends. Protect exposed steel surfaces with storage primer applied immediately after taping and before flash rusting of the surface. Use storage primer compatible with joint coating materials and welding operations.

1. Heat Shrinkable Coating Application:
   a. In accordance with ANSI/AWWA C216 and as described below:
      1) Preheat steel to maintain temperature in the required range during installation of joint coating. Apply primer to prepared steel surfaces and allow to dry as recommended by coating manufacturer.
      2) Apply filler tape to lap joints, step-downs, and other discontinuities to fully support tape and prevent voids, gaps, or bridging. For welded lap joints, apply filler on the weld and adjacent spigot.
      3) Loosely fit heat-shrink sleeve over joint, using spot attachments and closure strips as specified by manufacturer.
      4) Heat sleeve center portion on the spigot side of the weld to conform sleeve to the spigot and weld. Use gloved hand or light roller pressure to press sleeve into the base of weld as sleeve shrinks. Allow sleeve center portion to fully conform to the weld around the pipe circumference before shrinking sleeve outer edges.
      5) Work outward from center toward edges to shrink sleeve onto pipe. Press sleeve outer edges onto shop coating.
      6) Visually inspect installed sleeve to confirm that it is free of holes, and conforms to surfaces along pipe joint contour. Confirm that adhesive is visible along sleeve edges.
      7) After joint has cooled to ambient temperature, examine sleeve and conduct holiday testing in accordance with NACE SP0274. Confirm that sleeves tightly conform to pipe and without holidays, voids or gaps.
      8) Cement Mortar Overcoat: Mix mortar and install in accordance with ANSI/AWWA C205.

3.05 APPLICATION OF TAPE

A. Store and apply primer in accordance with manufacturer's requirements.

1. Use spray method and drum agitator. Provide uniform prime coat without skips, misses, runs or drips.
2. Allow primer to dry to the condition recommended by manufacturer prior to application of tape. Keep primed surface clean and free of contamination.

B. Maintain pipe temperature within a range of 45 degrees F to 100 degrees F during tape system application.

C. Maintain tape rolls at manufacturer's recommended temperature prior to application. Maintain inner layer tape at a minimum roll body temperature of 70 degrees F during application. Maintain middle and outer layer tapes at a minimum roll body temperature of 90 degrees F during application. Maintain tape temperature within 20 degrees F of pipe surface temperature during application.

D. Maintain tape tension at a value that produces a tape width reduction equal to 1.5 percent to 2.0 percent of the tape width during application as recommended by tape manufacturer. Continuously maintain width reduction simultaneously with required tape temperature.

E. At the point of tape application, press tape onto pipe with a pressure roller that maintains a constant pressure. Use sufficient pressure to fully bond tape to pipe.

F. Use filler tape at lap joints, weld step-downs, and other discontinuities to prevent bridging of tape coating.

3.06 INSPECTION AND TESTING

A. Electrically holiday test each section of pipe after application of the inner wrap. Repair holidays before application of additional tape layers. Retest the repaired area for holidays. Test holidays in middle and outerwrap layers in accordance with tape manufacturer's instructions.

B. Inspect and test finished tape coating system for complete bonding and absence of bubbles, voids, gaps, and wrinkles.

C. Perform adhesion tests in accordance with ANSI/AWWA C214 or ANSI/AWWA C209, as applicable to the coating being tested.

D. Remove and replace coatings at all defects found. Repair coatings damaged by adhesion testing.

3.07 SHOP REPAIRS

A. Repair detected holidays (defects) before application of additional tape layers. Repair the holiday area by priming and applying a patch of repair tape. Cover the repair tape a minimum of 4 inches in each direction from damaged area. Retest the repaired area for holidays. Test holidays in middle and outerwrap layers in accordance with the tape manufacturer’s directions.

3.08 APPLICATION OF CEMENT MORTAR OVERCOAT

A. Apply reinforced mortar coat over finished tape application in accordance with AWWA C205.

B. Reinforcing shall not make metal-to-metal contact with the steel pipe.

C. Mortar coating shall not damage dielectric properties or integrity of the tape coating.

3.09 TAPE APPLICATION TO FITTINGS AND SPECIALS

A. Prepare and prime surfaces as specified in this section.

B. Use filler tape to fill voids and prevent bridging of tape coating at discontinuities.

C. Apply inner tape layer using manual tension control device. Cover all surfaces as specified in ANSI/AWWA C209.

D. Visually inspect tape application and perform holiday testing; repair all defects found.

E. Apply outer tape layer using manual tension control and roller as required to completely cover and seal inner tape layer without gaps or wrinkles.

F. Complete final visual inspection for complete coverage and bond of outer layer to inner layer.

3.10 FIELD QUALITY CONTROL

A. Immediately before lowering coated pipe into the trench, provide a visual and field electrical holiday inspection of the tape coating on the pipe.

B. Electrical Coating Inspection:

1. Furnish one portable high-voltage detector for each pipe laying crew.
2. Electrically test field-applied pipe coatings and pipe coating repairs with portable high-voltage holiday detector. Provide equipment and conduct testing in accordance with NACE Standard SP0274 and the coating manufacturer's written directions for type and thickness of coating being tested.
3. Perform holiday testing at the voltage determined by the following formula:
   a. Testing Voltage = 1,250 $\sqrt{T}$ where T = average coating thickness in mils.
4. Provide detector with minimum and maximum voltage setting, inspection speed, and holiday detector electrode type (wire brush or electrically conductive silicone or coil spring) as recommended by coating manufacturer for the coating type and thickness being tested. Maintain holiday test equipment in good working condition in accordance with detector manufacturer's recommendations.
5. Adjust the holiday detector during testing to the correct voltage setting and operate in accordance with holiday detector manufacturer's recommendations. Recheck voltage setting at start of each day and a minimum of two times during the day.
6. Provide an acceptable ground and a low electrical resistance between the holiday detector and the pipeline. Make only direct connections to uncoated areas or to the pipe ends at the pipe joint cut back areas.
7. Mark location of detected holidays for repair. Retest after repair.

3.11 FIELD REPAIR OF TAPE COATING

A. Conduct field repairs including pipe surface preparation, primer application, and tape coating in a continuous operation. Store, handle, and apply products used for field coating in accordance with ANSI/AWWA C209 and AWWA C214 and the tape manufacturer's instructions.

B. Thoroughly mix primer prior to application and keep container sealed when not in use. Do not dilute primer. Apply primer above 50 degrees F.

C. Preheat pipe when required to achieve and maintain the temperature range specified by the coating manufacturer.

D. Temporarily enclose work areas as required to provide protection from moisture, dust, and conditions that prevent proper coating repairs.

E. Repair areas where damage or holidays are present. Repair coating shall have the same number of layers and thickness as the damaged factory coating. Minor repairs may use field primer and 4-inch or 6-inch-wide repair tape.

F. Remove damaged coating layers. Holiday test the inner wrap prior to repair of outer wrap. Provide one extra layer of repair tape to areas where coating damage to the base metal is present.

G. Solvent Wipe: Solvent clean (SSPC-SP-1) areas of oil and grease contamination with an approved solvent. Use solvent recommended by coating manufacturer.

H. Thoroughly mix primer and apply to clean surface. Keep primed area free of contamination and allow to dry to the condition recommended by the manufacturer before application of repair tape.

I. Remove release liner just prior to application of the tape to the primed pipe surface. Dispose of the release liner properly and not in the pipe trench. Protect the adhesive surface of the tape from moisture and contamination.

J. Apply repair tape of the same color as the shop applied tape to primed area and press firmly into place. Extend repair tape a minimum of 4 inches in each direction onto undamaged coating. If damaged area is wider than the repair tape width, provide a minimum of 4-inch coverage in each direction by lapping the first tape layer with additional repair tape layers. Lap each layer over the first layer, 1-inch minimum, as required to provide the minimum 4-inch coverage. Start the first layer at the bottom side of the pipe so that additional layers overlap top portion of first layer.

K. If the damaged area is over 6 inches in size, apply the outer layer in a straight wrap around entire pipe circumference. Overlap straight wrap ends a minimum of 6 inches and point downward.

L. Tape repairs that do not adhere tightly to the factory coating and present a smooth appearance will be rejected. Apply, test and repair field coating to a condition equal to the original factory-coated system.

END OF SECTION

SECTION 26 05 02
BASIC ELECTRICAL REQUIREMENTS

PART 1 GENERAL

1.01 RELATED SECTIONS

A. Requirements specified within this section apply to Division 26, Electrical. Work specified herein shall be performed as if specified in the individual sections.

1.02 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. National Electrical Contractors Association (NECA): National Electrical Installation Standards.
2. National Electrical Manufacturers Association (NEMA):
   a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
   b. Z535.4, Product Safety Signs and Labels.
3. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).

1.03 DESIGN REQUIREMENTS

A. Provide anchorage and bracing design drawings, calculations, and related information where required under Section 01 88 15, Anchorage and Bracing.

B. Provide seismic certification per requirements of Section 01 45 33, Special Inspection, Observation, and Testing, where required in that section for electrical equipment listed.

1.04 ELECTRIC SERVICE DIVISION OF RESPONSIBILITY

A. Incoming aerial and underground electrical service facilities provided by the serving utility as part of its normal obligation to customers is work provided outside this Contract. Under this Contract, provide customer required service provisions and electrical work including, but not limited to, primary trench and backfill, transformer pad site preparation, transformer pad, and metering components and associated conduit. Schedule and coordinate work of serving utility as required to provide electric service to the Work.

1.05 SUBMITTALS

A. Action Submittals:

1. Provide manufacturers' data for the following:
   a. Electrical service components.
   b. Telephone service components.
   c. Nameplates, signs, and labels.
2. Anchorage and bracing drawings and catalog information, as required by Section 01 88 15, Anchorage and Bracing, for loads in Section 01 61 00, Common Product Requirements.

B. Informational Submittals: Anchorage and bracing calculations, as required by Section 01 88 15, Anchorage and Bracing, for loads in Section 01 61 00, Common Product Requirements.

1.06 QUALITY ASSURANCE

A. Provide the Work in accordance with NFPA 70. Where required by Authority Having Jurisdiction (AHJ), material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ, in order to provide a basis for approval under the NEC.

B. Materials and equipment manufactured within the scope of standards published by UL shall conform to those standards and shall have an applied UL listing mark or label.

C. Provide materials and equipment acceptable to AHJ for Class, Division, and Group of hazardous area indicated.

1.07 ENVIRONMENTAL CONDITIONS

A. All areas are classified nonhazardous and wet. Use materials and methods required for such areas.

PART 2 PRODUCTS

2.01 GENERAL

A. Where two or more units of the same class of material or equipment are required, provide products of a single manufacturer. Component parts of materials or equipment need not be products of the same manufacturer.

B. Materials and equipment installed outdoors shall be capable of continuous operation at their specified rating within the ambient temperature range stated in Section 01 61 00, Common Product Requirements.

C. Equip panels installed outdoors in direct sun with sun shields.

2.02 EQUIPMENT FINISH

A. Manufacturer's standard finish color, except where specific color is indicated. If manufacturer has no standard color, finish equipment in accordance with Section 09 90 00, Painting and Coating.

2.03 NAMEPLATES

A. Material: Laminated plastic.

B. Attachment Screws:

1. Stainless steel.
2. Adhesive: Single-part, room temperature vulcanizing adhesive suitable for the environment and materials installed. Use adhesive on NEMA 4 or NEMA 4X enclosures only.

C. Color: White, engraved to a black core.

D. Letter Height:

1. Pushbuttons/Selector Switches: 1/8 inch.
2. Other Electrical Equipment: 1/4 inch.

2.04 SIGNS AND LABELS

A. Sign size, lettering, and color shall be in accordance with NEMA Z535.4.

PART 3 EXECUTION

3.01 GENERAL

A. Electrical Drawings show general locations of equipment, devices, and raceway, unless specifically dimensioned. Contractor shall be responsible for actual location of equipment and devices and for proper routing and support of raceways, subject to approval of Engineer.

B. Check approximate locations of light fixtures, switches, electrical outlets, equipment, and other electrical system components shown on Drawings for conflicts with openings, structural members, and components of other systems

and equipment having fixed locations. In the event of conflicts, notify Engineer in writing.

C. Install work in accordance with NECA Standard of Installation, unless otherwise specified.

D. Keep openings in boxes and equipment closed during construction.

E. Lay out work carefully in advance. Do not cut or notch any structural member or building surface without specific approval of Engineer. Carefully perform cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, paving, or other surfaces required for the installation, support, or anchorage of conduit, raceways, or other electrical materials and equipment. Following such work, restore surfaces to original condition.

3.02 ANCHORING, BRACING, AND MOUNTING

A. Equipment anchoring and mounting shall be in accordance with manufacturer's requirements for Project design criteria provided in Section 01 61 00, Common Product Requirements, to meet the requirements of Section 01 88 15, Anchorage and Bracing.

3.03 COMBINING CIRCUITS INTO COMMON RACEWAY

A. Homerun circuits shown on Drawings indicate functional wiring requirements for power and control circuits. Circuits may be combined into common raceways in accordance with the following requirements:

1. Analog control circuits from devices in same general area to same destination.
    a. No power or ac discrete control circuits shall be combined in same conduit with analog circuits.
    b. No Class 2 or Class 3 circuits including, but not limited to, HVAC control circuits, fire alarm circuits, paging system circuits shall be combined with power or Class 1 circuits.
    c. Analog circuits shall be continuous from source to destination. Do not add TJB, splice, or combine into a multi-pair cable without authorization of Engineer.
    d. Raceways shall be sized per General Circuit and Raceway Schedule and not to exceed 40 percent fill.
    e. Changes shall be documented on Record Drawings.
2. Discrete control circuits from devices in the same general area to the same destination.
    a. No power or analog control circuits shall be combined in same conduit with discrete circuits.

b. No Class 2 or Class 3 circuits including, but not limited to, HVAC control circuits, fire alarm circuits, and paging system circuits shall be combined with power or Class 1 circuits.
c. Raceways shall be sized per the General Circuit and Raceway Schedule and do not exceed 40 percent fill.
d. Changes shall be documented on Record Drawings.

3. Power circuits from loads in same general area to same source location (such as: panelboard, switchboard, low voltage motor control center).
   a. Lighting Circuits: Combine no more than three circuits to a single raceway. Contractor shall be responsible for increasing conduit and conductor size if derating is required by NEC.
   b. Receptacle Circuits, 120 Volt Only: Combine no more than three circuits to a single raceway. Provide a separate neutral conductor for each circuit. Contractor shall be responsible for increasing conduit and conductor size if derating is required by NEC.
   c. All Other Power Circuits: Do not combine power circuits without authorization of Engineer.

3.04 NAMEPLATES, SIGNS, AND LABELS

A. Arc Flash Protection Warning Signs:

1. Field mark switchboard, motor control center, and panelboards to warn qualified persons of potential arc-flash hazards. Locate marking so to be clearly visible to persons before working on energized equipment.
2. Use arc flash hazard boundary, energy level, PPE level and description, shock hazard, bolted fault current, and equipment name from study required in Section 26 05 70, Electrical Systems Analysis, as basis for warning signs.

B. Available Fault Current Signs:

1. Install label on service equipment to indicate the maximum available fault current at the equipment. Labels shall be of sufficient durability for the environment in which the equipment is installed. Labels shall include the following information:
   a. Equipment name or identification.
   b. Available fault current at the equipment.
   c. Date the fault current calculations were performed.
2. Use bolted fault current and equipment name from study required in Section 26 05 70, Electrical Systems Analysis, as basis for the label.
3. Where existing electrical systems are modified, completely remove existing fault current labels if present, and install new labels in accordance with the above requirements.

C. Equipment Nameplates:

1. Provide a nameplate to label electrical equipment including switchgear, switchboards, motor control centers, panelboards, motor starters, transformers, terminal junction boxes, disconnect switches, switches and control stations.
2. Switchgear, motor control center, transformer, and terminal junction box nameplates shall include equipment designation.
3. Disconnect switch, starter, and control station nameplates shall include name and number of equipment powered or controlled by that device.
4. Switchboard and panelboard nameplates shall include equipment designation, service voltage, and phases.

3.05 LOAD BALANCE

A. Drawings and Specifications indicate circuiting to electrical loads and distribution equipment.

B. Balance electrical load between phases as nearly as possible on switchboards, panelboards, motor control centers, and other equipment where balancing is required.

C. When loads must be reconnected to different circuits to balance phase loads, maintain accurate record of changes made, and provide circuit directory that lists final circuit arrangement.

3.06 CLEANING AND TOUCHUP PAINTING

A. Cleaning: Throughout the Work, clean interior and exterior of devices and equipment by removing debris and vacuuming.

B. Touchup Paint:

1. Touchup scratches, scrapes and chips on exterior and interior surfaces of devices and equipment with finish matching type, color, and consistency and type of surface of original finish.
2. If extensive damage is done to equipment paint surfaces, refinish entire equipment in a manner that provides a finish equal to or better than factory finish, that meets requirements of Specification, and is acceptable to Engineer.

3.07 PROTECTION FOLLOWING INSTALLATION

A. Protect materials and equipment from corrosion, physical damage, and effects of moisture on insulation and contact surfaces.

B. When equipment intended for indoor installation is installed at Contractor's convenience in areas where subject to dampness, moisture, dirt or other adverse atmosphere until completion of construction, ensure adequate protection from these atmospheres is provided and acceptable to Engineer.

END OF SECTION

SECTION 26 05 04
BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. A1011/A1011M, Standard Specification for Steel, Sheet, and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low Alloy and High-Strength Low Alloy Formability.
   b. E814, Method of Fire Tests of Through-Penetration Fire Stops.
2. Canadian Standards Association (CSA).
3. Institute of Electrical and Electronics Engineers, Inc. (IEEE): 18, Standard for Shunt Power Capacitors.
4. International Society of Automation (ISA): RP12.06.01, Wiring Practices for Hazardous (Classified) Locations Instrumentation–Part 1: Intrinsic Safety.
5. National Electrical Manufacturers Association (NEMA):
   a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
   b. C12.1, Code for Electricity Metering.
   c. C12.6, Phase-Shifting Devices Used in Metering, Marking and Arrangement of Terminals.
   d. ICS 2, Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated 600 Volts.
   e. ICS 5, Industrial Control and Systems: Control Circuit and Pilot Devices.
   f. KS 1, Enclosed and Miscellaneous Distribution Switches (600 Volts Maximum).
6. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
7. UL:
   a. 98, Standard for Enclosed and Dead-Front Switches.
   b. 248, Standard for Low Voltage Fuses.
   c. 486E, Standard for Equipment Wiring Terminals for use with Aluminum and/or Copper Conductors.
   d. 489, Standard for Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures.
   e. 508, Standard for Industrial Control Equipment.
   f. 810, Standard for Capacitors.

g. 943, Standard for Ground-Fault Circuit-Interrupters.
h. 1059, Standard for Terminal Blocks.
i. 1479, Fire Tests of Through-Penetration Fire Stops.

1.02 SUBMITTALS

A. Action Submittals:

1. Provide manufacturers' data for the following:
   a. Control devices.
   b. Control relays.
   c. Circuit breakers.
   d. Fused switches.
   e. Nonfused switches.
   f. Timers.
   g. Fuses.
   h. Magnetic contactors.
   i. Enclosures: Include enclosure data for products having enclosures.
2. Seismic anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals: Seismic anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.

1.03 EXTRA MATERIALS

A. Furnish, tag, and box for shipment and storage the following spare parts and special tools:

1. Fuses, 0 Volt to 600 Volts: Six of each type and each current rating installed.

PART 2 PRODUCTS

2.01 PUSHBUTTON, INDICATING LIGHT, AND SELECTOR SWITCH

A. Contact Rating: 7,200VA make, 720VA break, at 600V, NEMA ICS 5 Designation A600.

B. Selector Switch Operating Lever: Standard.

C. Indicating Light: LED, full voltage.

D. Pushbutton Color:

1. ON or START: Black.
2. OFF or STOP: Red.

E. Pushbutton and selector switch lockable in OFF position where indicated.

F. Legend Plate:

1. Material: Aluminum.
2. Engraving: Enamel filled in high contrasting color.
3. Text Arrangement: 11-character/spaces on one line, 14-character/spaces on each of two lines, as required, indicating specific function.
4. Letter Height: 7/64 inch.

G. Manufacturers and Products:

1. Heavy-Duty, Oil-Tight Type:
   a. General Electric Co.; Type CR 104P.
   b. Square D Co.; Type T.
   c. Eaton/Cutler-Hammer; Type 10250T.
2. Heavy-Duty, Watertight, and Corrosion-Resistant Type:
   a. Square D Co.; Type SK.
   b. General Electric Co.; Type CR 104P.
   c. Eaton/Cutler-Hammer; Type E34.
   d. Crouse-Hinds; Type NCS.

2.02 TERMINAL BLOCK, 600 VOLTS

A. UL 486E and UL 1059.

B. Size components to allow insertion of necessary wire sizes.

C. Capable of termination of control circuits entering or leaving equipment, panels, or boxes.

D. Screw clamp compression, dead front barrier type, with current bar providing direct contact with wire between compression screw and yoke.

E. Yoke, current bar, and clamping screw of high strength and high conductivity metal.

F. Yoke shall guide all strands of wire into terminal.

G. Current bar shall ensure vibration-proof connection.

H. Terminals:

1. Capable of wire connections without special preparation other than stripping.
2. Capable of jumper installation with no loss of terminal or rail space.
3. Individual, rail mounted.

I. Marking system, allowing use of preprinted or field-marked tags.

J. Manufacturers:

1. Weidmuller, Inc.
2. Ideal.
3. Electrovert USA Corp.

2.03 MAGNETIC CONTROL RELAY

A. Industrial control with field convertible contacts rated 10 amperes continuous, 7,200VA make, 720VA break.

B. NEMA ICS 2, Designation: A600 (600 volts).

C. Time Delay Relay Attachment:

1. Pneumatic type, timer adjustable as shown.
2. Field convertible from ON delay to OFF delay and vice versa.

D. Latching Attachment: Mechanical latch, having unlatching coil and coil clearing contacts.

E. Manufacturers and Products:

1. Eaton/Cutler-Hammer; D26 Type M.
2. General Electric Co.; Type CR120B.
3. Square D; Type X.

2.04 TIME DELAY RELAY

A. Industrial relay with contacts rated 5 amperes continuous, 3,600VA make, 360VA break.

B. NEMA ICS 2 Designation: B150 (150 volts).

C. Solid-state electronic, field convertible ON/OFF delay.

D. One normally open and one normally closed contact (minimum).

E. Repeat accuracy plus or minus 2 percent.

F. Timer adjustment from 1 second to 60 seconds, unless otherwise indicated on Drawings.

G. Manufacturers and Products:

1. Square D Co.; Type XO.
2. Eaton/Cutler-Hammer; Type D26MR.
3. General Electric Co.; Type CR120.

2.05 ELAPSED TIME METER

A. Drive: Synchronous motor.

B. Range: 0 hour to 99,999.9 hours, nonreset type.

C. Mounting: Semiflush panel.

D. Manufacturers and Products:

1. General Electric Co.; Type 240, 2-1/2 inch Big Look.
2. Eagle Signal Controls; Bulletin 705.

2.06 SUPPORT AND FRAMING CHANNELS

A. Carbon Steel Framing Channel:

1. Material: Rolled, mild strip steel, 12-gauge minimum, ASTM A1011/ A1011M, Grade 33.
2. Finish: Hot-dip galvanized after fabrication.

B. Paint Coated Framing Channel: Carbon steel framing channel with electro-deposited rust inhibiting acrylic or epoxy paint.

C. PVC-Coated Framing Channel: Carbon steel framing channel with 40-mil polyvinyl chloride coating.

D. Stainless Steel Framing Channel: Rolled, Type 316 stainless steel, 12-gauge minimum.

E. Manufacturers:

1. B-Line Systems, Inc.
2. Unistrut Corp.
3. Aickinstrut.

2.07 ENCLOSURES

A. Finish: Sheet metal structural and enclosure parts shall be completely painted using an electrodeposition process so interior and exterior surfaces as well as bolted structural joints have a complete finish coat on and between them.

B. Color: Manufacturer's standard color (gray) baked-on enamel, unless otherwise shown.

C. Barriers: Provide metal barriers within enclosures to separate wiring of different systems and voltage.

D. Enclosure Selections:

1. Except as shown otherwise, provide electrical enclosures according to the following table:

Enclosures			
Location	**Finish**	**Environment**	**NEMA 250 Type**
Indoor and Outdoor	Any	Denoted "WP"	3R

PART 3 EXECUTION

3.01 GENERAL

A. Install equipment in accordance with manufacturer's recommendations.

3.02 PUSHBUTTON, INDICATING LIGHT, AND SELECTOR SWITCH

A. Install heavy-duty, oil-tight type in nonhazardous, indoor, dry locations, including motor control centers, control panels, and individual stations, unless otherwise shown.

B. Install heavy-duty, watertight and corrosion-resistant type in nonhazardous, outdoor, or normally wet areas, unless otherwise shown.

3.03 SUPPORT AND FRAMING CHANNEL

A. Install where required for mounting and supporting electrical equipment, raceway, and cable tray systems.

B. Channel Type:

1. Outdoor, Noncorrosive Locations:
   a. Steel Raceway: Carbon steel or paint coated framing channel, except where mounted on aluminum handrail, then use aluminum framing channel.
   b. Aluminum Raceway and Other Systems Not Covered: Aluminum framing channel or carbon steel with neoprene material isolators.
2. Aluminum Railings: Devices mounted on aluminum railing shall use aluminum framing channel.

C. Paint cut ends prior to installation with the following:

1. Carbon Steel Channel: Zinc-rich primer.
2. Painted Channel: Rust-inhibiting epoxy or acrylic paint.
3. PVC-Coated Channel: PVC patch.

END OF SECTION

SECTION 26 05 05
CONDUCTORS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Association of Edison Illuminating Companies (AEIC): CS 8, Specification for Extruded Dielectric Shielded Power Cables Rated 5 kV through 46 kV.
2. ASTM International (ASTM):
   a. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
   b. B3, Standard Specification for Soft or Annealed Copper Wire.
   c. B8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
   d. B496, Standard Specification for Compact Round Concentric-Lay-Stranded Copper Conductors.
3. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
   a. 48, Standard Test Procedures and Requirements for Alternating-Current Cable Terminations Used on Shielded Cables Having Laminated Insulation Rated 2.5 kV through 765 kV or Extruded Insulation Rated 2.5 kV Through 500 kV.
   b. 386, Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V.
   c. 404, Standard for Extruded and Laminated Dielectric Shielded Cable Joints Rated 2500 V to 500000 V.
4. Insulated Cable Engineer’s Association, Inc. (ICEA):
   a. S-58-679, Standard for Control Cable Conductor Identification.
   b. S-73-532, Standard for Control Thermocouple Extensions and Instrumentation Cables.
   c. T-29-520, Conducting Vertical Cable Tray Flame Tests with Theoretical Heat Input of 210,000 Btu/hour.
5. National Electrical Manufacturers’ Association (NEMA):
   a. CC 1, Electric Power Connectors for Substations.
   b. WC 57, Standard for Control, Thermocouple Extension, and Instrumentation Cables.
   c. WC 70, Standard for Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy.
   d. WC 71, Standard for Nonshielded Cables Rated 2001-5000 Volts for Use in the Distribution of Electric Energy.

e. WC 74, 5-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy.

6. National Fire Protection Association (NFPA):
   a. 70, National Electrical Code (NEC).
   b. 262, Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.
7. Telecommunications Industry Association (TIA): TIA-568-C, Commercial Building Telecommunications Cabling Standard.
8. UL:
   a. 13, Standard for Safety for Power-Limited Circuit Cables.
   b. 44, Standard for Safety for Thermoset-Insulated Wires and Cables.
   c. 62, Standard for Safety for Flexible Cord and Cables.
   d. 486A-486B, Standard for Safety for Wire Connectors.
   e. 486C, Standard for Safety for Splicing Wire Connectors.
   f. 510, Standard for Safety for Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape.
   g. 854, Standard for Safety for Service-Entrance Cables.
   h. 1072, Standard for Safety for Medium-Voltage Power Cables.
   i. 1277, Standard for Safety for Electrical Power and Control Tray Cables with Optional Optical-Fiber Members.
   j. 1569, Standard for Safety for Metal-Clad Cables.
   k. 1581, Standard for Safety for Reference Standard for Electrical Wires, Cables, and Flexible Cords.

1.02 SUBMITTALS

A. Action Submittals:

1. Product Data:
   a. Wire and cable.
   b. Wire and cable accessories.
   c. Cable fault detection system.
2. Manufactured Wire Systems:
   a. Product data.
   b. Rating information.
   c. Dimensional drawings.
   d. Special fittings.
3. Busway:
   a. Product data.
   b. Rating information.
   c. Dimensional drawings.

d. Special fitting.
e. Equipment interface information for equipment to be connected to busways.

B. Informational Submittals: Certified Factory Test Report per AEIC CS 8, including AEIC qualification report for conductors above 600 volts.

1.03 QUALITY ASSURANCE

A. Authority Having Jurisdiction (AHJ):

1. Provide the Work in accordance with NFPA 70. Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.
2. Materials and equipment manufactured within the scope of standards published by UL shall conform to those standards and shall have an applied UL listing mark.

PART 2 PRODUCTS

2.01 CONDUCTORS 600 VOLTS AND BELOW

A. Conform to applicable requirements of NEMA WC 70.

B. Conductor Type:

1. 120-Volt and 277-Volt Lighting, 10 AWG and Smaller: Solid copper.
2. 120-Volt Receptacle Circuits, 10 AWG and Smaller: Solid copper.
3. All Other Circuits: Stranded copper.

C. Insulation: Type THHN/THWN-2, except for sizes No. 6 and larger, with XHHW-2 insulation.

2.02 600-VOLT RATED CABLE

A. General:

1. Type TC, meeting requirements of UL 1277, including Vertical Tray Flame Test at 70,000 Btu per hour, and NFPA 70, Article 340, or UL 13 meeting requirements of NFPA 70, Article 725.
2. Permanently and legibly marked with manufacturer’s name, maximum working voltage for which cable was tested, type of cable, and UL listing mark.
3. Suitable for installation in open air, in cable trays, or conduit.

4. Minimum Temperature Rating: 90 degrees C dry locations, 75 degrees C wet locations.
5. Overall Outer Jacket: PVC, flame-retardant, sunlight- and oil-resistant.

B. Type 3, 16 AWG, Twisted, Shielded Pair, Instrumentation Cable: Single pair, designed for noise rejection for process control, computer, or data log applications meeting NEMA WC 57 requirements.

1. Outer Jacket: 45-mil nominal thickness.
2. Individual Pair Shield: 1.35-mil, double-faced aluminum/synthetic polymer overlapped to provide 100 percent coverage.
3. Dimension: 0.31-inch nominal OD.
4. Conductors:
   a. Bare soft annealed copper, Class B, seven-strand concentric, meeting requirements of ASTM B8.
   b. 20 AWG, seven-strand tinned copper drain wire.
   c. Insulation: 15-mil nominal PVC.
   d. Jacket: 4-mil nominal nylon.
   e. Color Code: Pair conductors, black and red.
5. Manufacturers:
   a. Okonite Co.
   b. Alpha Wire Corp.
   c. Belden.

C. Type 5, 18 AWG, Multitwisted Shielded Pairs, with a Common Overall Shield, Instrumentation Cable: Designed for use as instrumentation, process control, and computer cable, meeting NEMA WC 57 requirements.

1. Conductors:
   a. Bare soft annealed copper, Class B, seven-strand concentric, in accordance with ASTM B8.
   b. Tinned copper drain wires.
   c. Pair drain wire AWG 20, group drain wire AWG 18.
   d. Insulation: 15-mil PVC.
   e. Jacket: 4-mil nylon.
   f. Color Code: Pair conductors, black and red with red conductor numerically printed for group identification.
   g. Individual Pair Shield: 1.35-mil, double-faced aluminum/synthetic polymer.
2. Cable Shield: 2.35-mil, double-faced aluminum/synthetic polymer, overlapped for 100 percent coverage.

3. Cable Sizes:

Number of Pairs	Maximum Outside Diameter (Inches)	Nominal Jacket Thickness (Mils)
4	0.50	45
8	0.68	60
12	0.82	60
16	0.95	80
24	1.16	80
36	1.33	80
50	1.56	80

4. Manufacturers:
   a. Okonite Co.
   b. Alpha Wire Corp.
   c. Belden.

2.03 SPECIAL CABLES

A. Type 30, Unshielded Twisted Pair (UTP) Telephone and Data Cable, 300V:

1. Category 6 UTP, UL listed, and third party verified to comply with TIA/EIA 568-C Category 6 requirements.
2. Suitable for high speed network applications including gigabit ethernet and video. Cable shall be interoperable with other standards compliant products and shall be backward compatible with Category 5 and Category 5e.
3. Provide four each individually twisted pair, 23 AWG conductors, with FEP insulation and blue PVC jacket.
4. NFPA 70 Plenum (CMP) rated; comply with flammability plenum requirements of NFPA 70 and NFPA 262.
5. Cable shall withstand a bend radius of 1-inch minimum at a temperature of minus 20 degrees C maximum without jacket or insulation cracking.
6. Manufacturer and Product: Belden; 7852A.

2.04 GROUNDING CONDUCTORS

A. Equipment: Stranded copper with green, Type USE/RHH/RHW-XLPE or THHN/THWN, insulation.

B. Direct Buried: Bare stranded copper.

2.05 ACCESSORIES FOR CONDUCTORS 600 VOLTS AND BELOW

A. Tape:

1. General Purpose, Flame Retardant: 7-mil, vinyl plastic, Scotch Brand 33+, rated for 90 degrees C minimum, meeting requirements of UL 510.
2. Flame Retardant, Cold and Weather Resistant: 8.5-mil, vinyl plastic, Scotch Brand 88.
3. Arc and Fireproofing:
   a. 30-mil, elastomer.
   b. Manufacturers and Products:
      1) 3M; Scotch Brand 77, with Scotch Brand 69 glass cloth tapebinder.
      2) Plymouth; 53 Plyarc, with 77 Plyglas glass cloth tapebinder.

B. Identification Devices:

1. Sleeve:
   a. Permanent, PVC, yellow or white, with legible machine-printed black markings.
   b. Manufacturers and Products:
      1) Raychem; Type D-SCE or ZH-SCE.
      2) Brady, Type 3PS.
2. Heat Bond Marker:
   a. Transparent thermoplastic heat bonding film with acrylic pressure sensitive adhesive.
   b. Self-laminating protective shield over text.
   c. Machine printed black text.
   d. Manufacturer and Product: 3M Co.; Type SCS-HB.
3. Marker Plate: Nylon, with legible designations permanently hot stamped on plate.
4. Tie-On Cable Marker Tags:
   a. Chemical-resistant white tag.
   b. Size: 1/2 inch by 2 inches.
   c. Manufacturer and Product: Raychem; Type CM-SCE.
5. Grounding Conductor: Permanent green heat-shrink sleeve, 2-inch minimum.

C. Connectors and Terminations:

1. Nylon, Self-Insulated Crimp Connectors:
   a. Manufacturers and Products:
      1) Thomas & Betts; Sta-Kon.
      2) Burndy; Insulug.
      3) ILSCO.
2. Nylon, Self-Insulated, Crimp Locking-Fork, Torque-Type Terminator:
   a. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
   b. Seamless.
   c. Manufacturers and Products:
      1) Thomas & Betts; Sta-Kon.
      2) Burndy; Insulink.
      3) ILSCO; ILSCONS.
3. Self-Insulated, Freespring Wire Connector (Wire Nuts):
   a. UL 486C.
   b. Plated steel, square wire springs.
   c. Manufacturers and Products:
      1) Thomas & Betts.
      2) Ideal; Twister.
4. Self-Insulated, Set Screw Wire Connector:
   a. Two piece compression type with set screw in brass barrel.
   b. Insulated by insulator cap screwed over brass barrel.
   c. Manufacturers:
      1) 3M Co.
      2) Thomas & Betts.
      3) Marrette.

D. Cable Lugs:

1. In accordance with NEMA CC 1.
2. Rated 600 volts of same material as conductor metal.
3. Uninsulated Crimp Connectors and Terminators:
   a. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
   b. Manufacturers and Products:
      1) Thomas & Betts; Color-Keyed.
      2) Burndy; Hydent.
      3) ILSCO.

4. Uninsulated, Bolted, Two-Way Connectors and Terminators:
   a. Manufacturers and Products:
      1) Thomas & Betts; Locktite.
      2) Burndy; Quiklug.
      3) ILSCO.

E. Cable Ties:

1. Nylon, adjustable, self-locking, and reusable.
2. Manufacturer and Product: Thomas & Betts; TY-RAP.

F. Heat Shrinkable Insulation:

1. Thermally stabilized cross-linked polyolefin.
2. Single wall for insulation and strain relief.
3. Dual wall, adhesive sealant lined, for sealing and corrosion resistance.
4. Manufacturers and Products:
   a. Thomas & Betts; SHRINK-KON.
   b. Raychem; RNF-100 and ES-2000.

2.06 PULLING COMPOUND

A. Nontoxic, noncorrosive, noncombustible, nonflammable, water-based lubricant; UL listed.

B. Suitable for rubber, neoprene, PVC, polyethylene, hypalon, CPE, and lead-covered wire and cable.

C. Approved for intended use by cable manufacturer.

D. Suitable for zinc-coated steel, aluminum, PVC, bituminized fiber, and fiberglass raceways.

E. Manufacturers:

1. Ideal Co.
2. Polywater, Inc.
3. Cable Grip Co.

2.07 MANUFACTURED WIRING SYSTEMS

A. System Rating:

1. 20 amperes load-carrying capacity each phase with final assemblies consisting of maximum of three-phase conductors.

2. Composition: Type MC cable with 90 degrees C insulation and stranded copper conductors.

B. Cable Configuration:

1. Three, single-phase, five-wire circuit with standard color wire coding:
   a. 208/120 Volt: Black, red, blue, white, green.
   b. 480/277 Volt: Brown, orange, yellow, white, green.

C. Locking Mechanism: Latch/strike with voltage clearly marked on latch.

D. NFPA 262 listed for use in air handling plenums, listed to connect or disconnect under load, and manufactured in accordance with NFPA 70, Article No. 604.

2.08 WARNING TAPE

A. As specified in Section 26 05 33, Raceway and Boxes.

2.09 SOURCE QUALITY CONTROL

A. Conductors 600 Volts and Below: Test in accordance with UL 44 and UL 854.

PART 3 EXECUTION

3.01 GENERAL

A. Conductor installation shall be in accordance with manufacturer's recommendations.

B. Conductor and cable sizing shown is based on copper conductors, unless noted otherwise.

C. Do not exceed cable manufacturer's recommendations for maximum pulling tensions and minimum bending radii.

D. Terminate conductors and cables, unless otherwise indicated.

E. Tighten screws and terminal bolts in accordance with UL 486A-486B for copper conductors [and aluminum conductors].

F. Cable Lugs: Provide with correct number of holes, bolt size, and center-to-center spacing as required by equipment terminals.

G. Bundling: Where single conductors and cables in manholes, handholes, vaults, cable trays, and other indicated locations are not wrapped together by some

other means, bundle conductors from each conduit throughout their exposed length with cable ties placed at intervals not exceeding 12 inches on center.

H. Ream, remove burrs, and clear interior of installed conduit before pulling wires or cables.

I. Concrete-Encased Raceway Installation: Prior to installation of conductors, pull through each raceway a mandrel approximately 1/4 inch smaller than raceway inside diameter.

J. Cable Tray Installation:

1. Install wire and cable parallel and straight in tray.
2. Bundle, in groups, wire and cable of same voltage having a common routing and destination; use cable ties, at maximum intervals of 8 feet.
3. Clamp cable bundles prior to making end termination connections.
4. Separate cables of different voltage rating in same cable tray with barriers.
5. Fasten wires, cables, and bundles to tray with nylon cable straps at the following maximum intervals:
   a. Horizontal Runs: 20 feet.
   b. Vertical Runs: 5 feet.

3.02 POWER CONDUCTOR COLOR CODING

A. Conductors 600 Volts and Below:

1. 6 AWG and Larger: Apply general purpose, flame retardant tape at each end, and at accessible locations wrapped at least six full overlapping turns, covering area 1-1/2 inches to 2 inches wide.
2. 8 AWG and Smaller: Provide colored conductors.
3. Colors:

System	Conductor	Color
All Systems	Equipment Grounding	Green
240/120 Volts, Single-Phase, Three-Wire	Grounded Neutral One Hot Leg Other Hot Leg	White Black Red
208Y/120 Volts, Three-Phase, Four-Wire	Grounded Neutral Phase A Phase B Phase C	White Black Red Blue

System	Conductor	Color
240/120 Volts, Three-Phase, Four-Wire, Delta, Center Tap, Ground on Single-Phase	Grounded Neutral Phase A High (wild) Leg Phase C	White Black Orange Blue
480Y/277 Volts, Three-Phase, Four-Wire	Grounded Neutral Phase A Phase B Phase C	White Brown Orange Yellow
Note: Phase A, B, C implies direction of positive phase rotation.		

4. Tracer: Outer covering of white with identifiable colored strip, other than green, in accordance with NFPA 70.

3.03 CIRCUIT IDENTIFICATION

A. Identify power, instrumentation, and control conductor circuits at each termination, and in accessible locations such as manholes, handholes, panels, switchboards, motor control centers, pull boxes, and terminal boxes.

B. Circuits Appearing in Circuit Schedules: Identify using circuit schedule designations.

C. Circuits Not Appearing in Circuit Schedules:

1. Assign circuit name based on device or equipment at load end of circuit.
2. Where this would result in same name being assigned to more than one circuit, add number or letter to each otherwise identical circuit name to make it unique.

D. Method:

1. Conductors 3 AWG and Smaller: Identify with sleeves or heat bond markers.
2. Cables and Conductors 2 AWG and Larger:
   a. Identify with marker plates or tie-on cable marker tags.
   b. Attach with nylon tie cord.
3. Taped-on markers or tags relying on adhesives not permitted.

3.04 CONDUCTORS 600 VOLTS AND BELOW

A. Install 10 AWG or 12 AWG conductors for branch circuit power wiring in lighting and receptacle circuits.

B. Do not splice incoming service conductors and branch power distribution conductors 6 AWG and larger, unless specifically indicated or approved by Engineer.

C. Connections and Terminations:

1. Install wire nuts only on solid conductors. Wire nuts are not allowed on stranded conductors.
2. Install nylon self-insulated crimp connectors and terminators for instrumentation and control, circuit conductors.
3. Install self-insulated, set screw wire connectors for two-way connection of power circuit conductors 12 AWG and smaller.
4. Install uninsulated crimp connectors and terminators for instrumentation, control, and power circuit conductors 4 AWG through 2/0 AWG.
5. Install uninsulated, bolted, two-way connectors and terminators for power circuit conductors 3/0 AWG and larger.
6. Install uninsulated terminators bolted together on motor circuit conductors 10 AWG and larger.
7. Place no more than one conductor in any single-barrel pressure connection.
8. Install crimp connectors with tools approved by connector manufacturer.
9. Install terminals and connectors acceptable for type of material used.
10. Compression Lugs:
    a. Attach with a tool specifically designed for purpose. Tool shall provide complete, controlled crimp and shall not release until crimp is complete.
    b. Do not use plier type crimpers.

D. Do not use soldered mechanical joints.

E. Splices and Terminations:

1. Insulate uninsulated connections.
2. Indoors: Use general purpose, flame retardant tape or single wall heat shrink.
3. Outdoors, Dry Locations: Use flame retardant, cold- and weather-resistant tape or single wall heat shrink.
4. Below Grade and Wet or Damp Locations: Use dual wall heat shrink.

F. Cap spare conductors with UL listed end caps.

G. Cabinets, Panels, and Motor Control Centers:

1. Remove surplus wire, bridle and secure.
2. Where conductors pass through openings or over edges in sheet metal, remove burrs, chamfer edges, and install bushings and protective strips of insulating material to protect the conductors.

H. Control and Instrumentation Wiring:

1. Where terminals provided will accept such lugs, terminate control and instrumentation wiring, except solid thermocouple leads, with insulated, locking-fork compression lugs.
2. Terminate with methods consistent with terminals provided, and in accordance with terminal manufacturer’s instructions.
3. Locate splices in readily accessible cabinets or junction boxes using terminal strips.
4. Where connections of cables installed under this section are to be made under Section 40 90 00, Instrumentation and Control for Process Systems, leave pigtails of adequate length for bundled connections.
5. Cable Protection:
    a. Under Infinite Access Floors: May install without bundling.
    b. All Other Areas: Install individual wires, pairs, or triads in flex conduit under floor or grouped into bundles at least 1/2 inch in diameter.
    c. Maintain integrity of shielding of instrumentation cables.
    d. Ensure grounds do not occur because of damage to jacket over shield.

I. Extra Conductor Length: For conductors to be connected by others, install minimum 6 feet of extra conductor in freestanding panels and minimum 2 feet in other assemblies.

END OF SECTION

SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Institute of Electrical and Electronics Engineers (IEEE): C2, National Electrical Safety Code (NESC).
2. National Fire Protection Association (NFPA): 70, National Electrical Code. (NEC).

1.02 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Product data for the following:
      1) Exothermic weld connectors.
      2) Mechanical connectors.
      3) Compression connectors.

1.03 QUALITY ASSURANCE

A. Authority Having Jurisdiction (AHJ):

1. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, provide material and equipment labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ to provide a basis for approval under NEC.
2. Materials and equipment manufactured within the scope of standards published by UL:
   a. Confirm conformance with UL standards.
   b. Supply with an applied UL listing mark.

PART 2 PRODUCTS

2.01 GROUND ROD

A. Material: Copper-clad.

B. Diameter: Minimum 5/8-inch.

C. Length: 10 feet.

2.02 GROUND CONDUCTORS

A. As specified in Section 26 05 05, Conductors.

2.03 CONNECTORS

A. Exothermic Weld Type:

1. Outdoor Weld: Suitable for exposure to elements or direct burial.
2. Indoor Weld: Use low-smoke, low-emission process.
3. Manufacturers and Products:
    a. Erico Products, Inc.; Cadweld and Cadweld Exolon.
    b. Thermoweld.

B. Compression Type:

1. Compress-deforming type; wrought copper extrusion material.
2. Single indentation for conductors 6 AWG and smaller.
3. Double indentation with extended barrel for conductors 4 AWG and larger.
4. Barrels prefilled with oxide-inhibiting and antiseizing compound and sealed.
5. Manufacturers and Products:
    a. Burndy Corp.; Hyground Irreversible Compression.
    b. Thomas and Betts Co.
    c. ILSCO.

C. Mechanical Type: Split-bolt, saddle, or cone screw type; copper alloy material.

1. Manufacturers:
    a. Burndy Corp.
    b. Thomas and Betts Co.

2.04 GROUNDING WELLS

A. Ground rod box complete with cast-iron riser ring and traffic cover marked “GROUND ROD”.

B. Manufacturers and Products:

1. Christy Co.; No. G5.
2. Lightning and Grounding Systems, Inc.; I-R Series.

PART 3 EXECUTION

3.01 GENERAL

A. Grounding: In compliance with NFPA 70 and IEEE C2.

B. Ground electrical service neutral at service entrance equipment with grounding electrode conductor to grounding electrode system.

C. Ground each separately derived system neutral with common grounding electrode conductor to grounding electrode system.

D. Bond together all grounding electrodes that are present at each building or structure served to form one common grounding electrode system.

E. Bond together system neutrals, service equipment enclosures, exposed noncurrent-carrying metal parts of electrical equipment, metal raceways, ground conductor in raceways and cables, receptacle ground connections, and metal piping systems.

F. Shielded Power Cables: Ground shields at each splice or termination in accordance with recommendations of splice or termination manufacturer.

G. Shielded Instrumentation Cables:

1. Ground shield to ground bus at power supply for analog signal.
2. Expose shield minimum 1-inch at termination to field instrument and apply heat shrink tube.
3. Do not ground instrumentation cable shield at more than one point.

3.02 WIRE CONNECTIONS

A. Ground Conductors: Install in conduit containing power conductors and control circuits above 50 volts.

B. Nonmetallic Raceways and Flexible Tubing: Install equipment grounding conductor connected at both ends to noncurrent-carrying grounding bus.

C. Connect ground conductors to raceway grounding bushings.

D. Extend and connect ground conductors to ground bus in all equipment containing a ground bus.

E. Connect enclosure of equipment containing ground bus to that bus.

F. Bolt connections to equipment ground bus.

G. Bond grounding conductors to metallic enclosures at each end, and to intermediate metallic enclosures.

H. Junction Boxes: Furnish materials and connect to equipment grounding system with grounding clips mounted directly on box, or with 3/8-inch machine screws.

I. Metallic Equipment Enclosures: Use furnished ground lug; if none furnished, tap equipment housing and install solderless terminal connected to box with machine screw. For circuits greater than 20 amperes use minimum 5/16-inch diameter bolt.

3.03 MOTOR GROUNDING

A. Extend equipment ground bus via grounding conductor installed in motor feeder raceway; connect to motor frame.

B. Nonmetallic Raceways and Flexible Tubing: Install an equipment grounding conductor connected at both ends to noncurrent-carrying grounding bus.

C. Motors Less Than 10 hp: Use furnished ground lug in motor connection box. If none furnished, provide compression, spade-type terminal connected to conduit box mounting screw.

D. Motors 10 hp and Above: Use furnished ground lug in motor connection box. If none furnished, tap motor frame or equipment housing; furnish compression, one-hole, lug type terminal connected with minimum 5/16-inch brass threaded stud with bolt and washer.

E. Circuits 20 Amperes or Above: Tap motor frame or equipment housing. Install solderless terminal with minimum 5/16-inch diameter bolt.

3.04 GROUND RODS

A. Install full length with conductor connection at upper end.

B. Install with connection point below finished grade, unless otherwise shown.

C. Space multiple ground rods by one rod length.

D. Install to 8 feet below local frost depth.

3.05 GROUNDING WELLS

A. Install for ground rods located inside buildings, asphalt and paved areas, and where shown on Drawings.

B. Install riser ring and cover flush with surface.

C. Place 12 inches of crushed rock in bottom of each well.

3.06 CONNECTIONS

A. General:

1. Abovegrade Connections: Install exothermic weld, mechanical, or compression-type connectors; or brazing.
2. Belowgrade Connections: Install exothermic weld or compression type connectors.
3. Remove paint, dirt, or other surface coverings at connection points to allow good metal-to-metal contact.
4. Notify Engineer prior to backfilling ground connections.

B. Exothermic Weld Type:

1. Wire brush or file contact point to bare metal surface.
2. Use welding cartridges and molds in accordance with manufacturer’s recommendations.
3. Avoid using badly worn molds.
4. Mold to be completely filled with metal when making welds.
5. After completed welds have cooled, brush slag from weld area and thoroughly clean joint.

C. Compression Type:

1. Install in accordance with connector manufacturer’s recommendations.
2. Install connectors of proper size for grounding conductors and ground rods specified.
3. Install using connector manufacturer’s compression tool having proper sized dies and operate per manufacturer’s instructions.

D. Mechanical Type:

1. Apply homogeneous blend of colloidal copper and rust and corrosion inhibitor before making connection.
2. Install in accordance with connector manufacturer’s recommendations.
3. Do not conceal mechanical connections.

3.07 METAL STRUCTURE GROUNDING

A. Bond metal sheathing and exposed metal vertical structural elements to grounding system.

B. Bond electrical equipment supported by metal platforms to the platforms.

C. Provide electrical contact between metal frames and railings supporting pushbutton stations, receptacles, and instrument cabinets, and raceways carrying circuits to these devices.

3.08 MANHOLE AND HANDHOLE GROUNDING

A. Install one ground rod inside each manhole and handhole larger than 24-inch by 24-inch inside dimensions.

B. Ground Rod Floor Protrusion: 4 inches to 6 inches above floor.

C. Make connections of grounding conductors fully visible and accessible.

D. Connect all noncurrent-carrying metal parts and any metallic raceway grounding bushings to ground rod with 6 AWG copper conductor.

3.09 TRANSFORMER GROUNDING

A. Bond neutrals of transformers within buildings to system ground network and to any additional indicated grounding electrodes.

B. Bond neutrals of pad-mounted transformers to locally driven ground rod and system ground network.

3.10 SURGE PROTECTION EQUIPMENT GROUNDING

A. Connect surge arrestor ground terminals to equipment ground bus.

END OF SECTION

SECTION 26 05 33
RACEWAY AND BOXES

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Association of State Highway and Transportation Officials (AASHTO): HB, Standard Specifications for Highway Bridges.
2. ASTM International (ASTM):
   a. A123/123M, Standard Specification for Zinc (Hot-Dipped Galvanized) Coatings on Iron and Steel Products.
   b. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
   c. A240/A240M, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
   d. C857, Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.
   e. D149, Standard Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies.
3. Telecommunications Industry Association (TIA): 569B, Commercial Building Standard for Telecommunications Pathways and Spaces.
4. National Electrical Contractor’s Association, Inc. (NECA): Installation standards.
5. National Electrical Manufacturers Association (NEMA):
   a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
   b. C80.1, Electrical Rigid Steel Conduit (ERSC).
   c. C80.3, Steel Electrical Metallic Tubing (EMT).
   d. C80.5, Electrical Rigid Aluminum Conduit (ERAC).
   e. C80.6, Electrical Intermediate Metal Conduit (EIMC).
   f. RN 1, Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
   g. TC 2, Electrical Polyvinyl Chloride (PVC) Conduit.
   h. TC 3, Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing.
   i. TC 6, Polyvinyl Chloride (PVC) Plastic Utilities Duct for Underground Installation.

j. TC 14, Reinforced Thermosetting Resin Conduit (RTRC) and Fittings.
k. VE 1, Metallic Cable Tray Systems.

6. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
7. UL:
   a. 1, Standard for Safety for Flexible Metal Conduit.
   b. 5, Standard for Safety for Surface Metal Raceways and Fittings.
   c. 6, Standard for Safety for Electrical Rigid Metal Conduit – Steel.
   d. 6A, Standard for Safety for Electrical Rigid Metal Conduit – Aluminum, Red Brass and Stainless.
   e. 360, Standard for Safety for Liquid-Tight Flexible Steel Conduit.
   f. 514B, Standard for Safety for Conduit, Tubing, and Cable Fittings.
   g. 651, Standard for Safety for Schedule 40 and 80 Rigid PVC Conduit and Fittings.
   h. 651A, Standard for Safety for Type EB and A Rigid PVC Conduit and HDPE Conduit.
   i. 797, Standard for Safety for Electrical Metallic Tubing – Steel.
   j. 870, Standard for Safety for Wireways, Auxiliary Gutters, and Associated Fittings.
   k. 1242, Standard for Safety for Electrical Intermediate Metal Conduit – Steel.
   l. 1660, Standard for Safety for Liquid-Tight Flexible Nonmetallic Conduit.
   m. 1684, Standard for Safety for Reinforced Thermosetting Resin Conduit (RTRC) and Fittings.
   n. 2024, Standard for Safety for Optical Fiber and Communication Cable Raceway.

1.02 SUBMITTALS

A. Action Submittals:

1. Manufacturer’s Literature:
   a. Rigid galvanized steel conduit.
   b. PVC Schedule 40 conduit.
   c. PVC-coated rigid galvanized steel conduit, submittal to include copy of manufacturer’s warranty.
   d. Flexible metal, liquid-tight conduit.
   e. Flexible, nonmetallic, liquid-tight conduit.
   f. Flexible metal, nonliquid-tight conduit.
   g. Conduit fittings.

h. Junction and pullboxes used at or below grade.
i. Large junction and pullboxes.
j. Terminal junction boxes.

2. Precast Manholes and Handholes:
   a. Dimensional drawings and descriptive literature.
   b. Traffic loading calculations.
   c. Accessory information.
3. Equipment and machinery proposed for bending metal conduit.
4. Method for bending PVC conduit less than 30 degrees.
5. Seismic anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

1. Seismic anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
2. Component and attachment testing seismic certificate of compliance as required by Section 01 45 33, Special Inspection, Observation, and Testing.
3. Manufacturer's certification of training for PVC-coated rigid galvanized steel conduit installer.

1.03 QUALITY ASSURANCE

A. Authority Having Jurisdiction (AHJ):

1. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.
2. Materials and equipment manufactured within scope of standards published by UL shall conform to those standards and shall have an applied UL listing mark.

B. PVC-Coated, Rigid Galvanized Steel Conduit Installer: Certified by conduit manufacturer as having received minimum 2 hours of training on installation procedures.

PART 2 PRODUCTS

2.01 CONDUIT AND TUBING

A. Rigid Galvanized Steel Conduit (RGS):

1. Meet requirements of NEMA C80.1 and UL 6.
2. Material: Hot-dip galvanized with chromated protective layer.

B. PVC Schedule 40 Conduit:

1. Meet requirements of NEMA TC 2 and UL 651.
2. UL listed for concrete encasement, underground direct burial, concealed or direct sunlight exposure, and 90 degrees C insulated conductors.

C. PVC-Coated Rigid Galvanized Steel Conduit:

1. Meet requirements of NEMA RN 1 and ETL.
2. Material:
   a. Meet requirements of NEMA C80.1 and UL 6.
   b. Exterior Finish: PVC coating, 40-mil nominal thickness; bond to metal shall have tensile strength greater than PVC.
   c. Interior Finish: Urethane coating, 2-mil nominal thickness.
3. Threads: Hot-dipped galvanized and factory coated with urethane.
4. Bendable without damage to interior or exterior coating.

D. Flexible Metal, Liquid-Tight Conduit:

1. UL 360 listed for 105 degrees C insulated conductors.
2. Material: Galvanized steel with extruded PVC jacket.

E. Flexible Metal, Nonliquid-Tight Conduit:

1. Meet requirements of UL 1.
2. Material: Galvanized steel.

2.02 FITTINGS

A. Rigid Galvanized Steel and Intermediate Metal Conduit:

1. General:
   a. Meet requirements of UL 514B.
   b. Type: Threaded, galvanized. Set screw and threadless compression fittings not permitted.

2. Bushing:
    a. Material: Malleable iron with integral insulated throat, rated for 150 degrees C.
    b. Manufacturers and Products:
        1) Appleton; Series BU-I.
        2) O-Z/Gedney; Type HB.
3. Grounding Bushing:
    a. Material: Malleable iron with integral insulated throat rated for 150 degrees C, with solderless lugs.
    b. Manufacturers and Products:
        1) Appleton; Series GIB.
        2) O-Z/Gedney; Type HBLG.
4. Conduit Hub:
    a. Material: Malleable iron with insulated throat with bonding screw.
    b. UL listed for use in wet locations.
    c. Manufacturers and Products:
        1) Appleton, Series HUB-B.
        2) O-Z/Gedney; Series CH.
        3) Meyers; ST Series.
5. Conduit Bodies:
    a. Sized as required by NFPA 70.
    b. Manufacturers and Products (For Normal Conditions):
        1) Appleton; Form 35 threaded unilets.
        2) Crouse-Hinds; Form 7 or Form 8 threaded condulets.
        3) Killark; Series O electrolets.
        4) Thomas & Betts; Form 7 or Form 8.
    c. Manufacturers (For Hazardous Locations):
        1) Appleton.
        2) Crouse-Hinds.
        3) Killark.
6. Couplings: As supplied by conduit manufacturer.
7. Unions:
    a. Concrete tight, hot-dip galvanized malleable iron.
    b. Manufacturers and Products:
        1) Appleton; Series SCC bolt-on coupling or Series EC three-piece union.
        2) O-Z/Gedney; Type SSP split coupling or Type 4 Series, three-piece coupling.
8. Conduit Sealing Fitting:
    a. Manufacturers and Products:
        1) Appleton; Type EYF, EYM, or ESU.
        2) Crouse-Hinds; Type EYS or EZS.
        3) Killark; Type EY or Type EYS.

9. Drain Seal:
    a. Manufacturers and Products:
        1) Appleton; Type EYD.
        2) Crouse-Hinds; Type EYD or Type EZD.
10. Drain/Breather Fitting:
    a. Manufacturers and Products:
        1) Appleton; Type ECDB.
        2) Crouse-Hinds; ECD.
11. Expansion Fitting:
    a. Manufacturers and Products:
        1) Deflection/Expansion Movement:
            a) Appleton; Type DF.
            b) Crouse-Hinds; Type XD.
        2) Expansion Movement Only:
            a) Appleton; Type XJ.
            b) Crouse-Hinds; Type XJ.
            c) Thomas & Betts; XJG-TP.

B. PVC Conduit and Tubing:

1. Meet requirements of NEMA TC 3.
2. Type: PVC, slip-on.

C. PVC-Coated Rigid Galvanized Steel Conduit:

1. Meet requirements of UL 514B.
2. Fittings: Rigid galvanized steel type, PVC coated by conduit manufacturer.
3. Conduit Bodies: Cast metal hot-dipped galvanized or urethane finish. Cover shall be of same material as conduit body. PVC coated by conduit manufacturer.
4. Finish: 40-mil PVC exterior, 2-mil urethane interior.
5. Overlapping pressure-sealing sleeves.
6. Conduit Hangers, Attachments, and Accessories: PVC-coated.
7. Manufacturers:
    a. Robroy Industries.
    b. Ocal.
8. Expansion Fitting:
    a. Manufacturer and Product: Ocal; OCAL-BLUE XJG.

D. Flexible Metal, Liquid-Tight Conduit:

1. Metal insulated throat connectors with integral nylon or plastic bushing rated for 105 degrees C.

2. Insulated throat and sealing O-rings.
3. Manufacturers and Products:
    a. Thomas & Betts; Series 5331.
    b. O-Z/Gedney; Series 4Q.

E. Flexible Metal, Nonliquid-Tight Conduit:

1. Meet requirements of UL 514B.
2. Body: Galvanized steel or malleable iron.
3. Throat: Nylon insulated.
4. 1-1/4 Inch Conduit and Smaller: One screw body.
5. 1-1/2 Inch Conduit and Larger: Two screw body.
6. Manufacturer and Product: Appleton; Series 7400.

2.03 OUTLET AND DEVICE BOXES

A. Sheet Steel: One-piece drawn type, zinc-plated or cadmium-plated.

B. Cast Aluminum:

1. Material:
    a. Box: Cast, copper-free aluminum.
    b. Cover: Gasketed, weatherproof, cast copper-free aluminum with stainless steel screws.
2. Hubs: Threaded.
3. Lugs: Cast mounting.
4. Manufacturers and Products, Nonhazardous Locations:
    a. Crouse-Hinds; Type FS-SA or Type FD-SA.
    b. Appleton; Type FS or Type FD.
    c. Killark.
5. Manufacturers and Products, Hazardous Locations:
    a. Crouse-Hinds; Type GUA-SA.
    b. Appleton; Type GR.

2.04 JUNCTION AND PULLBOXES

A. Outlet Box Used as Junction or Pullbox: As specified under Article Outlet and Device Boxes.

B. Conduit Bodies Used as Junction Boxes: As specified under Article Fittings.

C. Large Stainless Steel Box:

1. NEMA 250 Type 4X.
2. Box: 14-gauge, ASTM A240/A240M, Type 316 stainless steel, with white enamel painted interior mounting panel.
3. Cover: Nonhinged with screws.
4. Hardware and Machine Screws: ASTM A167, Type 316 stainless steel.
5. Manufacturers:
   a. Hoffman Engineering Co.
   b. Robroy Industries.
   c. Wiegman.

D. Concrete Box, Traffic Areas:

1. Box: Reinforced, cast concrete with extension and bottom slab.
2. Cover: Steel checked plate; H/20 loading with screw down.
3. Cover Marking: ELECTRICAL, TELEPHONE, or as shown.
4. Manufacturers and Products:
   a. Christy, Concrete Products, Inc.; B1017BOX.
   b. Utility Vault Co.; 3030 SB.

2.05 TERMINAL JUNCTION BOX

A. Cover: Hinged, unless otherwise shown.

B. Interior Finish: Paint with white enamel or lacquer.

C. Terminal Blocks:

1. Separate connection point for each conductor entering or leaving box.
2. Spare Terminal Points: 50 percent, minimum.

2.06 ACCESSORIES

A. Identification Devices:

1. Raceway Tags:
   a. Material: Permanent, polyethylene.
   b. Shape: Round.
   c. Raceway Designation: Pressure stamped, embossed, or engraved.
   d. Tags relying on adhesives or taped-on markers not permitted.
2. Warning Tape:
   a. Material: Polyethylene, 4-mil gauge with detectable strip.
   b. Color: Red.
   c. Width: Minimum 6 inches.

d. Designation: Warning on tape that electric circuit is located below tape.
e. Identifying Letters: Minimum 1-inch high permanent black lettering imprinted continuously over entire length.
f. Manufacturers and Products:
1) Panduit; Type HTDU.
2) Reef Industries; Terra Tape.

3. Buried Raceway Marker:
a. Material: Sheet bronze, consisting of double-ended arrows, straight for straight runs and bent at locations where runs change direction.
b. Designation: Engrave to depth of 3/32 inch; ELECTRIC CABLES, in letters 1/4-inch high.
c. Minimum Dimension: 1/4-inch thick, 10 inches long, and 3/4-inch wide.

B. Raceway Coating: Clean and paint in accordance with Section 09 90 00, Painting and Coating.

C. Heat Shrinkable Tubing:

1. Material: Heat-shrinkable, cross-linked polyolefin.
2. Semi-flexible with meltable adhesive inner liner.
3. Color: Black.
4. Manufacturers:
a. Raychem.
b. 3M.

D. Wraparound Duct Band:

1. Material: Heat-shrinkable, cross-linked polyolefin, precoated with hot-melt adhesive.
2. Width: 50 mm minimum.
3. Manufacturer and Product: Raychem; Type TWDB.

PART 3 EXECUTION

3.01 GENERAL

A. Conduit and tubing sizes shown are based on use of copper conductors. Reference Section 26 05 05, Conductors, concerning conduit sizing for aluminum conductors.

B. Comply with NECA Installation Standards.

C. Crushed or deformed raceways not permitted.

D. Maintain raceway entirely free of obstructions and moisture.

E. Immediately after installation, plug or cap raceway ends with watertight and dust-tight seals until time for pulling in conductors.

F. Aluminum Conduit: Do not install in direct contact with concrete. Install in PVC sleeve or cored hole through concrete walls and slabs.

G. Sealing Fittings: Provide drain seal in vertical raceways where condensate may collect above sealing fitting.

H. Avoid moisture traps where possible. When unavoidable in exposed conduit runs, provide junction box and drain fitting at conduit low point.

I. Group raceways installed in same area.

J. Proximity to Heated Piping: Install raceways minimum 12 inches from parallel runs.

K. Follow structural surface contours when installing exposed raceways. Avoid obstruction of passageways.

L. Run exposed raceways parallel or perpendicular to walls, structural members, or intersections of vertical planes.

M. Install watertight fittings in outdoor, underground, or wet locations.

N. Paint threads and cut ends, before assembly of fittings, galvanized conduit, PVC-coated galvanized conduit, or IMC installed in exposed or damp locations with zinc-rich paint or liquid galvanizing compound.

O. Metal conduit shall be reamed, burrs removed, and cleaned before installation of conductors, wires, or cables.

P. Do not install raceways in concrete equipment pads, foundations, or beams without Engineer approval.

Q. Horizontal raceways installed under floor slabs shall lie completely under slab, with no part embedded within slab.

R. Install concealed, embedded, and buried raceways so that they emerge at right angles to surface and have no curved portion exposed.

S. Install conduits for fiber optic cables, telephone cables, and Category 6 data cables in strict conformance with the requirements of TIA 569B.

3.02 INSTALLATION IN CAST-IN-PLACE STRUCTURAL CONCRETE

A. Minimum Cover: 2 inches, including fittings.

B. Conduit placement shall not require changes in reinforcing steel location or configuration.

C. Provide nonmetallic support during placement of concrete to ensure raceways remain in position.

D. Conduit larger than 1 inch shall not be embedded in concrete slabs, walls, foundations, columns, or beams unless approved by Engineer.

E. Slabs and Walls (Requires Engineer Approval):

1. Trade size of conduit not to exceed one-fourth of slab or wall thickness.
2. Install within middle two-fourths of slab or wall.
3. Separate conduit less than 2-inch trade size by a minimum ten times conduit trade size, center-to-center, unless otherwise shown.
4. Separate conduit 2-inch and greater trade size by a minimum eight times conduit trade size, center-to-center, unless otherwise shown.
5. Cross conduit at an angle greater than 45 degrees, with minimum separation of 1 inch.
6. Separate conduit by a minimum six times the outside dimension of expansion/deflection fittings at expansion joints.
7. Conduit shall not be installed below the maximum water surface elevation in walls of water holding structures.

F. Columns and Beams (Requires Engineer Approval):

1. Trade size of conduit not to exceed one-fourth of beam thickness.
2. Conduit cross-sectional area not to exceed 4 percent of beam or column cross section.

3.03 CONDUIT APPLICATION

A. Diameter: Minimum 3/4 inch.

B. Exterior, Exposed:

1. Rigid galvanized steel.
2. PVC-coated rigid galvanized steel.

C. Direct Earth Burial:

1. PVC Schedule 40.
2. PVC-coated rigid galvanized steel.

D. Under Slabs-On-Grade:

1. PVC Schedule 40.
2. PVC-coated rigid galvanized steel.

E. Transition from Underground or Concrete Embedded to Exposed: PVC-coated rigid steel conduit.

F. Under Equipment Mounting Pads: PVC-coated rigid steel conduit.

G. Exterior Light Pole Foundations: PVC Schedule 40 conduit.

3.04 FLEXIBLE CONNECTIONS

A. For motors, dry type transformers, electrically operated valves, instrumentation, and other locations approved by Engineer where flexible connection is required to minimize vibration:

1. Conduit Size 4 Inches or Less: Flexible, liquid-tight conduit.
2. Conduit Size Over 4 Inches: Nonflexible.
3. Wet or Corrosive Areas: Flexible, nonmetallic or flexible metal liquid-tight.

B. Outdoor Areas, Process Areas Exposed to Moisture, and Areas Required to be Oiltight and Dust-Tight: Flexible metal, liquid-tight conduit.

C. Flexible Conduit Length: 18 inches minimum, 60 inches maximum; sufficient to allow movement or adjustment of equipment.

3.05 PENETRATIONS

A. Make at right angles, unless otherwise shown.

B. Notching or penetration of structural members, including footings and beams, not permitted.

C. Apply heat shrinkable tubing or single layer of wraparound duct band to metallic conduit protruding through concrete floor slabs to a point 2 inches above and 2 inches below concrete surface.

D. Concrete Walls, Floors, or Ceilings (Aboveground): Provide nonshrink grout dry-pack, or use watertight seal device.

E. Entering Structures:

1. General: Seal raceway at first box or outlet with oakum or expandable plastic compound to prevent entrance of gases or liquids from one area to another.
2. Concrete Roof or Membrane Waterproofed Wall or Floor:
   a. Provide a watertight seal.
   b. Without Concrete Encasement: Install watertight entrance seal device on each side.
   c. With Concrete Encasement: Install watertight entrance seal device on accessible side.
   d. Securely anchor malleable iron body of watertight entrance seal device into construction with one or more integral flanges.
   e. Secure membrane waterproofing to watertight entrance seal device in a permanent, watertight manner.
3. Manholes and Handholes:
   a. Metallic Raceways: Provide insulated grounding bushings.
   b. Nonmetallic Raceways: Provide bell ends flush with wall.
   c. Install such that raceways enter as near as possible to one end of wall, unless otherwise shown.

3.06 SUPPORT

A. Support from structural members only, at intervals not exceeding NFPA 70 requirements. Do not exceed 8 feet in any application. Do not support from piping, pipe supports, or other raceways.

B. Multiple Adjacent Raceways: Provide ceiling trapeze. For trapeze-supported conduit, allow 20 percent extra space for future conduit.

C. Application/Type of Conduit Strap:

1. Rigid Steel or EMT Conduit: Zinc coated steel, pregalvanized steel or malleable iron.
2. PVC-Coated Rigid Steel Conduit: PVC-coated metal.
3. Nonmetallic Conduit: Nonmetallic or PVC-coated metal.

D. Provide and attach wall brackets, strap hangers, or ceiling trapeze as follows:

1. Concrete or Brick: Expansion shields, or threaded studs driven in by powder charge, with lock washers and nuts.

2. Steelwork: Machine screws.
3. Location/Type of Hardware:
   a. Wet, Noncorrosive Areas: Stainless steel.

3.07 BENDS

A. Install concealed raceways with a minimum of bends in the shortest practical distance.

B. Make bends and offsets of longest practical radius. Bends in conduits and ducts being installed for fiber optic cables shall be not less than 20 times cable diameter, 15 inches minimum.

C. Install with symmetrical bends or cast metal fittings.

D. Avoid field-made bends and offsets, but where necessary, make with acceptable hickey or bending machine. Do not heat metal raceways to facilitate bending.

E. Make bends in parallel or banked runs from same center or centerline with same radius so that bends are parallel.

F. Factory elbows may be installed in parallel or banked raceways if there is change in plane of run, and raceways are same size.

G. PVC Conduit:

1. Bends 30 Degrees and Larger: Provide factory-made elbows.
2. 90-Degree Bends: Provide rigid steel elbows, PVC-coated where direct buried.
3. Use manufacturer’s recommended method for forming smaller bends.

H. Flexible Conduit: Do not make bends that exceed allowable conductor bending radius of cable to be installed or that significantly restricts conduit flexibility.

3.08 EXPANSION/DEFLECTION FITTINGS

A. Provide on raceways at structural expansion joints and in long tangential runs.

B. Provide expansion/deflection joints for 50 degrees F maximum temperature variation.

C. Install in accordance with manufacturer’s instructions.

3.09 PVC CONDUIT

A. Solvent Welding:

1. Apply manufacturer recommended solvent to joints.
2. Install in order that joint is watertight.

B. Adapters:

1. PVC to Metallic Fittings: PVC terminal type.
2. PVC to Rigid Metal Conduit or IMC: PVC female adapter.

C. Belled-End Conduit: Bevel unbelled end of joint prior to joining.

3.10 PVC-COATED RIGID STEEL

A. Install in accordance with manufacturer's instructions.

B. Tools and equipment used in cutting, bending, threading and installation of PVC-coated rigid conduit shall be designed to limit damage to PVC coating.

C. Provide PVC boot to cover exposed threading.

3.11 TERMINATION AT ENCLOSURES

A. Cast Metal Enclosure: Install manufacturer's premolded insulating sleeve inside metallic conduit terminating in threaded hubs.

B. Sheet Metal Boxes, Cabinets, and Enclosures:

1. General:
   a. Install insulated bushing on ends of conduit where grounding is not required.
   b. Provide insulated throat when conduit terminates in sheet metal boxes having threaded hubs.
   c. Utilize sealing locknuts or threaded hubs on sides and bottom of NEMA 3R and NEMA 12 enclosures.
   d. Terminate conduits at threaded hubs at the tops of NEMA 3R and NEMA 12 boxes and enclosures.
   e. Terminate conduits at threaded conduit hubs at NEMA 4 and NEMA 4X boxes and enclosures.
2. Rigid Galvanized Conduit:
   a. Provide one lock nut each on inside and outside of enclosure.
   b. Install grounding bushing at source enclosure.

c. Provide bonding jumper from grounding bushing to equipment ground bus or ground pad.

3. Electric Metallic Tubing: Provide gland compression, insulated connectors.
4. Flexible Metal Conduit: Provide two screw type, insulated, malleable iron connectors.
5. Flexible, Nonmetallic Conduit: Provide nonmetallic, liquid-tight strain relief connectors.
6. PVC-Coated Rigid Galvanized Steel Conduit: Provide PVC-coated, liquid-tight, metallic connector.
7. PVC Schedule 40 Conduit: Provide PVC terminal adapter with lock nut, except where threaded hubs required above.

C. Motor Control Center, Switchboard, and Free-Standing Enclosures:

1. Terminate metal conduit entering bottom with grounding bushing; provide grounding jumper extending to equipment ground bus or grounding pad.
2. Terminate PVC conduit entering bottom with bell end fittings.

3.12 UNDERGROUND RACEWAYS

A. Grade: Maintain minimum grade of 4 inches in 100 feet, either from one manhole, handhole, or pullbox to the next, or from a high point between them, depending on surface contour.

B. Cover: Maintain minimum 2-foot cover above conduit and concrete encasement, unless otherwise shown.

C. Make routing changes as necessary to avoid obstructions or conflicts.

D. Couplings: In multiple conduit runs, stagger so couplings in adjacent runs are not in same transverse line.

E. Union type fittings not permitted.

F. Spacers:

1. Provide preformed, nonmetallic spacers designed for such purpose, to secure and separate parallel conduit runs in a trench or concrete encasement.
2. Install at intervals not greater than that specified in NFPA 70 for support of the type conduit used, but in no case greater than 10 feet.

G. Support conduit so as to prevent bending or displacement during backfilling or concrete placement.

H. Transition from Underground to Exposed: PVC-coated rigid steel conduit.

I. Installation with Other Piping Systems:

1. Crossings: Maintain minimum 12-inch vertical separation.
2. Parallel Runs: Maintain minimum 12-inch separation.
3. Installation over valves or couplings not permitted.

J. Provide expansion fittings that allow minimum of 4 inches of movement in vertical conduit runs from underground where exposed conduit will be fastened to or will enter building or structure.

K. Provide expansion/deflection fittings in conduit runs that exit building or structure belowgrade. Conduit from building wall to fitting shall be PVC-coated rigid steel.

L. Backfill:

1. As specified in Section 31 23 23.15, Trench Backfill. Controlled low strength fill is an acceptable bedding and pipe zone material. Backfill material to within 12 inches of surface.
2. Do not backfill until inspected by Engineer.

3.13 UNDER SLAB RACEWAYS

A. Make routing changes as necessary to avoid obstructions or conflicts.

B. Support raceways so as to prevent bending or displacement during backfilling or concrete placement.

C. Install raceways with no part embedded within slab and with no interference with slab on grade construction.

D. Raceway spacing, in a single layer or multiple layers:

1. 3 inches clear between adjacent 2-inch or larger raceway.
2. 2 inches clear between adjacent 1-1/2-inch or smaller raceway.

E. Multiple Layers of Raceways: Install under slab on grade in trench below backfill zone, as specified in Section 31 23 23.15, Trench Backfill.

F. Individual Raceways and Single Layer Multiple Raceways: Install at lowest elevation of backfill zone with spacing as specified herein. Where conduits

cross at perpendicular orientation, installation of conduits shall not interfere with placement of under slab fill that meets compaction and void limitations of earthwork specifications.

G. Under slab raceways that emerge from below slab to top of slab as exposed, shall be located to avoid conflicts with structural slab rebar. Coordinate raceway stub ups with location of structural rebar.

H. Fittings:

1. Union type fittings are not permitted.
2. Provide expansion/deflection fittings in raceway runs that exit building or structure below slab. Locate fittings 18 inches, maximum, beyond exterior wall. Raceway type between building exterior wall to fitting shall be PVC-coated rigid steel.
3. Couplings: In multiple raceway runs, stagger so couplings in adjacent runs are not in same traverse line.

3.14 OUTLET AND DEVICE BOXES

A. General:

1. Install plumb and level.
2. Install suitable for conditions encountered at each outlet or device in wiring or raceway system, sized to meet NFPA 70 requirements.
3. Open no more knockouts in sheet steel device boxes than are required; seal unused openings.
4. Install galvanized mounting hardware in industrial areas.

B. Size:

1. Depth: Minimum 2 inches, unless otherwise required by structural conditions. Box extensions not permitted.
   a. Hollow Masonry Construction: Install with sufficient depth such that conduit knockouts or hubs are in masonry void space.
2. Ceiling Outlet: Minimum 4-inch octagonal device box, unless otherwise required for installed fixture.
3. Switch and Receptacle: Minimum 2-inch by 4-inch device box.

C. Locations:

1. Drawing locations are approximate.
2. To avoid interference with mechanical equipment or structural features, relocate outlets as directed by Engineer.

3. Light Fixture: Install in symmetrical pattern according to room layout, unless otherwise shown.

D. Mounting Height:

1. General:
   a. Dimensions given to centerline of box.
   b. Where specified heights do not suit building construction or finish, adjust up or down to avoid interference.
   c. Do not straddle CMU block or other construction joints.
2. Light Switch:
   a. 48 inches above floor.
   b. When located next to door, install on lock side of door.
3. Convenience Receptacle:
   a. Outdoor Areas: 24 inches above finished grade.
4. Special-Purpose Receptacle: 24 inches above floor or as shown.
5. Switch, Motor Starting: 48 inches above floor, unless otherwise indicated on Drawings.

E. Supports:

1. Support boxes independently of conduit by attachment to building structure or structural member.
2. Install bar hangers in frame construction or fasten boxes directly as follows:
   a. Steelwork: Machine screws.

3.15 JUNCTION AND PULLBOXES

A. General:

1. Install plumb and level.
2. Installed boxes shall be accessible.
3. Do not install on finished surfaces.
4. Use outlet boxes as junction and pullboxes wherever possible and allowed by applicable codes.
5. Use conduit bodies as junction and pullboxes where no splices are required and allowed by applicable codes.
6. Install pullboxes where necessary in raceway system to facilitate conductor installation.
7. Install where shown and where necessary to terminate, tap-off, or redirect multiple conduit runs.
8. Install in conduit runs at least every 150 feet or after the equivalent of three right-angle bends.

B. Mounting Hardware:

1. Noncorrosive Wet Areas: Stainless steel.

C. Supports:

1. Support boxes independently of conduit by attachment to building structure or structural member.
2. Install bar hangers in frame construction or fasten boxes directly as follows:
   a. Steelwork: Machine screws.
3. Boxes embedded in concrete or masonry need not be additionally supported.

D. At or Below Grade:

1. Install boxes for below grade conduit flush with finished grade in locations outside of paved areas, roadways, or walkways.
2. If adjacent structure is available, box may be mounted on structure surface just above finished grade in accessible but unobtrusive location.
3. Obtain Engineer's written acceptance prior to installation in paved areas, roadways, or walkways.
4. Use boxes and covers suitable to support anticipated weights.

E. Install Drain/breather fittings in NEMA 250 Type 4 and Type 4X enclosures.

3.16 MANHOLES AND HANDHOLES

A. Excavate, shore, brace, backfill, and final grade in accordance with Section 31 23 16, Excavation, and Section 31 23 23.15, Trench Backfill.

B. Do not install until final raceway grading has been determined.

C. Install such that raceway enters at nearly right angle and as near as possible to end of wall, unless otherwise shown.

D. Grounding: As specified in Section 26 05 26, Grounding and Bonding for Electrical Systems.

E. Identification: Field stamp covers with manhole or handhole number as shown. Stamped numbers to be 1-inch minimum height.

3.17 EMPTY RACEWAYS

A. Provide permanent, removable cap over each end.

B. Provide PVC plug with pull tab for underground raceways with end bells.

C. Provide nylon pull cord.

D. Identify, as specified in Article Identification Devices, with waterproof tags attached to pull cord at each end, and at intermediate pull point.

3.18 IDENTIFICATION DEVICES

A. Raceway Tags:

1. Identify origin and destination.
2. For exposed raceways, install tags at each terminus, near midpoint, and at minimum intervals of every 50 feet, whether in ceiling space or surface mounted.
3. Install tags at each terminus for concealed raceways.
4. Provide nylon strap for attachment.

B. Warning Tape: Install approximately 12 inches above underground or concrete-encased raceways. Align parallel to, and within 12 inches of, centerline of run.

C. Buried Raceway Marker:

1. Install at grade to indicate direction of underground raceway.
2. Install at bends and at intervals not exceeding 100 feet in straight runs.
3. Embed and secure to top of concrete base, sized 14 inches long, 6 inches wide, and 8 inches deep; top set flush with finished grade.

3.19 PROTECTION OF INSTALLED WORK

A. Protect products from effects of moisture, corrosion, and physical damage during construction.

B. Provide and maintain manufactured watertight and dust-tight seals over conduit openings during construction.

C. Touch up painted conduit threads after assembly to cover nicks or scars.

D. Touch up coating damage to PVC-coated conduit with patching compound approved by manufacturer. Compound shall be kept refrigerated according to manufacturers' instructions until time of use.

END OF SECTION

SECTION 26 05 70
ELECTRICAL SYSTEMS ANALYSIS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American National Standards Institute (ANSI).
2. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
   a. C57.12.00, Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.
   b. 242, Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
   c. 399, Recommended Practice for Industrial and Commercial Power System Analysis.
   d. 519, Recommended Practices and requirements for Harmonic Control in Electrical Power Systems.
   e. 1584, Guide for Performing Arc Flash Hazard Calculations, 2018 edition.
3. National Electrical Manufacturers Association (NEMA): Z535.4, Product Safety Signs and Labels.
4. National Fire Protection Association (NFPA):
   a. 70, National Electrical Code (NEC).
   b. 70E, Standard for Electrical Safety in the Workplace.
5. Occupational Safety and Health Standards (OSHA): 29 CFR, Part 1910 Subpart S, Electrical.

1.02 SUBMITTALS

A. Action Submittals:

1. Initial Short circuit study.
2. Final Short circuit study.
3. Protective Device Coordination Study: Submit within 90 days after approval of initial short circuit study.
4. Final Protective Device Coordination Study.
5. Arc Flash Study: Submit initial study with protective Device Coordination Study. Submit final study prior to equipment energization.
6. Arc flash warning labels; submit sample with initial study.
7. Electronic files on USB Flash Drive of final studies including all engineering software input files, output reports, and libraries.

1.03 QUALITY ASSURANCE

A. Short circuit and protective device coordination and arc flash studies shall be prepared by a professional electrical engineer registered in the State of California, in accordance with IEEE 242 and IEEE 399.

1.04 SEQUENCING AND SCHEDULING

A. Initial complete short circuit study shall be submitted and reviewed before Engineer will review Shop Drawings for switchboard equipment.

B. Initial complete protective device coordination and arc flash studies shall be submitted within 90 days after approval of initial short circuit study.

C. Initial complete arc flash study shall be submitted and accepted prior to energization of the electrical equipment.

D. Revised short circuit, protective device coordination, and arc flash studies, and arc flash labels shall be submitted 10 days before energizing electrical equipment.

E. Final short circuit, protective device coordination, and arc flash studies shall be completed prior to Project Substantial Completion. Final version of study shall include as-installed equipment, materials, and parameter data or settings entered into equipment based on study.

F. Submit final arc flash labels described herein and in compliance with NEMA Z535.4 prior to approved Facility Performance Demonstration/Certificates, per Section 01 91 14, Equipment Testing and Facility Startup.

1.05 GENERAL STUDY REQUIREMENTS

A. Equipment and component titles used in the studies shall be identical to equipment and component titles shown on Drawings.

B. Perform studies using one of the following electrical engineering software packages:

1. SKM Power Tools for Windows.
2. ETAP.
3. Paladin.
4. Easy Power.

C. Perform complete fault calculations for each proposed source combination.

1. Source combination may include present and future power company supply circuits, large motors, or generators.

D. Utilize proposed load data for study obtained from Contract Documents.

E. Device coordination time-current curves for low voltage distribution system; include individual protective device time-current characteristics.

1.06 SHORT CIRCUIT STUDY

A. General:

1. Prepare in accordance with IEEE 399.
2. Use cable impedances based on copper conductors, except where aluminum conductors are specified or shown.
3. Use bus impedances based on copper bus bars, except where aluminum bus bars are specified or shown.
4. Use cable and bus resistances calculated at 25 degrees C.
5. Use medium-voltage cable reactances based on use of typical dimensions of shielded cables with 133 percent insulation levels.
6. Use 600-volt cable reactances based on use of typical dimensions of THHN/THWN conductors.
7. Use transformer impedances 92.5 percent of “nominal” impedance based on tolerances specified in IEEE C57.12.00.

B. Provide:

1. Calculation methods and assumptions.
2. Typical calculation.
3. Tabulations of calculated quantities.
4. Results, conclusions, and recommendations.
5. Selected base per unit quantities.
6. One-line diagrams.
7. Source impedance data, including electric utility system and motor fault contribution characteristics.
8. Impedance diagrams.
9. Zero-sequence impedance diagrams.

C. Calculate short circuit interrupting and momentary (when applicable) duties for an assumed three-phase bolted fault at each:

1. Electric utility’s supply termination point.
2. Main switchboard.

3. Low-voltage switchboards.
4. Motor control centers.
5. Branch circuit panelboards.
6. Future load contributions as shown on one-line diagram.

D. Provide bolted line-to-ground fault current study for areas as defined for three-phase bolted fault short circuit study.

E. Provide bolted line-to-line fault current study for areas as defined for three-phase bolted fault short circuit study.

F. Verify:

1. Equipment and protective devices are applied within their ratings.
2. Adequacy of switchboard and motor control centers bus bars to withstand short circuit stresses.
3. Adequacy of transformer windings to withstand short circuit stresses.
4. Cable and busway sizes for ability to withstand short circuit heating, in addition to normal load currents.

G. Tabulations:

1. General Data:
   a. Short circuit reactances of rotating machines.
   b. Cable and conduit material data.
   c. Bus data.
   d. Transformer data.
   e. Circuit resistance and reactance values.
2. Short Circuit Data:
   a. Fault impedances.
   b. X to R ratios.
   c. Asymmetry factors.
   d. Motor contributions.
   e. Short circuit kVA.
   f. Symmetrical and asymmetrical fault currents.
3. Equipment Evaluation:
   a. Equipment bus bracing, equipment short circuit rating, transformer, cable, busway.
   b. Maximum fault current available.

H. Written Summary:

1. Scope of studies performed.
2. Explanation of bus and branch numbering system.
3. Prevailing conditions.

4. Selected equipment deficiencies.
5. Results of short circuit study.
6. Comments or suggestions.

I. Suggest changes and additions to equipment rating and/or characteristics.

J. Notify Engineer in writing of existing circuit protective devices improperly rated for new fault conditions.

K. Revise data for “as-installed” condition.

1.07 PROTECTIVE DEVICE COORDINATION STUDY

A. General:

1. Prepare in accordance with IEEE 242.
2. Proposed protective device coordination time-current curves for distribution system, graphically displayed on conventional log-log curve sheets.
   a. Provide separate curve sheets for phase and ground fault coordination for each scenario.
   b. Each curve sheet to have title and one-line diagram that applies to specific portion of system associated with time-current curves on that sheet. Limit number of devices shown to four to six.
   c. Identify device associated with each curve by manufacturer type, function, and, if applicable, recommended tap, time delay, instantaneous and other settings recommended.
   d. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which device is exposed.
   e. Apply motor protection methods that comply with NFPA 70.

B. Plot Characteristics on Curve Sheets:

1. Electric utility’s relays.
2. Electric utility’s fuses including manufacturer’s minimum melt, total clearing, tolerance, and damage bands.
3. Low-voltage fuses including manufacturer’s minimum melt, total clearing, tolerance, and damage bands.
4. Low-voltage equipment circuit breaker trip devices, including manufacturers tolerance bands.
5. Pertinent transformer full-load currents at 100 percent.
6. Transformer magnetizing inrush currents.
7. Transformer damage curves; appropriate for system operation and location.

8. ANSI transformer withstand parameters.
9. Significant symmetrical and asymmetrical fault currents.
10. Motor overload relay settings for motors greater than 40 hp.
11. Ground fault protective device settings.
12. Other system load protective devices for largest branch circuit and feeder circuit breaker in each motor control center.

C. Primary Protective Device Settings for Delta-Wye Connected Transformer:

1. Secondary Line-to-Ground Fault Protection: Primary protective device operating band within transformer's characteristics curve, including a point equal to 58 percent of IEEE C57.12.00 withstand point.
2. Secondary Line-to-Line Faults: 16 percent current margin between primary protective device and associated secondary device characteristic curves.

D. Separate medium voltage relay characteristics curves from curves for other devices by at least 0.4-second time margin.

E. Tabulate Recommended Protective Device Settings:

1. Relays:
   a. Current tap.
   b. Time dial.
   c. Instantaneous pickup.
   d. Electronic settings data file.
2. Circuit Breakers:
   a. Adjustable pickups.
   b. Adjustable time-current characteristics.
   c. Adjustable time delays.
   d. Adjustable instantaneous pickups.
   e. I^2t In/Out.
   f. Zone interlocking.
   g. Electronic settings data file.

F. Written Summary:

1. Scope of studies performed.
2. Summary of protective device coordination methodology.
3. Prevailing conditions.
4. Selected equipment deficiencies.
5. Results of coordination study.
6. Appendix of complete relay and circuit breaker electronic setting files, submit electronic data files from manufacturer's software.
7. Comments or suggestions.

1.08 ARC FLASH STUDY

A. Perform arc flash hazard study after short circuit and protective device coordination study has been completed, reviewed and accepted.

B. Perform arc flash study in accordance with NFPA 70E, OSHA 29 CFR, Part 1910 Subpart S, and IEEE 1584.

C. Base Calculation:

1. For each major part of electrical power system, determine the following:
   a. Flash hazard protection boundary.
   b. Limited approach boundary.
   c. Restricted approach boundary.
   d. Incident energy level.
   e. Glove class required.

D. Produce arc flash warning labels that list items in Paragraph Base Calculation, and the following additional items.

1. Bus name.
2. Bus voltage.

E. Produce bus detail sheets that list items in Paragraph Base Calculation, and the following additional items:

1. Bus name.
2. Upstream protective device name, type, and settings.
3. Bus line-to-line voltage.

F. Produce arc flash evaluation summary sheet listing the following additional items:

1. Bus name.
2. Upstream protective device name, type, settings.
3. Bus line-to-line voltage.
4. Bus bolted fault.
5. Protective device bolted fault current.
6. Arcing fault current.
7. Protective device trip/delay time.
8. Breaker opening time.
9. Solidly grounded column.
10. Equipment type.
11. Gap.

12. Arc flash boundary.
13. Working distance.
14. Incident energy.

G. Analyze short circuit, protective device coordination, and arc flash calculations and highlight equipment that is determined to be underrated or causes incident energy values greater than 8 cal/cm^2. Propose approaches to reduce energy levels.

H. Prepare report summarizing arc flash study with conclusions and recommendations which may affect integrity of electric power distribution system. As a minimum, include the following:

1. Equipment manufacturer's information used to prepare study.
2. Assumptions made during study.
3. Reduced copy of one-line drawing; 11 inches by 17 inches maximum.
4. Arc flash evaluations summary spreadsheet.
5. Bus detail sheets.
6. Arc flash warning labels printed in color on thermally bonded adhesive backed UV and weather-resistant labels.

PART 2 PRODUCTS

2.01 ARC FLASH WARNING LABELS

A. Arc flash warning labels printed in color on thermally bonded adhesive backed, UV- and weather-resistant labels. An example label is located following end of this section in Figure 1 and Figure 2.

PART 3 EXECUTION

3.01 GENERAL

A. Adjust relay and protective device settings according to values established by coordination study.

B. Make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.

C. Notify Engineer in writing of required major equipment modifications.

D. Provide laminated one-line diagrams (minimum size 11 inches by 17 inches) to post on interior of electrical room doors.

E. Provide arc flash labels according to the following types:

1. For incident energy levels less than 40 cal/cm^2 provide warning label similar to Figure 1, in Article Supplements.
2. For incident energy levels greater than 40 cal/cm^2 provide danger label similar to Figure 2, in Article Supplements.

F. Provide arc flash warning labels on the following equipment:

1. Utility metering equipment.
2. Incoming service disconnecting means.
3. Switchboards.
4. Motor control centers.
5. Panelboards.
6. Control cabinets fed by 120 volts or greater.
7. Equipment requiring servicing, adjustment, or inspection while energized.

3.02 SUPPLEMENTS

A. The supplements listed below, following “End of Section,” are part of this Specification:

1. Figure 1: Example Arc Flash Warning Label.
2. Figure 2: Example Arc Flash Danger Label.

END OF SECTION

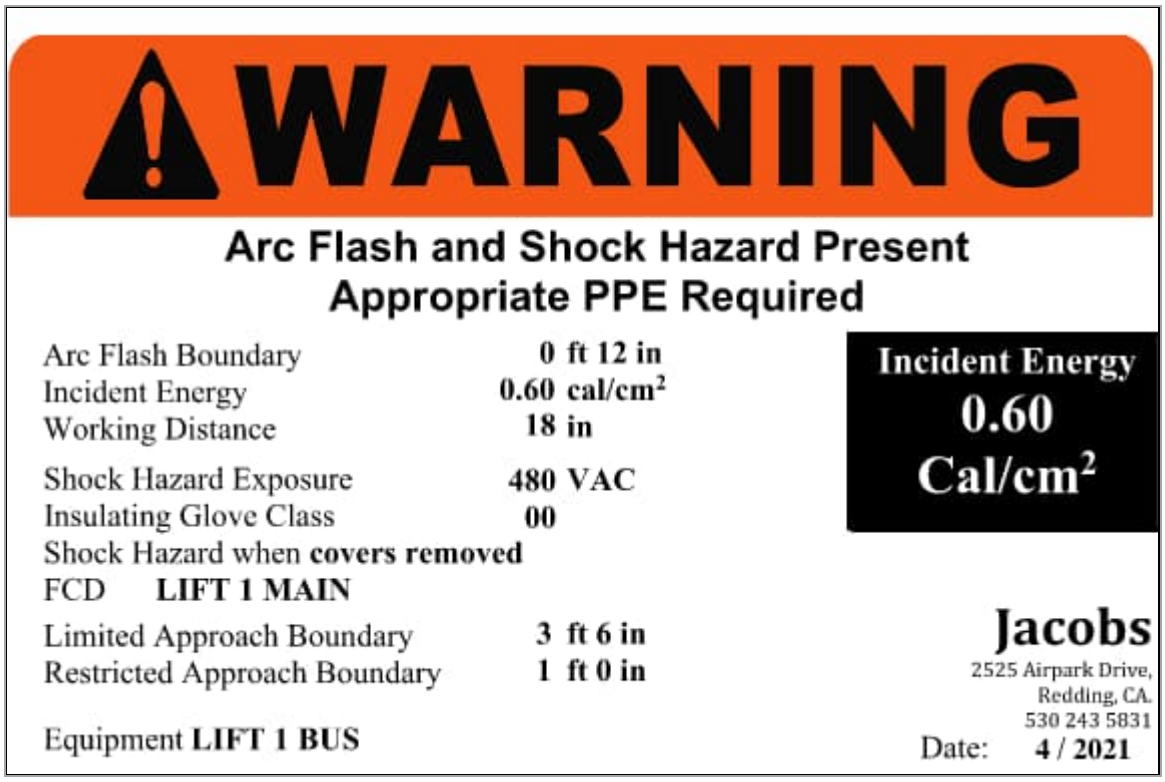


Figure 1
Example Arc Flash Warning Label

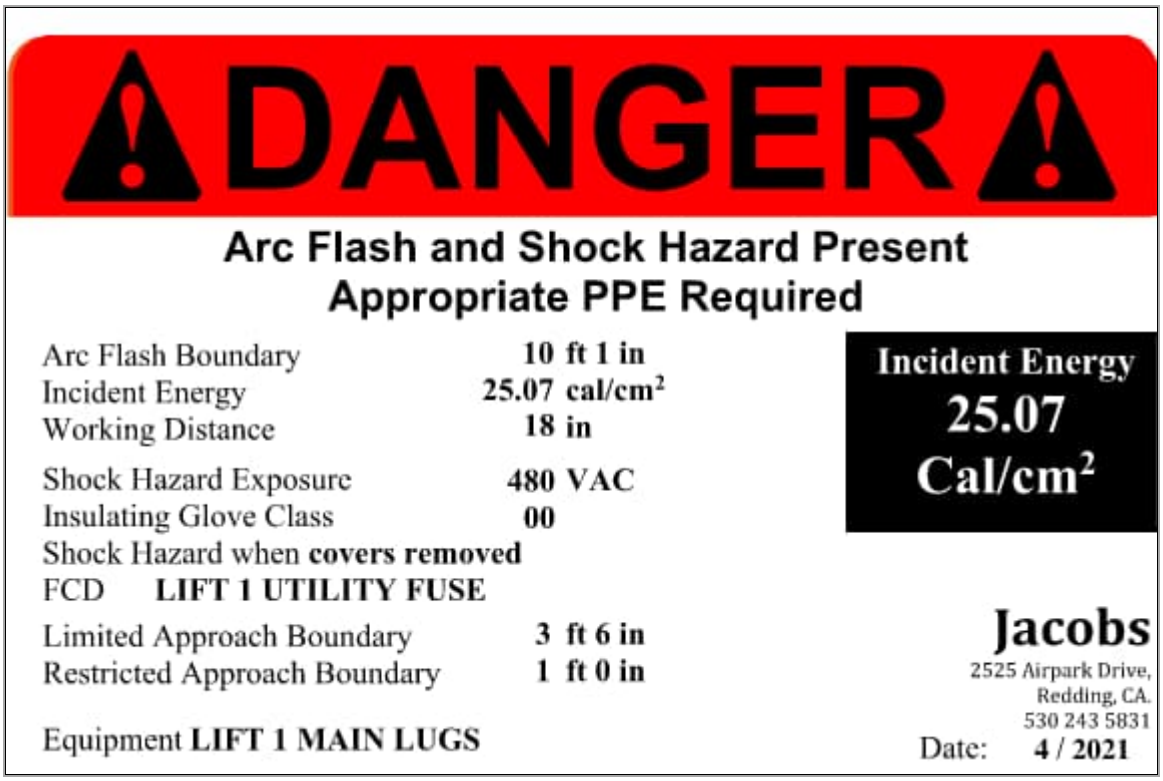


Figure 2
Example Arc Flash Danger Label

SECTION 26 08 00
COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. D877/D877M, Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes.
   b. D923, Standard Practices for Sampling Electrical Insulating Liquids.
   c. D924, Standard Test Method for Dissipation Factor (or Power Factor) and Relative Permittivity (Dielectric Constant) of Electrical Insulating Liquids.
   d. D971, Standard Test Method for Interfacial Tension of Oil Against Water by the Ring Method.
   e. D974, Standard Test Method for Acid and Base Number by Color-Indicator Titration.
   f. D1298, Standard Test Method for Density, Relative Density, or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method.
   g. D1500, Standard Test Method for ASTM Color of Petroleum Products (ASTM Color Scale).
   h. D1524, Standard Test Method for Visual Examination of Used Electrical Insulating Liquids in the Field.
   i. D1533, Standard Test Method for Water in Insulating Liquids by Coulometric Karl Fischer Titration.
   j. D1816, Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using VDE Electrodes.
2. Institute of Electrical and Electronics Engineers (IEEE):
   a. 43, Recommended Practice for Testing Insulation Resistance of Electric Machinery.
   b. 48, Standard Test Procedures and Requirements for Alternating-Current Cable Terminators Used on Shielded Cables Having Laminated Insulation Rated 2.5 kV through 765 kV or Extruded Insulation Rated 2.5 kV through 500 kV.
   c. 81, Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.
   d. 95, Recommended Practice for Insulation Testing of AC Electric Machinery (2300V and Above) with High Direct Voltage.

e. 386, Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V.
f. 400, Guide for Field Testing and Evaluation of the Insulation of Shielded Power Cable Systems Rated 5 kV and Above.
g. 450, Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications.
h. C2, National Electrical Safety Code.
i. C37.20.1, Standard for Metal-Enclosed Low-Voltage (1000 Vac and below, 3200 Vdc and below) Power Circuit Breaker Switchgear.
j. C37.20.2, Standard for Metal-Clad Switchgear.
k. C37.20.3, Standard for Metal-Enclosed Interrupter Switchgear.
l. C37.23, Standard for Metal-Enclosed Bus.
m. C62.33, Standard Test Methods and Performance Values for Metal-Oxide Varistor Surge Protective Components.

3. Insulated Cable Engineers Association (ICEA):
   a. S-93-639, 5-46 kV Shielded Power Cables for Use in the Transmission and Distribution of Electric Energy.
   b. S-94-649, Concentric Neutral Cables Rated 5 through 46 kV.
   c. S-97-682, Standard for Utility Shielded Power Cables Rated 5 through 46 kV.
4. National Electrical Manufacturers Association (NEMA):
   a. AB 4, Guidelines for Inspection and Preventive Maintenance of Molded Case Circuit Breakers Used in Commercial and Industrial Applications.
   b. PB 2, Deadfront Distribution Switchboards.
   c. WC 74, 5-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy.
5. InterNational Electrical Testing Association (NETA): ATS, Acceptance Testing Specifications for Electrical Power Equipment and Systems.
6. National Fire Protection Association (NFPA):
   a. 70, National Electrical Code (NEC).
   b. 70B, Recommended Practice for Electrical Equipment Maintenance.
   c. 70E, Standard for Electrical Safety in the Workplace.
   d. 101, Life Safety Code.
7. National Institute for Certification in Engineering Technologies (NICET).
8. Occupational Safety and Health Administration (OSHA): CFR 29, Part 1910, Occupational Safety and Health Standards.

1.02 SUBMITTALS

A. Informational Submittals:

1. Submit 30 days prior to performing inspections or tests:
   a. Testing firm qualifications.
   b. Schedule for performing inspection and tests.
   c. List of references to be used for each test.
   d. Sample copy of equipment and materials inspection form(s).
   e. Sample copy of individual device test form.
   f. Sample copy of individual system test form.
2. Energization Plan:
   a. Prior to initial energization of electrical distribution equipment; include the following:
      1) Owner’s representative sign-off form for complete and accurate arc flash labeling and proper protective device settings for equipment to be energized.
      2) Staged sequence of initial energization of electrical equipment.
      3) Lock-Out-Tag-Out plan for each stage of the progressive energization.
      4) Barricading, signage, and communication plan notifying personnel of newly energized equipment.
3. Submit test or inspection reports and certificates for each electrical item tested within 30 days after completion of test.
4. Commissioning Report:
   a. Prior to turn-over of the facility to the Owner, provide a written report documenting the following:
      1) Project summary.
      2) Electrical system description.
      3) Identification of systems or assemblies that do not meet project requirements.
      4) Analysis and recommendations.
      5) Commissioning log listing closed and open issues.
      6) Resolution plan for incomplete tasks.
5. Operation and Maintenance Data:
   a. In accordance with Section 01 78 23, Operation and Maintenance Data.
   b. After test or inspection reports and certificates have been reviewed by Engineer and returned, insert a copy of each in Operation and Maintenance Manual.

6. Programmable Settings:
   a. At completion of Facility Performance Demonstration, as specified in Section 01 91 14, Equipment Testing and Facility Startup, submit final hardcopy printout and electronic files of as-left setpoints, programs, and device configuration files for:
      1) Protective relays.
      2) Intelligent overload relays.
      3) Adjustable frequency drives.
      4) Power metering devices.
      5) Uninterruptible power supplies.
      6) Electrical communications modules.

1.03 QUALITY ASSURANCE

A. Testing Firm Qualifications:

1. Corporately and financially independent organization functioning as an unbiased testing authority.
2. Professionally independent of manufacturers, suppliers, and installers of electrical equipment and systems being tested.
3. Employer of engineers and technicians regularly engaged in testing and inspecting of electrical equipment, installations, and systems.
4. Supervising engineer accredited as Certified Electrical Test Technologist by NICET or NETA and having a minimum of 5 years' testing experience on similar projects.
5. Technicians certified by NICET or NETA.
6. Assistants and apprentices assigned to Project at ratio not to exceed two certified to one noncertified assistant or apprentice.
7. Registered Professional Engineer to provide comprehensive Project report outlining services performed, results of such services, recommendations, actions taken, and opinions.
8. In compliance with OSHA CFR 29, Part 1910.7 criteria for accreditation of testing laboratories or a full member company of NETA.

B. Test equipment shall have an operating accuracy equal to or greater than requirements established by NETA ATS.

C. Test Instrument Calibration: In accordance with NETA ATS.

1.04 SEQUENCING AND SCHEDULING

A. Perform inspection and electrical tests after equipment listed herein has been installed.

B. Perform tests with apparatus de-energized whenever feasible.

1. Scheduled with Engineer and Owner prior to de-energization.
2. Minimized to avoid extended period of interruption to the operating plant equipment.

C. Notify Engineer and Owner at least 24 hours prior to performing tests on energized electrical equipment.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. Perform tests in accordance with requirements of Section 01 91 14, Equipment Testing and Facility Startup.

B. Tests and inspections shall establish:

1. Electrical equipment is operational within industry and manufacturer's tolerances and standards.
2. Installation operates properly.
3. Equipment is suitable for energization.
4. Installation conforms to requirements of Contract Documents and NFPA 70, NFPA 70E, NFPA 101, and IEEE C2.

C. Perform inspection and testing in accordance with NETA ATS, industry standards, and manufacturer's recommendations.

D. Set, test, and calibrate protective relays, circuit breakers, power monitoring meters, and other applicable devices in accordance with values established by studies as specified in Section 26 05 70, Electrical Systems Analysis.

E. Adjust mechanisms and moving parts of equipment for free mechanical movement.

F. Adjust and set electromechanical electronic relays and sensors to correspond to operating conditions, or as recommended by manufacturer.

G. Verify nameplate data for conformance to Contract Documents and approved Submittals.

H. Realign equipment not properly aligned and correct unlevelness.

I. Properly anchor electrical equipment found to be inadequately anchored.

J. Tighten accessible bolted connections, including wiring connections, with calibrated torque wrench/screw driver to manufacturer's recommendations, or as otherwise specified in NETA ATS.

K. Clean contaminated surfaces with cleaning solvents as recommended by manufacturer.

L. Provide proper lubrication of applicable moving parts.

M. Inform Engineer of working clearances not in accordance with NFPA 70.

N. Investigate and Repair or Replace:

1. Electrical items that fail tests.
2. Active components not operating in accordance with manufacturer's instructions.
3. Damaged electrical equipment.

O. Electrical Enclosures:

1. Remove foreign material and moisture from enclosure interior.
2. Vacuum and wipe clean enclosure interior.
3. Remove corrosion found on metal surfaces.
4. Repair or replace, as determined by Engineer door and panel sections having dented surfaces.
5. Repair or replace, as determined by Engineer poor fitting doors and panel sections.
6. Repair or replace improperly operating latching, locking, or interlocking devices.
7. Replace missing or damaged hardware.
8. Finish:
    a. Provide matching paint and touch up scratches and mars.
    b. If required because of extensive damage, as determined by Engineer, refinish entire assembly.

P. Replace fuses and circuit breakers that do not conform to size and type required by the Contract Documents or approved Submittals.

3.02 CHECKOUT AND STARTUP

A. Voltage Field Test:

1. Check voltage at point of termination of power company supply system to Project when installation is essentially complete and is in operation.
2. Check voltage amplitude and balance between phases for loaded and unloaded conditions.
3. Record supply voltage (all three phases simultaneously on same graph) for 24 hours during normal working day.
    a. Submit Voltage Field Test Report within 5 days of test.
4. Unbalance Corrections:
    a. Make written request to power company to correct condition if balance (as defined by NEMA) exceeds 1 percent, or if voltage varies throughout the day and from loaded to unloaded condition more than plus or minus 4 percent of nominal.
    b. Obtain written certification from responsible power company official that voltage variations and unbalance are within their normal standards if corrections are not made.

B. Equipment Line Current Tests:

1. Check line current in each phase for each piece of equipment.
2. Make line current check after power company has made final adjustments to supply voltage magnitude or balance.
3. If phase current for a piece of equipment is above rated nameplate current, prepare Equipment Line Phase Current Report that identifies cause of problem and corrective action taken.

3.03 SWITCHBOARD ASSEMBLIES

A. Visual and Mechanical Inspection:

1. Insulator damage and contaminated surfaces.
2. Proper barrier and shutter installation and operation.
3. Proper operation of indicating devices.
4. Improper blockage of air-cooling passages.
5. Proper operation of drawout elements.
6. Integrity and contamination of bus insulation system.
7. Check door and device interlocking system by:
    a. Closure attempt of device when door is in OPEN position.
    b. Opening attempt of door when device is in ON position.

8. Check nameplates for proper identification of:
    a. Equipment title and tag number with latest one-line diagram.
    b. Circuit breaker.
    c. Indicating meter.
9. Verify fuse and circuit breaker ratings, sizes, and types conform to those specified.
10. Check bus and cable connections for high resistance by low resistance ohmmeter and calibrated torque wrench applied to bolted joints.
    a. Ohmic value to be zero.
    b. Bolt torque level in accordance with NETA ATS, Table 100.12, unless otherwise specified by manufacturer.
11. Check operation and sequencing of electrical and mechanical interlock systems by:
    a. Closure attempt for locked open devices.
    b. Opening attempt for locked closed devices.
    c. Key exchange to operate devices in OFF-NORMAL positions.
12. Verify performance of each control device and feature.
13. Control Wiring:
    a. Compare wiring to local and remote control and protective devices with elementary diagrams.
    b. Proper conductor lacing and bundling.
    c. Proper conductor identification.
    d. Proper conductor lugs and connections.
14. Exercise active components.
15. Perform phasing check on double-ended equipment to ensure proper bus phasing from each source.

B. Electrical Tests:

1. Insulation Resistance Tests:
    a. Applied megohmmeter dc voltage in accordance with NETA ATS, Table 100.1.
    b. Each phase of each bus section.
    c. Phase-to-phase and phase-to-ground for 1 minute.
    d. With switches and breakers open.
    e. With switches and breakers closed.
    f. Control wiring except that connected to solid state components.
    g. Insulation resistance values equal to, or greater than, ohmic values established by manufacturer.
2. Overpotential Tests:
    a. Applied ac voltage and test procedure in accordance with IEEE C37.20.1 and NEMA PB 2.
    b. Each phase of each bus section.

c. Phase-to-phase and phase-to-ground for 1 minute.
d. Test results evaluated on a pass/fail basis.

3. Current Injection Tests:
   a. For entire current circuit in each section.
   b. Secondary injection for current flow of 1 ampere.
   c. Test current at each device.
4. Control Wiring:
   a. Apply secondary voltage to control power and potential circuits.
   b. Check voltage levels at each point on terminal boards and each device terminal.
5. Operational Test:
   a. Initiate control devices.
   b. Check proper operation of control system in each section.

3.04 PANELBOARDS

A. Visual and Mechanical Inspection:

1. Include the following inspections and related work:
   a. Inspect for defects and physical damage, labeling, and nameplate compliance with requirements of up-to-date drawings and panelboard schedules.
   b. Exercise and perform operational tests of mechanical components and other operable devices in accordance with manufacturer’s instruction manual.
   c. Check panelboard mounting, area clearances, and alignment and fit of components.
   d. Check tightness of bolted electrical connections with calibrated torque wrench. Refer to manufacturer’s instructions for proper torque values.
   e. Perform visual and mechanical inspection for overcurrent protective devices.

B. Electrical Tests:

1. Include the following items performed in accordance with manufacturer’s instruction:
   a. Insulation Resistance Tests:
      1) Applied megohmmeter dc voltage in accordance with NETA ATS, Table 100.1.
      2) Each phase of each bus section.
      3) Phase-to-phase and phase-to-ground for 1 minute.
      4) With breakers open.
      5) With breakers closed.

6) Control wiring except that connected to solid state components.
7) Insulation resistance values equal to, or greater than, ohmic values established by manufacturer.

b. Ground continuity test ground bus to system ground.

3.05 DRY TYPE TRANSFORMERS

A. Visual and Mechanical Inspection:

1. Physical and insulator damage.
2. Proper winding connections.
3. Bolt torque level in accordance with NETA ATS, Table 100.12, unless otherwise specified by manufacturer.
4. Defective wiring.
5. Proper operation of fans, indicators, and auxiliary devices.
6. Removal of shipping brackets, fixtures, or bracing.
7. Free and properly installed resilient mounts.
8. Cleanliness and improper blockage of ventilation passages.
9. Verify tap-changer is set at correct ratio for rated output voltage under normal operating conditions.
10. Verify proper secondary voltage phase-to-phase and phase-to-ground after energization and prior to loading.

B. Electrical Tests:

1. Insulation Resistance Tests:
   a. Applied megohmmeter dc voltage in accordance with NETA ATS, Table 100.5 for each:
      1) Winding-to-winding.
      2) Winding-to-ground.
   b. Test Duration: 10 minutes with resistances tabulated at 30 seconds, 1 minute, and 10 minutes.
   c. Results temperature corrected in accordance with NETA ATS, Table 100.14.
   d. Temperature corrected insulation resistance values equal to, or greater than, ohmic values established by manufacturer.
   e. Insulation resistance test results to compare within 1 percent of adjacent windings.
2. Perform tests and adjustments for fans, controls, and alarm functions as suggested by manufacturer.

3.06 LOW VOLTAGE CABLES, 600 VOLTS MAXIMUM

A. Visual and Mechanical Inspection:

1. Inspect each individual exposed power cable No. 6 and larger for:
   a. Physical damage.
   b. Proper connections in accordance with single-line diagram.
   c. Cable bends not in conformance with manufacturer's minimum allowable bending radius where applicable.
   d. Color coding conformance with specification.
   e. Proper circuit identification.
2. Mechanical Connections for:
   a. Proper lug type for conductor material.
   b. Proper lug installation.
   c. Bolt torque level in accordance with NETA ATS, Table 100.12, unless otherwise specified by manufacturer.
3. Shielded Instrumentation Cables for:
   a. Proper shield grounding.
   b. Proper terminations.
   c. Proper circuit identification.
4. Control Cables for:
   a. Proper termination.
   b. Proper circuit identification.
5. Cables Terminated Through Window Type CTs: Verify neutrals and grounds are terminated for correct operation of protective devices.

B. Electrical Tests for Conductors No. 6 and Larger:

1. Insulation Resistance Tests:
   a. Utilize 1,000V dc megohmmeter for 600-volt insulated conductors.
   b. Test each conductor with respect to ground and to adjacent conductors for 1 minute.
   c. Evaluate ohmic values by comparison with conductors of same length and type.
   d. Investigate values less than 50 megohms.
2. Continuity test by ohmmeter method to ensure proper cable connections.

3.07 INSTRUMENT TRANSFORMERS

A. Visual and Mechanical Inspection:

1. Visually check current, potential, and control transformers for:
   a. Cracked insulation.

b. Broken leads or defective wiring.
c. Proper connections.
d. Adequate clearances between primary and secondary circuit wiring.

2. Verify Mechanically:
   a. Grounding and shorting connections have good contact.
   b. Withdrawal mechanism and grounding operation, when applicable, operate properly.
3. Verify proper primary and secondary fuse sizes for potential transformers.

B. Electrical Tests:

1. Current Transformer Tests:
   a. Insulation resistance test of transformer and wiring-to-ground at 1,000V dc for 30 seconds.
   b. Polarity test.
   c. Ratio and accuracy test.
2. Potential Transformer Tests:
   a. Insulation resistance test at test voltages in accordance with NETA ATS, Table 100.9, for 1 minute on:
      1) Winding-to-winding.
      2) Winding-to-ground.
   b. Polarity test to verify polarity marks or H1-X1 relationship as applicable.
   c. Ratio and accuracy test.
3. Insulation resistance measurement on instrument transformer shall not be less than that shown in NETA ATS, Table 100.5.

3.08 METERING

A. Visual and Mechanical Inspection:

1. Verify meter connections in accordance with appropriate diagrams.
2. Verify meter multipliers.
3. Verify meter types and scales conform to Contract Documents.
4. Check calibration of meters at cardinal points.
5. Check calibration of electrical transducers.

3.09 GROUNDING SYSTEMS

A. Visual and Mechanical Inspection:

1. Equipment and circuit grounds in motor control center, panelboard, and switchboard assemblies for proper connection and tightness.

2. Ground bus connections in motor control center, panelboard, and switchboard assemblies for proper termination and tightness.
3. Effective transformer core and equipment grounding.
4. Accessible connections to grounding electrodes for proper fit and tightness.
5. Accessible exothermic-weld grounding connections to verify that molds were fully filled and proper bonding was obtained.

B. Electrical Tests:

1. Fall-of-Potential Test:
   a. In accordance with IEEE 81, Section 8.2.1.5 for measurement of main ground system's resistance.
   b. Main ground electrode system resistance to ground to be no greater than 3 ohm(s).
2. Two-Point Direct Method Test:
   a. In accordance with IEEE 81, Section 8.2.1.1 for measurement of ground resistance between main ground system, equipment frames, and system neutral and derived neutral points.
   b. Equipment ground resistance shall not exceed main ground system resistance by 0.25 ohm.

3.10 GROUND FAULT SYSTEMS

A. Inspection and testing limited to:

1. Zero sequence grounding systems.
2. Residual ground fault systems.

B. Visual and Manual Inspection:

1. Neutral main bonding connection to ensure:
   a. Zero sequence sensing system is grounded ahead of neutral disconnect link.
   b. Ground strap sensing system is grounded through sensing device.
   c. Neutral ground conductor is solidly grounded.
2. Verify control power has adequate capacity for system.
3. Manually operate monitor panels for:
   a. Trip test.
   b. No trip test.
   c. Nonautomatic rest.

4. Zero sequence system for symmetrical alignment of core balance transformers about current carrying conductors.
5. Relay check for pickup and time under simulated ground fault conditions.
6. Verify nameplate identification by device operation.

C. Electrical Tests:

1. Test system neutral insulation resistance with neutral ground link removed; minimum 1 megohm.
2. Determine relay pickup by primary current injection at the sensor. Relay pickup current within plus or minus 10 percent of device dial or fixed setting.
3. Test relay timing by injecting 300 percent of pick-up current or as specified by manufacturer. Relay operating time in accordance with manufacturer's time-current characteristic curves.
4. Test system operation at 55 percent rated control voltage, if applicable.
5. Test zone interlock system by simultaneous sensor current injection and monitoring zone blocking functions.

3.11 AC INDUCTION MOTORS

A. General: Inspection and testing limited to motors rated 5 hp and larger.

B. Visual and Mechanical Inspection:

1. Proper electrical and grounding connections.
2. Shaft alignment.
3. Blockage of ventilating air passageways.
4. Operate motor and check for:
   a. Excessive mechanical and electrical noise.
   b. Overheating.
   c. Correct rotation.
   d. Check vibration detectors, resistance temperature detectors, or motor inherent protectors for function ability and proper operation.
   e. Excessive vibration, in excess of values in NETA ATS, Table 100.10.
5. Check operation of space heaters.

C. Electrical Tests:

1. Insulation Resistance Tests:
   a. In accordance with IEEE 43 at test voltages established by NETA ATS, Table 100.1 for:
      1) Motors above 200 hp for 10-minute duration with resistances tabulated at 30 seconds, 1 minute, and 10 minutes.
      2) Motors 200 hp and less for 1-minute duration with resistances tabulated at 30 seconds and 60 seconds.
   b. Insulation resistance values equal to, or greater than, ohmic values established by manufacturers.
2. Calculate polarization index ratios for motors above 200 hp. Investigate index ratios less than 1.5 for Class A insulation and 2.0 for Class B insulation.
3. Insulation resistance test on insulated bearings in accordance with manufacturer's instructions.
4. Measure running current and voltage, and evaluate relative to load conditions and nameplate full-load amperes.

3.12 LOW-VOLTAGE MOTOR CONTROL

A. Visual and Mechanical Inspection:

1. Proper barrier and shutter installation and operation.
2. Proper operation of indicating and monitoring devices.
3. Proper overload protection for each motor.
4. Improper blockage of air-cooling passages.
5. Proper operation of drawout elements.
6. Integrity and contamination of bus insulation system.
7. Check door and device interlocking system by:
   a. Closure attempt of device when door is in OPEN position.
   b. Opening attempt of door when device is in ON position.
8. Check nameplates for proper identification of:
   a. Equipment title and tag number with latest one-line diagram.
   b. Pushbuttons.
   c. Control switches.
   d. Pilot lights.
   e. Control relays.
   f. Circuit breakers.
   g. Indicating meters.
9. Verify fuse and circuit breaker sizes and types conform to Contract Documents.

10. Verify current and potential transformer ratios conform to Contract Documents.
11. Check bus connections for high resistance by low-resistance ohmmeter.
12. Ohmic value to be zero.
13. Check operation and sequencing of electrical and mechanical interlock systems by:
    a. Closure attempt for locked open devices.
    b. Opening attempt for locked closed devices.
    c. Key exchange to operate devices in OFF-NORMAL positions.
14. Verify performance of each control device and feature furnished as part of motor control center.
15. Control Wiring:
    a. Compare wiring to local and remote control, and protective devices with elementary diagrams.
    b. Check for proper conductor lacing and bundling.
    c. Check for proper conductor identification.
    d. Check for proper conductor lugs and connections.
16. Exercise active components.
17. Inspect Contactors for:
    a. Correct mechanical operations.
    b. Correct contact gap, wipe, alignment, and pressure.
    c. Correct torque of connections.
18. Compare overload heater rating with full-load current for proper size.
19. Compare circuit breaker with motor characteristics proper size.
20. Perform phasing check on double-ended motor control centers to ensure proper bus phasing from each source.

B. Electrical Tests:

1. Insulation Resistance Tests:
    a. Applied megohmmeter dc voltage in accordance with NETA ATS, Table 100.1.
    b. Bus section phase-to-phase and phase-to-ground for 1 minute on each phase.
    c. Contactor phase-to-ground and across open contacts for 1 minute on each phase.
    d. Starter section phase-to-phase and phase-to-ground on each phase with starter contacts closed and protective devices open.
    e. Test values to comply with NETA ATS, Table 100.1.
2. Current Injection through Overload Unit at 300 Percent of Motor Full-Load Current and Monitor Trip Time:
    a. Trip time in accordance with manufacturer’s published data.
    b. Investigate values in excess of 120 seconds.

3. Control Wiring Tests:
    a. Apply secondary voltage to control power and potential circuits.
    b. Check voltage levels at each point on terminal board and each device terminal.
    c. Insulation resistance test at 1,000V dc on control wiring, except that connected to solid state components; 1 megohm minimum insulation resistance.
4. Operational test by initiating control devices to affect proper operation.

3.13 LOW VOLTAGE SURGE PROTECTIVE DEVICES

A. Visual and Mechanical Inspection:

1. Adequate clearances between arrestors and enclosures.
2. Ground connections to ground bus.

B. Electrical Tests:

1. Varistor Type Arrestors:
    a. Clamping voltage test.
    b. Rated RMS voltage test.
    c. Rated dc voltage test.
    d. Varistor arrestor test values in accordance with IEEE C62.33, Section 4.4 and Section 4.9.

END OF SECTION

SECTION 26 09 13
POWER MEASUREMENT AND CONTROL

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American National Standards Institute (ANSI).
2. Institute for Electrical and Electronics Engineers, Inc. (IEEE):
   a. C37.90, Standard for Relays and Relay Systems Associated with Electric Power Apparatus.
   b. C37.90.1, Standard for Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus.
   c. C57.13, Standard Requirements for Instrument Transformers.
3. International Electrotechnical Commission (IEC):
   a. 60255-26, Measuring Relays and Protection Equipment—Part 26: Electromagnetic Compatibility Requirements.
   b. 60870-5-104, Telecontrol Equipment and Systems—Part 5-104: Transmission Protocols—Network Access for IEC 60870-5-101 Using Standard Transport Profiles.
   c. 61850, Communication Networks and Systems for Power Utility Automation.
4. Telecommunications Industry Association (TIA):
   a. 232-F, Interface between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange.
   b. 485-A, Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems.
5. National Electrical Manufacturers Association (NEMA):
   a. C12.1, Electric Meters Code for Electricity Metering.
   b. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).

1.02 DEFINITIONS

A. CT: Current Transformer.

B. DNP: Distributed Network Protocol.

C. LCD: Liquid Crystal Display.

D. LED: Light Emitting Diode.

E. MPR: Motor Protection Relay.

F. PLC: Programmable Logic Controller.

G. PT: Potential Transformer.

H. RTD: Resistance Temperature Detectors.

I. UCA: Utility Communications Architecture.

1.03 SUBMITTALS

A. Action Submittals:

1. Instruction manuals for each type of device.
2. Special features, licensed programming software.
3. Potential and current schematic diagrams.
4. Control and metering schematic diagrams.
5. Interconnection wiring diagrams.
6. Installation and mounting requirements.
7. Complete descriptive literature and renewal parts data.

B. Informational Submittals:

1. Programming software used to configure devices, along with settings files necessary to reload or revise settings as left by Contractor.
2. Operation and Maintenance Data as specified in Section 01 78 23, Operation and Maintenance Data.

PART 2 PRODUCTS

2.01 POWER METER (PM)

A. General:

1. Solid state device with LED displays.
2. Direct voltage input up to 600V ac.
3. Current input via current transformer with 5-ampere secondary.
4. Programmable current and potential transformer ratios.
5. Programmable limits to activate up to four alarms.
6. Selectable Voltage Measurements: Line-to-line or line-to-neutral and wye or delta.

B. Simultaneous Display:

1. Volts, three-phase.
2. Amperes, three-phase.
3. Kilowatts.
4. Kilowatt hours.
5. Native ModBus TCP communications network capable.
6. Frequency.
7. kW Demand with programmable period intervals.
8. kVA.
9. kVAR.
10. kVARh.
11. Voltage Rating: 95V ac to 135V ac.
12. Manufacturers and Products:
    a. Shark; 200 Series.
    b. Allen Bradley; Model 5000 Series.
    c. Eaton; IQ DP-4000.
    d. “Or-equal.”

2.02 INSTRUMENT TRANSFORMERS

A. Current Transformer (CT), 600 Volts and Below:

1. Type: Molded bar or donut.
2. Accuracy:
    a. 3 percent for relaying.
    b. 0.6 percent for metering.
3. Shorting type terminal boards for current transformer leads.

B. Potential Transformer (PT), 600 Volts and Below:

1. Type: Molded.
2. Accuracy Classification: 0.3 at burden imposed by meters and instruments, including future.
3. Primary Fuses: Two, current-limiting.
4. Secondary Fuses: One, current-limiting.

PART 3 EXECUTION

3.01 INSTALLATION

A. In accordance with manufacturer’s written instructions.

B. As defined in Section 26 08 00, Commissioning of Electrical Systems.

3.02 MANUFACTURER'S SERVICES

A. Manufacturer's Representative present at distribution equipment factory, Site, and classroom designated by Owner, for the minimum person-days listed below, travel time excluded:

1. 2 person-days to enter, confirm, and assist in testing protective relay settings and communications configuration at the distribution equipment. Device settings to be based on values generated in the device coordination study.
2. 2 person-days for initial energization and start-up of distribution system equipment.
3. 2 person-days for post-startup training of Owner's personnel. Training shall not commence until an accepted detailed lesson plan for each training activity has been reviewed by the Engineer.

B. See Section 01 43 33, Manufacturers' Field Services, and Section 01 91 14, Equipment Testing and Facility Startup.

END OF SECTION

SECTION 26 14 13
SWITCHBOARDS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. National Electrical Manufacturers Association (NEMA):
   a. PB 2, Deadfront Distribution Switchboards.
   b. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
2. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
3. UL:
   a. 489, Standard for Safety for Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures.
   b. 891, Standard for Safety for Switchboards.
   c. 1561, Standard for Safety for Dry-Type General Purpose and Power Transformers.

1.02 SUBMITTALS

A. Action Submittals:

1. Descriptive product information.
2. Itemized Bill of Material.
3. Dimensional drawings.
4. Operational description.
5. One-line, three-line, and control schematic drawings.
6. Connection and interconnection drawings.
7. Circuit Breakers: Copies of time-current characteristics.
8. Ground Fault Protection: Relay time-current characteristics.
9. Bus data.
10. Incoming line section equipment data.
11. Transformer section equipment data.
12. Conduit entrance locations.
13. Anchoring instructions and details.
14. Seismic anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

1. Seismic anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
2. Manufacturer’s installation instructions.
3. Certified Factory Test Report.
4. Component and attachment testing seismic certificate of compliance as required by Section 01 45 33, Special Inspection, Observation, and Testing.
5. Operation and Maintenance Data: As specified in Section 01 78 23, Operation and Maintenance Data.

1.03 QUALITY ASSURANCE

A. Authority Having Jurisdiction (AHJ):

1. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.
2. Materials and equipment manufactured within scope of standards published by UL shall conform to those standards and shall have an applied UL listing mark.

1.04 EXTRA MATERIALS

A. Furnish, tag, and box for shipment and storage and deliver prior to 100 percent Project completion the following spare parts:

1. Fuses: One complete set of spare fuses of each current rating, both power and control.
2. Lights: One complete set of spare indicating lights.
3. Paint: One pint, to match enclosure exterior finish in color and quality.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Materials, equipment, and accessories specified in this section shall be products of the same as MCC manufacturer.

2.02 GENERAL REQUIREMENTS

A. Equipment suitable for 480Y/277-volt, three-phase, three-wire grounded-wye electrical system having available short-circuit current at line terminals of amperes rms symmetrical as shown on Drawings.

B. Comply with NEMA PB 2 and UL 891.

C. Switchboard and its major components to be manufactured and assembled by single manufacturer in order to achieve standardization for appearance, operation and maintenance, spare parts replacement, and manufacturer's services.

D. Lifting lugs on equipment and devices weighing over 100 pounds.

E. Operating Conditions:

1. Ambient Temperature: Maximum 45 degrees C.
2. Equipment shall be fully rated without derating for the above operating conditions.

2.03 STATIONARY STRUCTURE

A. Type: NEMA PB 2 construction, dead front, completely metal enclosed, self-supporting.

B. Sections bolted together to form one rigid assembly capable of being moved into position and bolted directly to floor without use of floor sills.

2.04 ENCLOSURE

A. Equipment Finish: Baked enamel applied over rust-inhibiting phosphated base coating.

1. Color:
   a. Exterior: Finish as approved by Owner.
   b. Interior: White.
   c. Unpainted Parts: Plated for corrosion resistance.

B. Walk-In Outdoor Enclosure:

1. NEMA 250, Type 3R enclosing NEMA 250, Type 1, enclosed switchboard.
2. Hinged, full-height doors with three-point latch operated by vault type handle with multiple padlocking provisions for each rear switchboard section.

3. Minimum 42-inch wide front.
4. Access Door: With panic hardware at each end of aisle.
5. Gasketed doors, end panels, and sloped roof having 4-inch minimum overhang on all sides.

2.05 BUSWORK

A. Material: Phase noninsulated tin-plated copper of sufficient cross section to limit temperature rise at rated current to 55 degrees C.

B. Bus Arrangement: A-B-C, left-to-right, top-to-bottom, and front-to-rear, as viewed from front.

C. Brace for short-circuit currents as shown.

D. Main Horizontal Bus: Nontapered, continuous current rating as shown.

E. Neutral Bus: Continuous current rating as shown.

F. Ground Bus:

1. Tin-plated copper.
2. Rating: As shown.
3. Bolted to each vertical section.
4. Bus Connections and Joints: Bolted with Belleville washers.

G. Extend each bus entire length of switchboard.

2.06 PROTECTIVE DEVICES

A. Molded-Case Circuit Breakers:

1. Main Protective Devices: Individually mounted, suitable for use with 75 degree C wire at full 75 degree C ampacity when mounted in switchboard.
2. Arrangement: Fully rated main and branch feeder as shown.
3. Breakers 225-Ampere Frame and Above: Continuously adjustable magnetic pickups five to ten times trip rating.
4. Breakers 600-Ampere Frame and Above: Solid-state trip unit.
5. Interrupting Rating: As Shown.
6. Mechanical interlock to prevent opening compartment door while breaker is in closed position.

B. Ground Fault Protection:

1. Ground sensor encircling phase conductors and neutral conductor, where used.
2. Solid-state sensing relay and monitor/test panel.
3. Zero sequence current detection, adjustable over range shown.
4. Monitor panel with fault detection indicating light, test, and reset buttons.
5. Control Power Source: Suitable to operate circuit protective device when connected to faulted phase conductor.

2.07 CONTROL WIRING

A. Control, Instrumentation, and Power/Current Circuits: NFPA 70, Type SIS, single-conductor, Class B, stranded copper, rated 600 volts.

B. Transducer Output/Analog Circuits: Shielded cable rated 600 volts, 90 degrees C minimum.

C. Conductor Lugs: Preinsulated, self-locking, spade-type, with reinforced sleeves.

D. Identification: Individually, with permanent wire markers at each end.

E. Enclose in top and vertical steel wiring troughs, and front-to-rear in nonmetallic wiring troughs.

F. Splices: Not permitted in switchboard wiring.

2.08 TERMINAL BLOCKS

A. Enclosed in steel wiring troughs.

B. Rated 600 volts, 30 amperes minimum, one-piece barrier type with strap screws.

C. Shorting type for current transformer leads.

D. Provide terminal blocks for:

1. Conductors connecting to circuits external to switchboard.
2. Internal circuits crossing shipping splits.
3. Equipment parts requiring replacement and maintenance.

E. Spare Terminals: Not less than 20 percent.

F. Group terminal blocks for external circuit wiring leads.

G. Maintain 6-inch minimum space between columns of terminal blocks.

H. Identification: Permanent, for each terminal and columns of terminal blocks.

I. Manufacturer and Product: General Electric; Type EB-5.

2.09 UTILITY SECTION

A. Provide pull section, CT's and meter base per SMUD requirements.

2.10 IDENTIFICATION

A. Nameplates:

1. Master:
   a. Deep-etched aluminum, with manufacturer's name and model number.
   b. Riveted to main vertical section.
2. Circuit Breaker Cubicle and Door-Mounted Device:
   a. Engraved, acrylic.
   b. Color: Black with white.
   c. Characters: Block-type, 1/4-inch high.
   d. Size: Manufacturer's standard.
   e. Inscription: As shown on one-line diagram.
   f. Blank plates for future spaces.
   g. Attachment Screws: Self-tapping.

B. Section Identification:

1. Stamped metallic, riveted to each vertical section.
2. Serial number, bus rating, and section reference number.
3. Size: Manufacturer's standard.

C. Cubicle Labels:

1. Nonmetallic, applied inside each cubicle compartment.
2. Device serial number, rating, and description.

D. Metering Instruments: Meter type identified on meter face below pointer or dial.

E. Switchboard Sign:

1. Two signs each on front of switchboard.
2. Engraved, acrylic.
3. Size: Manufacturer's standard.
4. Color: Red with white.
5. Characters: Gothic-type, 1-inch high.
6. Inscription: DANGER/HIGH VOLTAGE/KEEP OUT.
7. Attachment: Four rivets each sign.

2.11 FACTORY TESTING

A. Performance tests in accordance with UL 891 and production tests in accordance with NEMA PB-2.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions and recommendations.

B. Secure to mounting pads with anchor bolts of sufficient size and number adequate for specified seismic conditions.

C. Install plumb and in longitudinal alignment with pad or wall.

D. Coordinate terminal connections with installation of secondary feeders.

3.02 MANUFACTURER'S SERVICES

A. Furnish manufacturer's representative in accordance with Section 01 43 33, Manufacturers' Field Services, for the following services at Site, for minimum person-days listed below, travel time excluded:

1. 1 person-day for installation assistance, final adjustment, and initial energization of equipment.
2. 1 person-day for functional and performance testing.

B. Furnish startup services and training of Owner's personnel at such times as requested by Owner.

END OF SECTION

SECTION 26 20 00
LOW-VOLTAGE AC INDUCTION MOTORS

PART 1 GENERAL

1.01 RELATED SECTIONS

A. This section applies to low-voltage AC induction motors, whether or not referenced by a motor-driven equipment specification. If equipment specification section deviates from this section in requirements such as, application, horsepower, enclosure type, mounting, shaft type, or synchronous speed, then those listed requirements shall take precedence over this section.

1.02 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Bearing Manufacturers Association (ABMA):
   a. 9, Load Ratings and Fatigue Life for Ball Bearings.
   b. 11, Load Ratings and Fatigue Life for Roller Bearings.
2. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
   a. 112, Standard Test Procedure for Polyphase Induction Motors and Generators.
   b. 620, Guide for the Presentation of Thermal Limit Curves for Squirrel Cage Induction Machines.
   c. 841, Standard for Petroleum and Chemical Industry—Premium Efficiency Severe Duty Totally Enclosed Fan-Cooled (TEFC) Squirrel Cage Induction Motors—Up to and Including 370 kW (500 hp).
3. National Electrical Manufacturers Association (NEMA):
   a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
   b. C50.41, Polyphase Induction Motors for Power Generating Stations.
   c. MG 1, Motors and Generators.
4. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
5. UL:
   a. 83, Standard for Safety for Thermoplastic-Insulated Wire and Cables.
   b. 674, Standard for Safety for Electric Motors and Generators for Use in Division 1 Hazardous (Classified) Locations.
   c. 2111, Standard for Safety for Overheating Protection for Motors.

1.03 DEFINITIONS

A. CISD-TEFC: Chemical industry, severe-duty enclosure.

B. DIP: Dust-ignition-proof enclosure.

C. EXP: Explosion-proof enclosure.

D. Inverter Duty Motor: Motor meeting applicable requirements of NEMA MG 1, Section IV, Parts 30 and 31.

E. Inverter Ready Motor: Motor meeting applicable requirements of NEMA MG 1, Section IV, Part 31.4.4.2.

F. Motor Nameplate Horsepower: That rating after any derating required to allow for extra heating caused by the harmonic content in the voltage applied to the motor by its controller.

G. ODP: Open drip-proof enclosure.

H. TEFC: Totally enclosed, fan-cooled enclosure.

I. TENV: Totally enclosed, nonventilated enclosure.

J. VPI: Vacuum pressure impregnated.

K. WPI: Open weather protected enclosure, Type I.

L. WPII: Open weather protected enclosure, Type II.

1.04 SUBMITTALS

A. Action Submittals:

1. Descriptive information.
2. Nameplate data in accordance with NEMA MG 1.
3. Additional Rating Information:
    a. Service factor.
    b. Locked rotor current.
    c. No load current.
    d. Safe stall time for motors 1 hp and larger.
    e. Multispeed load classification (for example, variable torque).
    f. Adjustable frequency drive motor load classification (for example, variable torque) and minimum allowable motor speed for that load classification.
    g. Guaranteed minimum full load efficiency and power factor.

4. Enclosure type and mounting (such as, horizontal, vertical).
5. Dimensions and total weight.
6. Conduit box dimensions and usable volume as defined in NEMA MG 1 and NFPA 70.
7. Bearing type.
8. Bearing lubrication.
9. Bearing life.
10. Space heater voltage and watts.
11. Description, ratings, and wiring diagram of motor thermal protection.
12. Motor sound power level in accordance with NEMA MG 1.
13. Maximum brake horsepower required by the equipment driven by the motor.
14. Description and rating of submersible motor moisture sensing system.
15. Anchorage and bracing data sheets and drawings as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

1. Anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
2. Factory test reports, certified.
3. Component and attachment testing seismic certificate of compliance as required by Section 01 45 33, Special Inspection, Observation, and Testing.
4. Operation and Maintenance Data: As specified in Section 01 78 23, Operation and Maintenance Data.
5. Manufacturer’s Certificate of Proper Installation, in accordance with Section 01 43 33, Manufacturers’ Field Services.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Materials, equipment, and accessories specified in this section shall be products of:

1. General Electric.
2. MagneTek.
3. Siemens Energy and Automation, Inc., Motors and Drives Division.
4. Baldor.
5. U.S. Electrical Motors.
6. TECO-Westinghouse Motor Co.
7. Toshiba International Corp., Industrial Division.
8. WEG Electric Motors Corp.

2.02 GENERAL

A. For multiple units of the same type of equipment, furnish identical motors and accessories of a single manufacturer.

B. In order to obtain single source responsibility, use a single supplier to provide drive motor, its driven equipment, and specified motor accessories.

C. Meet requirements of NEMA MG 1.

D. For motors used in hazardous (classified) locations, Class I, Division 1, Groups B, C, and D, and Class II, Division 1, Groups E, F, and G provide motors that conform to UL 674 and have an applied UL listing mark.

E. Provide motors specifically designed for the use and conditions intended, with a NEMA design letter classification to fit the application.

F. Lifting lugs on motors weighing 100 pounds or more.

G. Operating Conditions:

1. Maximum ambient temperature not greater than 40 degrees C.
2. Provide motors suitable for operating conditions without reduction in nameplate rated horsepower or exceeding rated temperature rise.
3. Overspeed in either direction in accordance with NEMA MG 1.

2.03 HORSEPOWER RATING

A. As designated in motor-driven equipment specification.

B. Constant Speed Applications: Brake horsepower of driven equipment at any operating condition not to exceed motor nameplate horsepower rating, excluding service factor.

C. Adjustable Frequency and Adjustable Speed Applications (Inverter Duty Motor, Inverter Ready Motor): Driven equipment brake horsepower at any operating condition not to exceed motor nameplate horsepower rating, excluding service factor.

2.04 SERVICE FACTOR

A. Inverter-Duty Motors: 1.0 at rated ambient temperature, unless otherwise noted.

B. Other Motors: 1.15 minimum at rated ambient temperature, unless otherwise noted.

2.05 VOLTAGE AND FREQUENCY RATING

A. System Frequency: 60 Hz.

B. Voltage Rating:

1. Unless otherwise indicated in motor-driven equipment specification:

Voltage Rating		
Size	**Voltage**	**Phase**
1/2 hp and smaller	115	1
3/4 hp through 400 hp	460	3

C. Suitable for full voltage starting.

D. Suitable for accelerating the connected load with supply voltage at motor starter supply terminals dipping to 90 percent of motor rated voltage.

2.06 EFFICIENCY AND POWER FACTOR

A. For all motors except single-phase, under 1 hp, multispeed, short-time rated and submersible motors, or motors driving gates, valves, elevators, cranes, trolleys, and hoists:

1. Efficiency:
   a. Tested in accordance with NEMA MG 1, Paragraph 12.59.
   b. Guaranteed minimum at full load in accordance with NEMA MG 1 Table 12-12, Full-load Efficiencies for NEMA Premium Efficiency Electric Motors Rated 600 Volts or Less (Random Wound), or as indicated in motor-driven equipment specification.
2. Power Factor: Guaranteed minimum at full load shall be manufacturer's standard or as indicated in motor-driven equipment specification.

2.07 LOCKED ROTOR RATINGS

A. Locked rotor kVA Code G or lower, if motor horsepower not covered by NEMA MG 1 tables.

B. Safe Stall Time: 12 seconds or greater.

2.08 INSULATION SYSTEMS

A. Single-Phase, Fractional Horsepower Motors: Manufacturer's standard winding insulation system.

B. Motors Rated Over 600 Volts: VPI windings in accordance with NEMA MG 1.

C. Three-phase and Integral Horsepower Motors: Unless otherwise indicated in motor-driven equipment specification, Class F with Class B rise at nameplate horsepower and designated operating conditions.

D. Motors With Form-Wound Coils: Locked coil bracing system in accordance with NEMA C50.41.

2.09 ENCLOSURES

A. Conform to NEMA MG 1.

B. TEFC and TENV: Furnish with drain hole with porous drain/weather plug.

C. Submersible: In accordance with Article Special Motors.

2.10 TERMINAL (CONDUIT) BOXES

A. Oversize main terminal boxes for motors.

B. Diagonally split, rotatable to each of four 90-degree positions. Threaded hubs for conduit attachment.

C. Except ODP, furnish gaskets between box halves and between box and motor frame.

D. Minimum usable volume in percentage of that specified in NEMA MG 1, Section 1, Paragraph 4.19 and NFPA 70, Article 430:

Terminal Box Usable Values		
Voltage	**Horsepower**	**Percentage**
Below 600	15 through 125	500
Below 600	150 through 300	275

E. Terminal for connection of equipment grounding wire in each terminal box.

F. Coordinate motor terminal box conduit entries versus size and quantity of conduits shown on Drawings.

2.11 BEARINGS AND LUBRICATION

A. Horizontal Motors:

1. 3/4 hp and Smaller: Permanently lubricated and sealed ball bearings, or regreasable ball bearings in labyrinth sealed end bells with removable grease relief plugs.
2. 1 hp through 400 hp: Regreasable ball bearings in labyrinth sealed end bells with removable grease relief plugs.
3. For Direct Drive Equipment: Minimum 100,000 hours L-10 bearing life for ball and roller bearings as defined in ABMA 9 and ABMA 11.
4. For Belt Driven Equipment: Minimum 30,000 hours L-10 bearing life for ball and roller bearings as defined in ABMA 9 and ABMA 11.

B. Vertical Motors:

1. Thrust Bearings:
   a. Antifriction bearing.
   b. Manufacturer’s standard lubrication 100 hp and smaller.
   c. Oil lubricated 125 hp and larger.
   d. Minimum 50,000 hours L-10 bearing life.
2. Guide Bearings:
   a. Manufacturer’s standard bearing type.
   b. Manufacturer’s standard lubrication 200 hp and smaller.
   c. Oil lubricated 250 hp and larger.
   d. Minimum 100,000 hours L-10 bearing life.

C. Regreasable Antifriction Bearings:

1. Readily accessible, grease injection fittings.
2. Readily accessible, removable grease relief plugs.

D. Oil Lubrication Systems:

1. Oil reservoirs with sight level gauge.
2. Oil fill and drain openings with opening plugs.
3. Provisions for necessary oil circulation and cooling.

E. Inverter Duty Rated Motors Larger than 50 hp:

1. Bearing Isolation: Provide electrically isolated bearings to prevent stray current damage.
2. Shaft ground ring.

2.12 NOISE

A. Measured in accordance with NEMA MG 1.

B. Maximum Sound Level for Motors Controlled by Adjustable Frequency Drive Systems: 3 dBA higher than NEMA MG 1.

2.13 BALANCE AND VIBRATION CONTROL

A. In accordance with NEMA MG 1, Part 7.

2.14 EQUIPMENT FINISH

A. Protect Motor for Service Conditions:

1. ODP Enclosures: Indoor industrial atmospheres.
2. Other Enclosures: Outdoor industrial atmospheres, including moisture and direct sunlight exposure.

B. Field painting in accordance with Section 09 90 00, Painting and Coating.

C. Internal Finish: Bore and end turns coated with clear polyester or epoxy varnish.

2.15 SPECIAL FEATURES AND ACCESSORIES

A. Screen Over Air Openings: Stainless steel on motors with ODP, WPI, and WPII enclosures meeting requirements for guarded machine in NEMA MG 1, and attached with stainless steel screws.

B. Winding Thermal Protection:

1. Thermostats:
   a. Motors for constant speed application 10 and larger.
   b. Bi-metal disk or rod type thermostats embedded in stator windings.
   c. Automatic reset contacts rated 120V ac, 5 amperes minimum, opening on excessive temperature. (Provide manual reset at motor controller.)

d. Leads extending to separate terminal box for motors 100 hp and larger.

C. Bearing Temperature Protection:

1. On each bearing of horizontal motors 100 hp and larger.
2. Bearing temperature sensor/relay, Mercoid, with contact opening on bearing overtemperature mounted in NEMA 250, Type 4X enclosure.
3. Bearing Temperature Detector:
   a. 100-ohm precision resistors with calibrated resistance-temperature characteristics.
   b. Compatible with monitoring instrumentation provided with motor controller and with adjustable speed control equipment.
   c. Leads brought to separate motor terminal box.

D. Space Heaters:

1. Provide winding space heaters with leads wired out to separate condulet or terminal box.
2. Provide extra hole or hub on motor terminal box as required.
3. Unless shown otherwise, heater shall be suitable for 120V ac supply, with wattage suitable for motor frame size.

E. Nameplates:

1. Raised or stamped letters on stainless steel or aluminum.
2. Display motor data required by NEMA MG 1, Paragraph 10.39 and Paragraph 10.40 in addition to bearing numbers for both bearings.
3. Premium efficiency motor nameplates to display NEMA nominal efficiency, guaranteed minimum efficiency, full load power factor, and maximum allowable kVAR for power factor correction capacitors.

F. Anchor Bolts: Provide meeting manufacturer’s recommendations and of sufficient size and number for specified seismic condition.

2.16 SPECIAL MOTORS

A. Requirements in this article take precedence over conflicting features specified elsewhere in this section.

B. Inverter Duty Motor:

1. Motor Supplied Power by Adjustable Voltage and Adjustable Frequency Drives: Inverter duty rated in accordance with NEMA Parts 30 and 31.

2. Provide winding insulation rated 1,600 peak volts, minimum.
3. Meet or exceed NEMA MG 1 corona inception voltage rating.
4. Suitable for operation over entire speed range indicated.
5. Provide forced ventilation where speed ratio is greater than published range for motor provided.
6. Shaft Grounding Device, Motors Larger than 50 hp: Furnish with shaft grounding brush or conductive micro fiber shaft grounding ring solidly bonded to grounded motor frame in accordance with manufacturer's recommendations.
    a. Manufacturers and Products:
        1) Grounding Brush: Sohre Turbomachinery, Inc.
        2) Grounding Ring: EST-Aegis.

C. Submersible Pump Motor: See motor-driven equipment specification.

2.17 FACTORY TESTING

A. Tests:

1. In accordance with IEEE 112 for polyphase motors.
2. Routine (production) tests in accordance with NEMA MG 1. Test multispeed motors at all speeds.
3. For energy efficient motors, test efficiency and power factor at 50 percent, 75 percent, and 100 percent of rated horsepower:
    a. In accordance with IEEE 112, Test Method B, and NEMA MG 1, Paragraph 12.59. and Paragraph 12.60.
    b. On motors of 100 hp and smaller, furnish certified copy of motor efficiency test report on an identical motor.
4. Additional Required Tests: Temperature rise at rated horsepower for motors 100 hp and larger.
5. Vibration (balance) for motors 200 hp and larger.
6. Provide test reports for polyphase motors 100 hp and smaller.
7. Provide certified test reports for polyphase motors 100 hp and larger.

B. Test Report Forms:

1. Routine Tests: IEEE 112, Form A-1.
2. Efficiency and power factor by Test Method B, IEEE 112, Form A-2, and NEMA MG 1, Table 12-11.
3. Efficiency and power factor by Test Method F, IEEE 112, Forms F-1, F-2, and F-3.
4. Temperature Test: IEEE 112, Form A-2.

PART 3 EXECUTION

3.01 INSTALLATION

A. In accordance with manufacturer's instructions and recommendations.

B. Align motor carefully and properly with driven equipment.

C. Secure equipment to mounting surface with anchor bolts.

3.02 MANUFACTURER'S SERVICES

A. Furnish manufacturer's representative at Site in accordance with Section 01 43 33, Manufacturers' Field Services, for installation assistance, inspection, equipment testing, and startup assistance for motors larger than 100 hp.

B. Manufacturer's Certificate of Proper Installation.

END OF SECTION

SECTION 26 22 00
LOW-VOLTAGE TRANSFORMERS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Code of Federal Regulations (CFR): 10 CFR Part 431, DOE 2016 efficiency.
2. Institute of Electrical and Electronics Engineers (IEEE): C57.96, Guide for Loading Dry Type Transformers.
3. National Electrical Contractor's Association (NECA): 409, Recommended Practice for Installing and Maintaining Dry-Type Transformers.
4. National Electrical Manufacturers Association (NEMA):
   a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
   b. ST 20, Dry-Type Transformers for General Applications.
5. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
6. UL:
   a. 486E, Standard for Equipment Wiring Terminals for use with Aluminum and/or Copper Conductors.
   b. 489, Standard for Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures.
   c. 1561, Standard for Dry-Type, General Purpose, and Power Transformers.

1.02 SUBMITTALS

A. Action Submittals:

1. Descriptive information.
2. Dimensions and weight.
3. Transformer nameplate data, including efficiency.
4. Schematic and connection diagrams.
5. Anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

1. Anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.

2. Test Report: Sound test certification for dry type power transformers (0 volt to 600 volt, primary).
3. Component and attachment testing seismic certificate of compliance as required by Section 01 45 33, Special Inspection, Observation, and Testing.

PART 2 PRODUCTS

2.01 GENERAL

A. UL 1561, NEMA ST 20, unless otherwise indicated.

B. Dry-type, self-cooled, two-winding, with copper windings.

C. Units larger than 5 kVA suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.

D. Efficiency: Meet or exceed DOE 2016 efficiency requirements. In California, transformers 15 kVA and larger shall comply with Title 20 and Title 24.

E. Maximum Sound Level per NEMA ST 20:

1. 40 decibels for 0 kVA to 9 kVA.
2. 45 decibels for 10 kVA to 50 kVA.
3. 50 decibels for 51 kVA to 150 kVA.
4. 55 decibels for 151 kVA to 300 kVA.
5. 60 decibels for 301 kVA to 500 kVA.

F. Overload Capability: Short-term overload per IEEE C57.96.

G. Wall Bracket: For single-phase units, 15 kVA to 37-1/2 kVA, and for three-phase units, 15 kVA to 30 kVA.

H. Vibration Isolators:

1. Rated for transformer’s weight.
2. Isolation Efficiency: 99 percent, at fundamental frequency of sound emitted by transformer.
3. Less Than 30 kVA: Isolate entire unit from structure with external vibration isolators.
4. 30 kVA and Above: Isolate core and coil assembly from transformer enclosure with integral vibration isolator.

I. Manufacturers:

1. ABB/GE.
2. Schneider Electric/Square D.
3. Eaton.

2.02 GENERAL PURPOSE TRANSFORMER

A. Insulation Class and Temperature Rise: Manufacturer's standard.

B. Core and Coil:

1. Encapsulated for single-phase units 1/2 kVA to 25 kVA and for three-phase units 3 kVA to 15 kVA.
2. Thermosetting varnish impregnated for single-phase units 37.5 kVA and above, and for three-phase units 30 kVA and above.

C. Enclosure:

1. Single-Phase, 3 kVA to 30 kVA: NEMA 250, Type 3R, nonventilated.

D. Voltage Taps:

1. Single-Phase, 15 kVA and Above: Four 2-1/2 percent, full capacity; two above and two below normal voltage rating.

E. Impedance: 1.9 percent minimum on units 75 kVA and larger.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with NECA and manufacturer's instructions.

B. Load external vibration isolator such that no direct transformer unit metal is in direct contact with mounting surface.

C. Provide moisture-proof, flexible conduit for electrical connections.

D. Connect voltage taps to achieve (approximately) rated output voltage under normal plant load conditions.

E. Provide wall brackets for single-phase units, 15 kVA to 167-1/2 kVA, and three-phase units, 15 kVA to 30 kVA.

END OF SECTION

SECTION 26 24 16
PANELBOARDS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. National Electrical Contractor's Association (NECA): 407, Recommended Practice for Installing and Maintaining Panelboards.
2. National Electrical Manufacturers Association (NEMA):
   a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
   b. 289, Application Guide for Ground Fault Circuit Interrupters.
   c. KS 1, Enclosed Switches.
   d. PB 1, Panelboards.
   e. PB 1.1, General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
3. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
4. UL:
   a. 67, Standard for Panelboards.
   b. 98, Standard for Enclosed and Dead-Front Switches.
   c. 486E, Standard for Equipment Wiring Terminals for use with Aluminum and/or Copper Conductors.
   d. 489, Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures.
   e. 508, Standard for Industrial Control Equipment.
   f. 870, Wireways, Auxiliary Gutters and Associated Fittings.
   g. 943, Ground-Fault Circuit-Interrupters.
   h. 1699, Standard for Arc-Fault Circuit-Interrupters.

1.02 SUBMITTALS

A. Action Submittals:

1. Manufacturer's data sheets for each type of panelboard, protective device, accessory item, and component.
2. Manufacturer's shop drawings including dimensioned plan, section, and elevation for each panelboard type, enclosure, and general arrangement.
3. Tabulation of features for each panelboard to include the following:
   a. Protective devices with factory settings.
   b. Provisions for future protective devices.
   c. Space for future protective devices.

d. Voltage, frequency, and phase ratings.
e. Enclosure type.
f. Bus and terminal bar configurations and current ratings.
g. Provisions for circuit terminations with wire range.
h. Short circuit current rating of assembled panelboard at system voltage.
i. Features, characteristics, ratings, and factory settings of auxiliary components.
j. Wiring and schematic diagrams detailing control wiring, and differentiating between manufacturer-installed and field-installed wiring.
k. Anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

1. Anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
2. Manufacturer's recommended installation instructions.
3. Component and attachment testing seismic certificate of compliance as required by Section 01 45 33, Special Inspection, Observation, and Testing.

1.03 QUALITY ASSURANCE

A. Listing and Labeling: Provide products specified in this section that are listed and labeled as defined in NEC Article 100.

1.04 EXTRA MATERIALS

A. Extra Materials: Furnish, tag, and box for shipment and storage spare parts per Manufacturer's recommendation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Materials, equipment, and accessories specified in this section shall be products of:

1. Eaton/Cutler-Hammer.
2. General Electric Co.
3. Square D Co.
4. Siemens.

B. Panelboards shall be of the same manufacturer as equipment furnished under Section 26 24 19, Low-Voltage Motor Control.

2.02 GENERAL

A. Provide low voltage panelboards for application at 600 volts or less in accordance with this section, including panelboards installed in other equipment specified in Section 26 24 19, Low-Voltage Motor Control.

B. Provide equipment in accordance with NEMA PB 1, NFPA 70, and UL 67.

C. Wire Terminations:

1. Provide panelboard assemblies, including protective devices, suitable for use with 75 degrees C or greater wire insulation systems at NFPA 70, 75 degrees C conductor ampacity, and in accordance with UL 486E.
2. Lugs for termination of conductors shall comply with Section 26 05 05, Conductors.
3. Lugs for termination of copper feeder phase and neutral conductors shall be replaceable, bolted mechanical or crimp compression type.

D. Load Current Ratings:

1. Unless otherwise indicated, load current ratings for panelboard assemblies, including bus and circuit breakers, are noncontinuous as defined by NEC. Continuous ratings shall be 80 percent of noncontinuous rating.
2. Where indicated “continuous” or “100 percent”, selected components and protective devices shall be rated for continuous load current at value shown.

E. Series-Connected Short Circuit Current Ratings: Panelboards shall be fully rated; application of series-connected device ratings is unacceptable.

2.03 OVERCURRENT PROTECTIVE DEVICES

A. Overcurrent Device Mounting and Arrangement: Design panelboards to accommodate device installation and replacement without disturbing adjacent devices and without removing main bus.

B. Overcurrent Protective Devices: In accordance with NEMA KS 1, UL 98, and UL 489. Protective devices shall be adapted to panelboard installation.

C. Provisions for Future Overcurrent Device:

1. Provide space, mountings and bus connections such that like device may be installed without additional hardware.
2. Panel openings shall be closed with individual removable cover for each provision for future device.
3. Unless otherwise indicated, “spaces” in panelboards shall be fully equipped provision for future like devices.
4. Provisions for future devices shall be suitable devices rated no less than 60 amperes.

D. Protective Device Locking: Furnish provisions for handle padlocking for main, subfeed, and branch devices where indicated.

E. Branch Protective Devices:

1. Provide Wire Lug Load Connections: Mechanical or crimp compression type, removable/replaceable, and suitable for 75 degrees C rated conductors without derating switch nor conductor ampacity.
2. Provide a nameplate for each circuit, blanks for spares.

2.04 CIRCUIT BREAKERS

A. General: Thermal-magnetic unless otherwise indicated, quick-make, quick-break, molded case, of indicating type showing ON/OFF and TRIPPED positions of operating handle. Circuit breakers shall comply with Section 26 05 04, Basic Electrical Materials and Methods.

B. Bus Connection: Bolt-on circuit breakers in 480Y/277-volt, and plug-in circuit breakers in 208Y/120 and 240/120-volt panelboards.

C. Trip Mechanism:

1. Individual permanent thermal and magnetic trip elements in each pole.
2. Variable magnetic trip elements with a single continuous adjustment 3X to 10X for frames greater than 100 amps.
3. Two and three pole, common trip.
4. Automatically opens all poles when overcurrent occurs on one pole.
5. Test button on cover.
6. Calibrated for 40 degrees C ambient, unless shown otherwise.

D. Unacceptable Substitution:

1. Do not substitute single-pole circuit breakers with handle ties for multi-pole breakers.
2. Do not use tandem or dual circuit breakers in normal single-pole spaces.

E. Specialty Breakers:

1. Where indicated, provide breakers with the following features:
   a. Ground Fault Circuit Interrupter (GFCI): Rated to trip on 5-mA ground fault within 0.025 second (UL 943, Class A sensitivity, for protection of personnel). Ground fault sensor shall be rated same as circuit breaker. Breaker shall include push-to-test and reset buttons.
   b. Equipment Ground Fault Interrupter (EGFI): Where indicated, equip breaker with ground fault sensor and rated to trip on 30-mA ground fault (UL listed for equipment ground fault protection).
   c. Arc Fault Circuit Interrupter (AFCI): Where indicated, equip breaker with arc fault sensor to detect and trip the circuit breakers when an arcing fault occurs (UL 1699 listed).
   d. Heating and Air Conditioning Rated (HACR): Where indicated, provide breaker UL listed for the protection of such equipment.
   e. Switching Duty (SWD) Rated: Where indicated, provide breaker UL listed for frequent switching of lighting and other branch circuit loads.

2.05 ENCLOSURES

A. General:

1. Provide as specified in Section 26 05 04, Basic Electrical Materials and Methods.
2. Type 1, Type 3R, and Type 3S material code-gauge, hot-dip galvanized sheet steel with reinforced steel frame.
3. Provide surface-mount panelboard from trim with same dimensions as box front.

B. Finish: Rust inhibitor prime followed by manufacturer’s standard gray baked enamel or lacquer.

C. NEMA 250 Type 1 Branch Panelboard Enclosure:

1. Secure front trim to box with concealed trim clamps.
2. Overlap flush panelboards front trims with box nominal 3/4 inch on all sides.

3. Provide door in panelboard front trim, with concealed hinges, to access protective device operating handles.
4. Provide multi-point latching for doors over 30 inches in height.
5. Door Lock: Secure with flush catch and tumbler lock; all panelboards keyed alike, with two milled keys each lock.
6. Circuit Directory: Metal frame with transparent plastic face and enclosed card, mounted inside each panel door.
7. Column-Type Panelboard Configuration: Narrow cabinet extended as wireway to overhead junction box equipped with ground and neutral terminal buses.

2.06 BUSSING AND TERMINAL BARS

A. Bus:

1. Material: Tin-plated copper full sized throughout length.
2. Provide for mounting of future protective devices along full length of bus regardless of number of units and spaces shown. Machine, drill, and tap as required for current and future positions.

B. Equipment Ground Terminal Bus: Copper with suitably sized provisions for termination of ground conductors, and bonded to box.

1. Provide individual mechanical termination points no less than the quantity of breaker pole positions.
2. Provide individual termination points for all other grounding conductors such as feeder, grounding electrode, etc.
3. Termination points shall be bolted crimp compression lugs for conductors 6 AWG and larger.

C. Neutral Terminal Bus: Copper with suitably sized provisions for termination of neutral conductors, and isolated from box.

1. Provide individual mechanical termination points no less than the quantity of breaker pole positions.
2. Provide individual termination points for all other neutral conductors.
3. Termination Points: Bolted crimp compression lugs for conductors 6 AWG and larger.

D. Provision for Future Devices: Equip with mounting brackets, bus connections, and necessary appurtenances for future protective device ampere ratings indicated.

2.07 SPECIAL FEATURES

A. General: Where indicated on Drawings or schedules, provide special features as specified.

B. Double Main Lugs: Furnish additional terminals on neutral and ground buses, sized to accommodate feeders indicated.

C. Surge Arresters:

1. Comply with Section 26 43 00, Surge Protective Devices.
2. Provide protective device within panelboard as disconnecting means and short circuit protection per manufacturer's recommendation.
3. Provide factory mounting within panelboard utilizing UL-recognized mounting device. Provide panelboard circuit breaker for SPD. Provide enclosure and mounting as shown.

PART 3 EXECUTION

3.01 GENERAL

A. Install in accordance with NECA 407, NEMA PB 1.1, and manufacturers' written installation instructions.

B. Install securely, plumb, in-line and square with walls.

C. Install top of cabinet trim 78 inches above floor, unless otherwise shown. Install cabinet so tops of protective device operating handles are no more than 78 inches above the floor.

D. Ground Fault Protection: Install panelboard ground fault circuit interrupter devices in accordance with installation guidelines of NEMA 289.

E. Install filler plates in unused spaces.

F. Wiring in Panel Gutters: Train conductors neatly in groups; bundle and wrap with nylon wire ties.

G. Mount flush panels uniformly flush with wall finish.

H. Provide typewritten circuit directory for each panelboard.

I. In addition to conduit or nipples otherwise required for feeder and branch circuit wiring between multi-section panelboard sections, provide nipples for branch circuits two trade sizes larger than required for installed branch circuit

wires or an empty 2-inch nipple, or a 1-1/4 inch trade size conduit if tubs are more than 24 inches apart.

J. Provision for Future Circuits at Flush Panelboards: Stub four 1-inch empty conduits from panel into accessible ceiling space or space designated to be ceiling space in future. Stub four 1-inch empty conduits into raised floor space or to accessible location below slab above grade.

K. Provide engraved identification for each protective device.

END OF SECTION

SECTION 26 24 19
LOW-VOLTAGE MOTOR CONTROL

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which shall be followed for this section:

1. Institute of Electrical and Electronics Engineers (IEEE):
   a. C2, National Electrical Safety Code (NESC).
   b. C37.20.7, Guide for Testing Metal Enclosed Switchgear Rated up to 38 kV for Internal Arcing Faults.
2. National Electrical Contractors Association (NECA): 402, Standard for Installing and Maintaining Motor Control Centers.
3. National Electrical Manufacturers Association (NEMA):
   a. 250, Enclosures for Electrical Equipment (1,000 volts maximum).
   b. ICS 1, Industrial Control and Systems: General Requirements.
   c. ICS 2, Controllers, Contactors, and Overload Relays Rated 600 Volts.
   d. ICS 2.3, Instructions for the Handling, Installation, Operation, and Maintenance of Motor Control Centers Rated Not More Than 600V.
   e. ICS 18, Motor Control Centers.
   f. KS 1, Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
4. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
5. UL:
   a. 98, Enclosed and Dead-Front Switches.
   b. 489, Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures.
   c. 845, Motor Control Centers.

1.02 DEFINITIONS

A. LCD: Liquid Crystal Display.

B. N.C.: Normally Closed.

C. N.O.: Normally Open.

D. SPD: Surge Protection Device.

1.03 SUBMITTALS

A. Action Submittals:

1. Descriptive information.
2. Itemized Bill of Material.
3. Dimensional drawings including network cable barrier locations.
4. Front Panel Elevations.
5. Conduit entrance locations.
6. Bus data.
7. Protective Devices: Copies of time-current characteristics.
8. Operational description.
9. Interior Network/Communication cabling and components.
10. Communications protocol setup and parameter setting information for plant control system communication programming.
11. Anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.
12. Anchoring instructions and details.
13. Typed Tabulation:
    a. Motor name; tag (equipment) numbers as shown on Drawings.
    b. Motor horsepower.
    c. Nameplate full load current.
    d. Measured load current and voltage.
    e. Overload model number and setting.
    f. Protective device trip settings.
    g. Manufacturer’s solid state starter switch or dip switch or program settings.
    h. Attach above typed, tabulated data to a copy of starter manufacturer’s overload relay or setting selection tables for starters provided.
14. Control diagrams.
15. One-line diagrams.
16. Schematic (elementary) diagrams.
17. Outline diagrams.
18. Wireless unit connection diagrams.
19. Interconnection diagrams.

B. Informational Submittals:

1. Anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
2. Manufacturer’s installation instructions.

3. Factory test reports, certified.
4. Operation and Maintenance Data as specified in Section 01 78 23, Operation and Maintenance Data.

1.04 QUALITY ASSURANCE

A. Provide products manufactured within scope of UL that conform to UL Standards and have applied UL Listing Mark.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Shipping Splits: Established by Contractor to facilitate ingress of equipment to final installation location within building.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide materials, equipment, and accessories specified in this section manufactured by:

1. Tesco.
2. “Or-equal.”

2.02 GENERAL

A. Like Items of Equipment: End product of one manufacturer and same manufacturer as low voltage switchboard and panelboards for standardization.

B. Make adjustments necessary to wiring, conduit, disconnect devices, motor starters, branch circuit protection, and other affected material or equipment to accommodate motors actually provided under this Contract.

C. Controllers: NEMA ICS 1, NEMA ICS 2, Class A.

D. Control Transformer:

1. Two winding, 120-volt secondary, primary voltage to suit.
2. Two current-limiting fuses for primary circuit.
3. One fuse in secondary circuit with blown fuse indicator.
4. Mount within starter unit.

E. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.

F. Lifting lugs on equipment and devices weighing over 100 pounds.

G. Anchor Bolts: Type 316 stainless steel, sized seismically by a licensed structural engineer registered in the State where equipment is to reside, and as specified in Section 05 50 00, Metal Fabrications.

H. Seismic Zone and Importance Factor: As specified in Section 01 61 00, Common Product Requirements.

I. Operating Conditions:

1. Ambient Temperature: Maximum 120 degrees F direct sun.
2. Altitude: 50 feet above sea level.
3. Equipment to be fully rated.

J. Enclosures: In accordance with NEMA 250.

K. Equipment Finish:

1. Electrocoating process applied over rust-inhibiting phosphated base coating.
2. Exterior Color: Owner’s standard.

2.03 MOTOR CONTROL CENTERS

A. General:

1. In accordance with NEMA ICS 1, NEMA ICS 2, NEMA ICS 18, and UL 845.
2. Provide MCCs rated for arc resistance with a minimum arc duration rating of 100 ms at 480 volts and 600 volts.
3. Accessibility Rating:
   a. MCCs Rated for Arc Resistance: Type 2 accessibility rating as defined in IEEE Guideline C37.20.7.
   b. Lineups Containing Clean Power Drives: Type 1 accessibility rating as defined in IEEE Guideline C37.20.7.
4. Voltage Rating: As shown.
5. Provide a ModBus TCP communications network within the motor control center to interconnect metering devices equipped with communications.
6. Modbus TCP equipped MCCs shall have a minimum of one network switch per shipping split, connected together for incorporation into a ring topology based external network.
   a. Manufacturers and Products:
      1) N-Tron; 700 Series.
      2) “Or-equal.”

7. Provide network devices, cabling, and connectors ODVA compliant for Modbus TCP networks.
8. Short Circuit Rating: As shown on Drawings.
9. Main and branch circuit breakers, controllers, wire connections, and other devices to be front mounted and accessible, unless otherwise noted.
10. NEMA ICS 18, Part 3.
    a. Class: I.
    b. Type: A.

B. Enclosure:

1. Type: NEMA 250 Type 3R, outdoor, raintight, nonwalk-in.
2. Vertical Section Standard Indoor Dimensions for NEMA 1 Type:
    a. Nominal, 90 inches high, 20 inches wide, 21 inches deep.
    b. Alternative width dimensions of 24 inches and 30 inches are acceptable for oversize devices or panels.
    c. Do not exceed space shown.
3. Construction:
    a. Sheet steel reinforced with channel or angle irons.
    b. Butt sections flush, end-to-end against similar section without bolts, nuts, or cover plates causing interference.
    c. Removable top cover plates and bottom cover plates.
    d. Removable plates on end panels for future bus extension.
    e. Arc Resistant MCCs:
        1) Structures: Totally-enclosed, dead-front, free-standing assemblies.
        2) Side Sheets, Back Sheets, Horizontal Wireway Doors, and Vertical Wireway Door Material: 12-gauge steel.
        3) Design to contain the high pressure and heat present during an arc flash event without requiring an exhaust plenum, roof flaps, or similar venting device/assembly on top of the MCC to vent the arc blast energy and gases generated.
        4) Provide isolation barriers between each structure to contain arc blast energy and prevent propagation of the event to subsequent structures in the lineup.
        5) Provide enhanced door hinges and door latches designed to contain arc blast energy and prevent doors from opening during an arc flash event. Provide more enhanced hinges and latches on each door than would be provided on a standard non-arc resistant MCC door.
4. Section Mounting: Removable formed-steel channel sills and lifting angles to meet specified seismic requirements.

5. Horizontal Wiring Compartments: Accessible from front, full width, top and bottom.
6. Vertical Wiring Compartment:
    a. Full height, isolated from unit starters with separate hinged door and tie supports.
    b. No terminal blocks allowed in vertical wireway compartment.
    c. Provide separate low level signal/network raceway in wireway.
7. Terminal board compartment at bottom with 20 percent spare terminals.
8. Unit Compartment: Individual compartments separated by steel barriers for each starter, feeder, or other unit capable of being wired from front without unit removal.
9. Compartment Doors: Separate hinged doors for each starter, feeder, or other unit.
10. Door Interlocking: Mechanically interlock starter and feeder doors so doors cannot be opened with unit energized. Provide defeater mechanism to allow intentional access and energizing at any time by qualified individual.
11. External disconnect handles with ON/OFF and trip positions showing, padlockable in OFF position with up to three-lock capability.
12. Cable Entrance: Main leads enter from top; control and feeder circuits enter from top and bottom.
13. Busway Entrance:
    a. Pull box with flanged connection for incoming busway, bus connection to motor control center main power bus, and cable connection to ground and neutral bus.
    b. Match dimensions of incoming busway.
    c. Provide Belleville washers on bus connection bolts.

C. Bus:

1. Horizontal Power Bus:
    a. Three-phase tin-plated, entire width of control center, rated as shown.
    b. Completely insulate the horizontal bus prevent arc flash events from being triggered on the horizontal bus.
    c. Tin or silver-plated at joints.
    d. Construct to allow future extension of additional sections.
    e. Pressure type solderless lugs for each incoming line cable.
    f. Isolated from top horizontal wireway.
    g. Provide Belleville washers on bus connection bolts.
2. Vertical Power Bus:
    a. Three-phase tin-plated, full height of section, rated 600 amperes.

b. Completely isolate and insulate the vertical bus on arc resistant MCCs by means of a labyrinth design barrier.
   1) Effectively isolate the vertical buses to prevent any fault-generated gases to pass from one phase to another.
   2) Include an automatic shutter mechanism that will allow the unit stabs to engage the vertical bus every 6 inches and provide complete isolation of the vertical bus when a unit is removed.
c. Tin-plated at joints.
d. Sandwich type bus insulation providing deadfront construction with starter units removed except for bus stab openings.
e. Insulated and isolated barrier, complete with shutters.
f. Provide Belleville washers on bus connection bolts.

3. Neutral Bus: None.
   a. Tin-plated.
   b. Provide Belleville washers on bus connection bolts.
4. Ground Bus:
   a. Tin-plated, rated 600 amperes, entire width of control center and in each vertical wireway.
   b. Provide Belleville washers on bus connection bolts.
5. Bus Bracing: 65,000 amperes rms symmetrical.

D. Motor Controller Unit:

1. Provide indicated individual components and control devices including pushbuttons, selector switches, indicating lights, control relays, time delay relays, and elapsed time meters as specified in Section 26 05 04, Basic Electrical Materials and Methods.
2. Construction:
   a. Drawout combination type with stab connections for starters NEMA ICS, Size 5 and smaller.
   b. Bolt-on combination type with cable connection to riser for starters NEMA ICS, Size 6 and larger.
   c. Readily interchangeable with starters of similar size.
   d. Pull-apart unit control wiring terminal boards capable of accepting up to two 14 AWG wires minimum on all units.
3. Motor Controller Communications:
   a. Communicate the following commands and status with the plant control system:
      1) Receive Commands: See P&ID.
      2) Status Feedback: See P&ID.
4. Starters:
   a. NEMA ICS 18, standard rating, except none smaller than NEMA ICS, Size 1.

b. Rating: Horsepower rated at 600 volt, UL labeled for 65,000 amperes at 480 volts short circuit capacity with overload protection.
c. Three-phase, nonreversing, unless specified otherwise.
d. Disconnect Type: Motor circuit protector or circuit breaker.
e. Combination Full Voltage, Magnetic Starter:
   1) Control: As shown on Drawings.
   2) Pilot Lights: As shown on Drawings.
f. Padlockable operating handle when de-energized with up to three-lock capability.
g. Unit door interlocked to prevent opening when disconnect is in closed position.
h. Mechanical interlocked to prevent placing disconnect in ON position when unit door is open.
i. Minimum Dimensions: 12 inches high by full section width, less vertical wireway.

5. Disconnecting Device:
   a. As indicated. In each starter, control circuit disconnect to de-energize circuits in unit which are not de-energized by starter power disconnect device.
   b. Padlockable in OPEN position for up to three locks.
6. Circuit Breaker:
   a. Meet requirements of UL 489.
   b. Molded case with manufacturer's recommended trip setting for maximum motor protection.
   c. Thermal-magnetic trip or magnetic trip only as shown.
   d. Tripping indicated by operating-handle position.
   e. Interrupting capacity required for connection to system with short-circuit capacity indicated.
   f. Shunt trip for ground fault protection.
7. Thermal Motor Overload Protection:
   a. Inverse-time-limit characteristic.
   b. Heater: Bimetallic overload, adjustable trip, or directly heated melting alloy, ratchet principle type element.
   c. Relay Trip: Standard, Class 20.
   d. Manual reset.
   e. Provide in each ungrounded phase.
   f. Mount within starter unit.
8. Motor Thermal Protector Interface: Manual-reset interposing relay for connection to motor-mounted thermal protector system.
9. Ground Fault Protection: Where indicated and as specified in Paragraph Main Protective Device and Feeder Units, except provide instantaneous operation device.

E. Control Unit:

1. Disconnecting Device: Pull-apart terminal blocks capable of de-energizing external source control circuits in unit.
2. Control Devices: As indicated and as specified in Section 26 05 04, Basic Electrical Materials and Methods.
3. Control Wiring:
   a. Copper, 14 AWG, minimum.
   b. Permanent sleeve type markers with wire numbers applied to each end of wires.
   c. Terminate wires using insulated locking fork or ring type crimp terminals.
   d. Terminate current transformer leads on shorting type terminal blocks.

F. Incoming Line Terminal:

1. Construction: As specified in Paragraph Motor Controller Unit.
2. Incoming Service Feeder: Cable.
3. Mechanical type CU-/AL lugs for 75 degrees C cable.

G. Main Protective Device and Feeder Unit:

1. Construction: As specified in Paragraph Motor Controller Unit.
2. Incoming Service Feeder: Cable.
3. Instantaneous Trip Mode Selector Switch:
   a. Provide switch on main circuit breaker for bypassing long and short time trip settings, and lowered instantaneous trip settings for incident energy reduction during maintenance. In addition, provide the following:
      1) Mode Status Light.
      2) Output contact, rated 5A at 120V ac, for remote Mode status to Plant Control System.
4. Solid State Trip Circuit Breaker:
   a. In accordance with UL 489.
   b. Main and feeder protective device where shown on Drawings.
   c. Insulated or molded case breakers with ambient insensitive solid-state trips and having current sensors and logic circuits integral in breaker frame.
   d. Solid-state current control with adjustable ampere setting, adjustable long-time delay, adjustable short-time trip and delay band, fixed or adjustable instantaneous trip, and adjustable ground fault trip and delay band.

e. Setting adjustments to be covered by a sealable, tamper-proof, transparent cover (insulated case breakers only) or by compartment door for other breakers).
f. Locate trip button on front cover of breaker to permit mechanical simulation overcurrent tripping for test purposes and to trip breaker quickly in emergency situation.

5. Molded Case Circuit Breaker:
   a. In accordance with UL 489.
   b. Main and feeder protective device where shown on Drawings.
   c. Thermal-magnetic trip and interrupting capacity required for connection to system with short circuit capacity indicated.
   d. Indicate tripping by operating-handle position.
   e. Suitable for use with 75 degrees C wire at full NEC 75 degrees C ampacity.
   f. Shunt trip for ground fault protection.
6. Ground Fault Protection:
   a. Suitable for 480-volt, three-phase, three-wire, solidly grounded wye system.
   b. Ground sensors to encircle phase conductors and neutral conductor where used, and connected to ground relays with adjustable pickup settings and time-current characteristics indicated.
   c. Circuit breaker shunt trip and relay operating from fused 120-volt ac control source within control center.
   d. Manufacturers and Products:
      1) Cutler-Hammer; GFR.
      2) General Electric; Ground Break

H. Digital Instruments:

1. Digital Power Meter: As specified in Section 26 09 13, Power Measurement and Control.

I. SPD: As specified in Section 26 43 00, Surge Protective Devices.

J. Transformers: As specified in Section 26 22 00, Low-Voltage Transformers.

K. Panelboards: As specified in Section 26 24 16, Panelboards.

L. Pushbuttons, Indicating Lights, Selector Switches, Elapsed Time Meters, Control Relays, Time-Delay Relays, and Reset Timers: As specified in Section 26 05 04, Basic Electrical Materials and Methods.

M. Nameplates:

1. As specified in Section 26 05 02, Basic Electrical Requirements.
2. Provide for each motor control center and each unit.
3. Engrave with inscription shown on single-line diagram.
4. Provide blank nameplates on spaces for future units.
5. Attach with stainless steel panhead screws on face of control center.

N. Space Heaters: Thermostatically controlled. Locate in bottom of each vertical section for operation from 120-volt power source derived internal to MCC.

2.04 SOURCE QUALITY CONTROL

A. Factory Testing:

1. Applicable Standards: NEMA ICS 18, UL 845, and NEC Article 430, Part VIII.
2. Perform standard factory inspection and tests in accordance with NEMA requirements to verify components have been designed to Specification, assembled in accordance with applicable standards, and each unit functions in accordance with electrical diagrams.
3. Actual operation shall be performed wherever possible. Otherwise, inspect and perform continuity checks.
4. Verify component devices operated correctly in circuits as shown on diagrams or as called for in Specification.
5. Control Circuits and Devices:
    a. Energize circuit at rated voltage.
    b. Operate control devices.
    c. Perform continuity check.
6. Instruments, Meters, Protective Relays, and Equipment:
    a. Verify devices functioned by energizing potential to rated values with connection to devices made at outgoing terminal blocks.
    b. Verify protective relays operated for functional checks and trips manually initiated to verify functioning of operation for indicator and associated circuits.
7. Perform dielectric tests on primary circuits and equipment, except potential transformers.
    a. Tests: Phase-to-phase and phase-to-around with 60-cycle test voltages applied for 1 second at 2,640 volts.
8. Verify equipment passed tests and inspection.
9. Provide standard factory inspection and test checklists, and final certified and signed test report.

B. Witnessed Factory Testing:

1. In accordance with Section 40 90 00, Instrumentation and Control for Process Systems.
2. Perform Equipment Communications Test (ECT) at the factory, with the PICS subcontractor, using the same PLC as being installed at the plant. PLC to be provided by the PICS subcontractor.
3. Include Testing and Coordination Activities:
   a. Drive parameter verification.
   b. Nodes/addressing coordination.
   c. Functional testing of communications-capable devices mounted in the MCC.
4. Complete Witnessed Factory Testing prior to shipping MCC to the Site.

PART 3 EXECUTION

3.01 INSTALLATION

A. General:

1. Install equipment in accordance with NEMA ICS 2.3, IEEE C2, NECA 402, Submittals, and manufacturer's written instructions and recommendations.
2. Secure equipment to mounting pads with anchor bolts of sufficient size and number adequate for specified seismic conditions.
3. Install equipment plumb and in longitudinal alignment with pad or wall.
4. Coordinate terminal connections with installation of secondary feeders.
5. Grout mounting channels into floor or mounting pads.
6. Retighten current-carrying bolted connections and enclosure support framing and panels to manufacturer's recommendations.
7. Motor Data:
   a. Provide typed, self-adhesive label attached inside each motor starter enclosure door displaying the following information:
      1) Motor served by tag number and equipment name.
      2) Nameplate horsepower.
      3) Motor code letter.
      4) Full load amperes.
      5) Service factor.
      6) Installed overload relay catalog number.

B. Circuit Breakers:

1. Field adjust trip settings of motor starter magnetic-trip-only circuit breakers.

2. Adjust to approximately 11 times motor rated current.
3. Determine motor rated current from motor nameplate following installation.

C. Solid State Overload Relay:

1. Select and install overload relay and apply settings based upon actual full-load current of motor. At a minimum, the following settings shall be made:
   a. Motor FLA: Set as recommended by manufacturer.
   b. Jam: 400 percent of FLA, 4-second time delay.
   c. Current Unbalance: 15 percent, 10-second time delay.
   d. Ground Fault: Set per manufacturer's recommendations, 2-second time delay.
   e. Phase Reversal: Set per manufacturer’s recommendations, use default time delay. Set to alarm only, no trip.
   f. Overvoltage: 550 volts, 10-second time delay. Set to alarm only, no trip.
   g. Undervoltage: 410 volts, 10-second time delay. Set to alarm only, no trip.
   h. Voltage Unbalance: 6 percent, 10-second time delay. Set to alarm only, no trip.
   i. Trip Class: Standard, Class 20.
   j. Fault Reset (No.): 2. This is the number of auto-reset attempts after a motor fault. Any fault (not just overload) shall trigger the fault counter.

3.02 MANUFACTURER’S SERVICES

A. Furnish manufacturer’s representative in accordance with Section 01 43 33, Manufacturers’ Field Services, for the following services at Job Site or classroom as designated by Owner, for minimum person-days listed below, travel time excluded:

1. 1 person-day for installation assistance, and inspection of installation.
2. 1 person-day for functional and performance testing.
3. 1 person-day for plant startup.
4. 1/2 person-day for training of Owner’s personnel.

END OF SECTION

SECTION 26 27 26
WIRING DEVICES

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM): A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
2. Federal Specifications (FS):
   a. W-C-596G, General Specification for Connector, Electrical, Power.
   b. W-S-896F, Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification).
3. Institute of Electrical and Electronic Engineers, Inc. (IEEE):
   a. C62.41.2, Recommended Practice on Characterization of Surges in Low-Voltage (1000V and less) AC Power Circuits.
   b. C62.45, Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000V and less) AC Power Circuits.
4. National Electrical Contractors Association (NECA): 1, Standard Practice of Good Workmanship in Electrical Contracting.
5. National Electrical Manufacturers Association (NEMA):
   a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
   b. FB 11, Plugs, Receptacles, and Connectors of the Pin and Sleeve Type for Hazardous Locations.
   c. WD 1, General Color Requirements for Wiring Devices.
   d. WD 6, Wiring Devices – Dimensional Specifications.
6. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
7. UL:
   a. 498, Standard for Safety for Attachment Plugs and Receptacles.
   b. 508, Standard for Safety for Industrial Control Equipment.
   c. 943, Standard for Safety for Ground-Fault Circuit-Interrupters.
   d. 1010, Standard for Safety for Receptacle-Plug Combinations for Use in Hazardous (Classified) Locations.
   e. 1436, Standard for Safety for Outlet Circuit Testers and Similar Indicating Devices.
   f. 1449, Standard for Safety for Surge Protective Devices (SPD).

1.02 SUBMITTALS

A. Action Submittals: Manufacturer’s product data for wiring devices.

PART 2 PRODUCTS

2.01 SWITCHES

A. Switch, General Purpose:

1. NEMA WD 1 and FS W-S-896F.
2. Totally enclosed, ac type, with quiet tumbler switch and screw terminal.
3. Rivetless one-piece brass or copper alloy contact arm with silver alloy contact.
4. Capable of controlling 100 percent tungsten filament and fluorescent lamp loads.
5. Rating: 20 amperes, 120/277 volts.
6. Automatic grounding clip and integral grounding terminal on mounting strap.
7. Special Features:
   a. Provide the following features in comparable devices where indicated:
      1) Three-way and four-way.
8. Manufacturers and Products, Industrial Grade:
   a. Eaton Arrow Hart; AH1220 Series.
   b. Bryant; 4901 Series.
   c. Hubbell; 1221 Series.
   d. Leviton; 1221 Series.

B. Switch, Motor Rated:

1. Type: Two-pole or three-pole, manual motor starting/disconnect switch without overload protection.
2. UL 508 listed.
3. Totally enclosed snap-action switch. Quick-make, slow-break design with silver alloy contacts.
4. Minimum General Purpose Rating: 30 amperes, 600V ac.
5. Minimum Motor Ratings:
   a. 2 hp for 120V ac, single-phase, two-pole.
   b. 3 hp for 240V ac, single-phase, two-pole.
   c. 15 hp for 480V ac, three-phase, three-pole.
6. Screw-type terminal.

7. Manufacturers and Products:
    a. Cooper Arrow Hart.
    b. Hubbell Bryant; HBL78 Series.
    c. Leviton.

2.02 RECEPTACLES

A. Receptacle, General Purpose:

1. NEMA WD 1 and FS W-C-596G.
2. Duplex, two-pole, three-wire grounding type with screw type wire terminals.
3. Impact resistant nylon cover and body, with finder grooves in face, unless otherwise indicated.
4. One-piece mounting strap with integral ground contact (rivetless construction).
5. Contact Arrangement: Contact to be made on two sides of each inserted blade without detent.
6. Rating: 125 volts, NEMA WD 1, Configuration 5-20R, 20 amperes, unless otherwise indicated.
7. Size: For 2-inch by 4-inch outlet box.
8. Special Features:
    a. Provide the following features in comparable devices where indicated:
        1) Listed weather-resistant per NEC 406.8 for installation in damp or wet locations.
9. Industrial Grade Manufacturers and Products:
    a. Eaton Arrow Hart; 5362 Series.
    b. Hubbell; HBL5362 Series.
    c. Leviton; 5362 Series.

B. Receptacle, Ground Fault Circuit Interrupter:

1. Meet requirements of general-purpose receptacle.
2. Listed Class A to UL 943, tripping at 5 mA.
3. Rectangular smooth face with push-to-test and reset buttons.
4. Listed weather-resistant per NEC 406.8 for installation in damp or wet locations.
5. Feed-through Capability: 20 amperes.
6. Manufacturers and Products:
    a. Hubbell; GFTR20 Series.
    b. Eaton Arrow Hart; WRVGF20 Series.
    c. Leviton; 7899 Series.

C. Receptacle, Special-Purpose:

1. Rating and number of poles as indicated or required for anticipated purpose.
2. Where indicated provide] matching plug with cord-grip features for each special-purpose receptacle.

2.03 DEVICE PLATES

A. Sectional type plate not permitted.

B. Weatherproof:

1. Receptacle, Weatherproof Type 2:
   a. UL listed for wet location while in use.
   b. Die cast metal cover.
   c. Locking type.
   d. Manufacturer and Product: TayMac; Type Multi-Mac.
2. Switch:
   a. Gasketed, cast-metal or cast-aluminum, incorporating external operator for internal switch.
   b. Mounting Screw: Stainless steel.
   c. Manufacturers and Products:
      1) Crouse-Hinds; DS-181 or DS-185.
      2) Appleton; FSK-1VTS or FSK-1VS.

2.04 FINISHES

A. Wiring device catalog numbers specified in this section do not designate device color. Unless otherwise indicated, or required by code, provide colors as specified below.

B. Wiring Device Connected to Normal Power System: White.

C. Special purpose devices may be manufacturer’s standard color (black).

PART 3 EXECUTION

3.01 INSTALLATION, GENERAL

A. Comply with NECA 1.

B. Coordination with Other Trades:

1. Ensure device and its box are protected. Do not place wall finish materials over device box and do not cut holes for box with router that is guided by riding against outside of box.
2. Keep outlet box free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate raceway system, conductors, and cables.
3. Install device box in brick or block wall such that cover plate does not cross a joint, unless otherwise indicated. Where indicated or directed to cross joint, trowel joint flush with face of wall.
4. Install wiring device after wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
2. Strip insulation evenly around conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. Length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:
    a. Cut back and pigtail, or replace damaged conductors.
    b. Straighten conductors that remain and remove corrosion and foreign matter.
    c. Pigtailing existing conductors is permitted provided outlet box is large enough.

D. Device Installation:

1. Replace devices that have been in temporary use during construction or that show signs they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches (150 mm) in length.
5. Use torque screwdriver when a torque is recommended or required by manufacturer.

6. When conductors larger than 12 AWG are installed on 15-ampere or 20-ampere circuits, splice 12 AWG pigtails for device connections.
7. Tighten unused terminal screws on device.
8. Device Plates:
    a. Do not use oversized or extra deep plate.
    b. Repair wall finishes and remount outlet box when standard device plate does not fit flush or does not cover rough wall opening.

3.02 SWITCH INSTALLATION

A. Switch, General Purpose:

1. Mounting Height: See Section 26 05 33, Raceway and Boxes.
2. Install with switch operation in vertical position.
3. Install single-pole, two-way switch such that toggle is in up position when switch is on.

3.03 RECEPTACLE INSTALLATION

A. Duplex Receptacle:

1. Install with grounding slot down, except where horizontal mounting is shown, in which case install with neutral slot up.
2. Ground receptacle to box with grounding wire only.
3. Weatherproof Receptacle:
    a. Install in cast metal box.
    b. Install such that hinge for protective cover is above receptacle opening.
4. Ground Fault Interrupter: Install feed-through model at locations where ground fault protection is specified for “downstream” conventional receptacles.
5. Special-Purpose Receptacle: Install in accordance with manufacturer’s instructions.

3.04 DEVICE PLATE INSTALLATION

A. Securely fasten to wiring device; ensure tight fit to box.

B. Flush Mounted: Install with all four edges in continuous contact with finished wall surface without use of mat or similar material. Plaster fillings will not be acceptable.

C. Surface Mounted: Plate shall not extend beyond sides of box, unless plate has no sharp corners or edges.

D. Install with alignment tolerance to box of 1/16 inch.

E. Label with designated title.

1. Engrave:
   a. Character Height: 1/8-inch.
   b. Filler: Black.

F. Type (Exterior):

1. Switch: Weatherproof.
2. Receptacle in Wet Location: Weatherproof Type 2.

3.05 IDENTIFICATION

A. Use tape labels for identification of individual wall switches and receptacles in dry indoor locations.

1. Degrease and clean device plate surface to receive tape labels.
2. Use 3/16-inch Kroy black letters on white background, unless otherwise indicated.
3. Identify panelboard and circuit number from which item is served on face of plate.

B. Identify conductors with durable wire markers or tags inside outlet boxes where more than one circuit is present.

3.06 FIELD QUALITY CONTROL

A. Perform tests and inspections, and prepare test reports.

B. Test Instrument for 125-Volt 20-Ampere Receptacle: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

C. Using test plug, verify device and its outlet box are securely mounted.

D. Line Voltage Range: 105 volts to 132 volts.

E. Percent Voltage Drop under 15-Ampere Load: Less than 6 percent; 6 percent or higher is not acceptable.

F. Ground Impedance: 2 ohms, maximum.

G. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.

H. Tests shall be diagnostic, indicating damaged conductors, high resistance at circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

END OF SECTION

SECTION 26 29 23
LOW-VOLTAGE ADJUSTABLE FREQUENCY DRIVE SYSTEM

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Electronic Industries Alliance (EIA): 359-A-1, Special Colors.
2. Hydraulic Institute Standards (HIS).
3. Institute of Electrical and Electronics Engineers (IEEE):
   a. 112, Standard Test Procedure for Polyphase Induction Motors and Generators.
   b. 519, Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems.
   c. C62.41, Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
4. National Electrical Manufacturer's Association (NEMA):
   a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
   b. CP 1, Shunt Capacitors.
   c. MG 1, Motors and Generators.
   d. WC 57, Standard for Control, Thermocouple Extensions, and Instrumentation Cables.
5. National Fire Protection Association (NFPA): 79, Electrical Standard for Industrial Machinery.

1.02 DEFINITIONS

A. Terms that may be used in this section:

1. AFD: Adjustable frequency drive.
2. CMOS: Complementary metal oxide semiconductor.
3. CSI: Current source inverter.
4. EMU: Energy monitoring unit.
5. GTO: Gate turn-off thyristor.
6. MPR: Motor protection relay.
7. MTBF: Mean time between failure.
8. PWM: Pulse width modulation.
9. ROM: Read only memory.
10. RTD: Resistance temperature detector.
11. RTU: Remote Telemetry Unit.
12. Rated Load: Load specified for equipment.

13. Rated Speed: Nominal rated (100 percent) speed specified for equipment.
14. TDD: Total demand distortion.
15. THD: Total harmonic distortion.
16. TTL: Transistor transistor logic.

1.03 SYSTEM DESCRIPTION

A. Performance Requirements:

1. Composite drive/motor efficiency (CE) is defined as ratio of motor shaft kW to drive input kW. AFD system minimum requirements:
   a. At 60-Hz drive output and 100 percent load, CE equals 92 percent.
   b. At 50-Hz drive output and 60 percent load CE equals 89 percent.
   c. At 40-Hz drive output and 30 percent load CE equals 84 percent.
   d. At 30-Hz drive output and 12.5 percent load CE equals 77 percent.
2. Rated Continuous Operation Capacity: Not less than 1.15 times full load current rating of driven motor, as indicated on motor nameplate, and suitable for continuous operation at continuous overload which may be imposed on motor by driven pump operating over specified speed range.

B. Design Requirements:

1. Drive system consisting of adjustable frequency controller, drive motor, auxiliary items, and components necessary for complete operating system.
2. Other equipment is being powered from same bus as adjustable frequency drives. Ensure proper operation of drives and other loads under normal and emergency conditions.
3. Furnish AFDs rated on basis of actual motor full load nameplate current rating times the service factor.
4. Drive System: Convert incoming three-phase, 60-Hz ac power to variable voltage, adjustable frequency output for adjustable speed operation of a standard ac induction squirrel-cage motor, using pulse-width-modulation (PWM) technique to produce adjustable frequency output.
5. System rated for continuous industrial duty and suitable for use with NEMA MG 1, Design B motors.
6. Incoming Line Circuit Breaker: Provide positive means of disconnecting incoming power, and overcurrent protection for drive system.

1.04 SUBMITTALS

A. Action Submittals:

1. Overall drive system operating data, including efficiencies, input currents, and power factors, at driven equipment actual load and rated system input voltage, at 0 percent, 40 percent, 60 percent, 80 percent, 100 percent, and 110 percent of rated speed.
2. AFD output pulse maximum peak voltage, pulse rise time, and pulse rate of rise including justification for proposed deviation from specified values. Include motor manufacturer's certification motor insulation will withstand long-term overvoltages caused at motor terminals due to specified output pulse data or proposed deviation from this data.
3. Data on shelf life of "dc link" capacitor.
4. Complete system rating, including nameplate data, continuous operation load capability throughout speed range of 0 percent to 120 percent of rated speed.
5. Complete adjustable frequency controller rating coordinated with motor full load nameplate current rating; list controller special features being supplied.
6. Controller, reactor, harmonic filter, and isolating transformer (if applicable) dimensional drawings; information on size and location of space for incoming and outgoing conduit.
7. Maximum heat dissipation from enclosure.
8. Layout of controller face showing pushbuttons, switches, instruments, and indicating lights.
9. Complete system operating description.
10. Complete system schematic (elementary) wiring diagrams.
11. Complete system interconnection diagrams between controller, drive motor, and related components or controls external to system, including wire numbers and terminal board point identification.
12. One-line diagram of system, including component ratings.
13. Description of diagnostic features being provided.
14. Descriptive literature for control devices such as relays and timers.
15. Itemized bill-of-materials listing system components.
16. Seismic anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

1. Statement of Supplier qualifications.
2. Seismic anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
3. Special shipping, storage and protection, and handling instructions.

4. Manufacturer’s printed installation instructions.
5. Factory functional test reports.
6. Certified copy of test report for identical motor tested in accordance with NEMA MG 1-12.53a and IEEE 112, Test Method B, showing rated load, rated speed efficiency meeting or exceeding specified values; motors not as specified will be rejected.
7. Field test reports.
8. Component and attachment testing seismic certificate of compliance as required by Section 01 45 33, Special Inspection, Observation, and Testing.
9. Suggested spare parts list to maintain equipment in service for period of 5 years. Include list of special tools required for checking, testing, parts replacement, and maintenance with current price information.
10. List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.
11. Operation and Maintenance Data: As specified in Section 01 78 23, Operation and Maintenance Data.
12. Manufacturer’s Certificate of Proper Installation, in accordance with Section 01 43 33, Manufacturers’ Field Services.

1.05 QUALITY ASSURANCE

A. Supplier: Minimum 5 years’ experience in furnishing similar size and type adjustable frequency, controlled speed, drive systems.

1.06 EXTRA MATERIALS

A. Furnish for Each Drive Unit:

1. Complete set of components likely to fail in normal service.
2. SCRs.
3. Integrated circuits.
4. One complete power bridge and one spare printed circuit card for each modular, plug-in type card in controller.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Components and accessories specified in this section shall be products of:

1. Eaton.
2. Allen-Bradley.
3. ABB.

2.02 SUPPLEMENTS

A. Some specific requirements are attached to this section as supplements.

2.03 SERVICE CONDITIONS

A. Ambient Operating Temperature: 32 degrees F to 104 degrees F.

B. Storage Temperature: Minus 40 degrees F to 158 degrees F.

C. Humidity: 0 percent to 95 percent relative (noncondensing).

D. Altitude: 0 foot to 3,300 feet.

E. Frequency Stability: Plus or minus 0.1 percent of maximum frequency.

2.04 COMPONENTS

A. Drive Units:

1. Incorporate switching power supply operating from dc bus, to produce PWM output waveform simulating sine wave and providing power loss ride through of 2 milliseconds at full load, full speed.
2. Current-limiting semiconductor fuses for protection of internal power semiconductors.
3. Employ diode bridge rectifier providing constant displacement power factor of 0.95 minimum at all operating speeds and loads.
4. Use transistors for output section, providing a minimum 97 percent drive efficiency at full speed, full load.
5. Employ dc power discharge circuit so that after removal of input power dc link capacitor voltage level will decay below 50V dc within 1 minute after de-energizing following NEMA CP 1 and NFPA 79. Design dc link capacitor for a MTBF of 5 years.
6. Operate with open circuited output.
7. Input Voltage: 480V ac plus or minus 10 percent.
8. Output Voltage: 0 to 480 volts, three-phase, 0 to 66-Hz, minimum.
9. Maximum peak voltage of PWM AFD output pulse of 1,000 volts, with pulse rise time of not less than 2 microseconds, and maximum rate of rise of 500 volts per microsecond. Maximum frequency of PWM AFD output pulse (carrier) frequency of 3,000-Hz. Should magnitudes of these characteristics be more stressful to motor insulation than specified values, furnish insulation systems on motors suitable for proposed values.

10. Motor Audible Noise Level: When operating throughout speed range of PWM AFD, no more than 3 dBA above that designated in NEMA MG 1 for same motor operated at constant speed with a 60-Hz supply voltage.
11. Short-Time Overload Capacity: 125 percent of rated load in rms current for 1 minute following full load, full speed operation.
12. Equipment Short-Circuit Rating: Suitable for connection to system with maximum source three-phase, bolted fault, short-circuit available of 42,000 amperes rms symmetrical at 480 volts.
13. Furnish drives with output current-limiting reactors mounted within equipment enclosure.
14. Diagnostics:
    a. Comprehensive for Drive Adjustment and Troubleshooting:
        1) Memory battery backup; 100-hour minimum during power loss.
        2) Status messages will not stop drive from running but will prevent it from starting.
        3) Fault Condition Messages and History:
            a) First fault protection function to be activated, ability to store six successive fault occurrences in order. Minimum faults numerically:
                (1) Overcurrent (time and instantaneous).
                (2) Overvoltage.
                (3) Undervoltage (dc and ac).
                (4) Overtemperature (drive, motor windings, motor bearing, pump bearing).
                (5) Serial communication fault.
                (6) Short-circuit/ground fault (motor and drive).
                (7) Motor stalled.
                (8) Semiconductor fault.
                (9) Microprocessor fault.
                (10) Single-phase voltage condition.
15. Drive Protection:
    a. Fast-acting semiconductor fuses.
    b. Overcurrent, instantaneous overcurrent trip.
    c. DC undervoltage protection, 70 percent dropout.
    d. DC overvoltage protection, 130 percent pickup.
    e. Overtemperature, drive, inverter, converter, and dc link components.
    f. Overtemperature, motor, and pump.
    g. Single-phase protection.
    h. Reset overcurrent protection (manual or automatic reset).
    i. Active current limit/torque limit protection.
    j. Semiconductor fault protection.
    k. Short-circuit/ground fault protection.

l. Serial communication fault protection.
m. Microprocessor fault.
n. Surge protection for transient overvoltage (6,000 volts, 80 joule surge, tested per IEEE C62.41).
o. Visual display of specific fault conditions.

16. Operational Features:
a. Use manufacturer's standard unless otherwise indicated.
b. Sustained power loss.
c. Momentary power loss.
d. Power interruption.
e. Power loss ride through (0.1 second).
f. Start on the fly.
g. Electronic motor overload protection.
h. Stall protection.
i. Slip compensation.
j. Automatic restart after power return (ability to enable/disable function).
k. Critical frequency lockout (three selectable points minimum, by 1.5-Hz steps in 10-Hz bands, to prevent resonance of system).
l. Drive maintenance system software for complete programming and diagnostics.
m. Ground fault protection, drive, and motor.
n. Operate with no motor connected to output terminals.

B. Rectifier: Active Front End (AFE).

C. Furnish series choke and capacitors on dc bus to reduce ripple in rectifier output and to reduce harmonic distortion reflected into incoming power feeders.

D. Controller: Microprocessor-controller PWM inverter to convert to dc voltage to variable voltage, adjustable frequency, three-phase ac output. Output voltage shall vary proportionally with frequency to maintain constant ratio of volts to hertz up to 60-Hz; above 60-Hz, voltage shall remain constant with drive operating in constant horsepower output mode.

E. Enclosure:

1. NEMA 250, Type 3R, gasketed, freestanding, enclosure for mounting against wall, completely front accessible, and hinged doors. Properly sized to dissipate heat generated by controller within limits of specified operating conditions (including ambient temperature and ambient airflow). Enclosure not to exceed dimensions shown on Drawings.

2. Cable termination compartment door interlocked main circuit breaker, defeatable (lockable in the open position), emergency stop pushbutton, alphanumeric keypad and display, and operator's controls. Components and controls specified in Section 26 05 04, Basic Electrical Materials and Methods.
3. Wire drive from below and above for power and control wiring.
4. Size forced-ventilation for periodic operation to cool each unit with maximum room ambient temperature of 95 degrees F. Furnish redundant fans such that if one fan fails remaining fans furnish adequate ventilation for drive when operating at maximum capacity. Furnish filters on ventilation intakes.
5. Wiring:
    a. Bundle stranded copper wiring neatly with nylon tie wraps or with continuous plastic spiral binding.
    b. Label each terminal for permanent identification of leads.
    c. Identify each wire at each end with imprinted mylar adhesive-back wire markers.
    d. Incorporate in as-installed wiring diagrams for wire and terminal numbers shown.
    e. Wiring across door hinge, use 19-strand, NEMA WC 57 Class C stranding looped for proper twist rather than bending at hinge.
    f. Wire connections internal to panels by crimp-on terminal types.
    g. For multiple enclosure systems, complete interconnection wiring with gasketed enclosure openings for wiring.
    h. Multipoint plug receptacles for control wiring crossing equipment shipping splits.
6. Selector switches, indicating lights, instruments, protective devices, and major system components identified by means of mechanically attached, engraved, laminated nameplates.

F. Operator Interface:

1. Control circuit disconnect shall de-energize circuits in units that are not de-energized by main power disconnect device as required by California Administrative Code.
2. 120 volts, single-phase, 60-Hz circuits for control power and operator controls from internal control power transformer. Furnish power for motor space heaters rated 120 volts.
3. Arrange component and circuit such that failure of a single component cannot cause cascading failure(s) of other component(s).
4. Alphanumeric Display:
    a. During normal operation and routine test, the following parameters shall be available:
        1) Motor current (percent of drive rated current).

2) Output frequency (Hertz).
3) Output voltage.
4) Running time.
5) Local/remote indicator.
6) Status of digital inputs and outputs.
7) Analog input and output values.
8) Output motor current per leg.
9) All test points.

5. Adjustable Parameters:
   a. Set drive operating parameters and indicate in numeric form. Potentiometers may not be used for parameter adjustment. Minimum setup parameters available:
      1) Frequency range, minimum, maximum.
      2) Adjustable acceleration/deceleration rate.
      3) Volts per Hertz (field weakening point).
      4) Active current limit/torque limit, 0 percent to 140 percent of drive rating.
      5) Adjustable voltage boost (IR compensation).
      6) Preset speed (adjustable, preset operating point).
      7) Provision for adjustment of minimum and maximum pump speed to be furnished as function of 4 mA to 20 mA remote speed signal.

G. Signal Interface:

1. Digital Input: As shown.
2. Digital Output: As shown.
3. Analog Input: As shown.
4. Analog Output: As shown.

H. Accessories:

1. Equipment Identification Plate: 16-gauge stainless steel with 1/4-inch die-stamped equipment tag number securely mounted in readily visible location.
2. Lifting Lugs: Equipment weighing over 100 pounds.
3. Anchor Bolts: Type 316 stainless steel, and as specified in Section 05 50 00, Metal Fabrications.

2.05 FACTORY FINISHING

A. Enclosure:

1. Primer: One coat of rust-inhibiting coating.

2. Finish:
   a. Interior: One coat white enamel.
   b. Exterior: As specified in Section 09 90 00, Paint and Coating.
3. Manufacturer's standard baked enamel finish.

2.06 SOURCE QUALITY CONTROL

A. Factory Inspections: Inspect control panels for required construction, electrical connection, and intended function.

B. Factory Tests and Adjustments: Test all control panels furnished.

C. Record test data for report.

D. Functional Test: Perform manufacturer's standard.

1. Test diodes, transistors, and GTOs at a thermal level of 125 degrees C.

E. Motor Test: See Section 26 20 00, Low-Voltage AC Induction Motors.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's printed instructions.

3.02 FIELD QUALITY CONTROL

A. Functional Test:

1. Conduct on each controller.
2. Inspect controller for electrical supply termination connections, interconnections, proper installation, and quiet operation.
3. Vibration Test:
   a. Complete assembly, consisting of motor, load, and flexible shafting, connected and in normal operation shall not develop amplitudes of vibration exceeding limits recommended by HIS.
   b. Where loads and drives are separated by intermediate flexible shafting, measure vibration both at top motor bearing and at two points on top pump bearing, 90 degrees apart.
4. Record test data for report.

B. Performance Test:

1. Conduct on each controller.
2. Perform under actual or approved simulated operating conditions.

3. Test for continuous 12-hour period without malfunction.
4. Demonstrate performance by operating continuous period while varying application load, as input conditions allow, to verify system performance.
5. With plant load connected to normal utility source, measure the following to show parameters within specified limits:
   a. Power factor at input side of each drive. Documented verification that power factor is maintained at 95 percent as speed of drive goes down from 100 percent to 33 percent.
6. Record test data for report.

C. Test Equipment:

1. Use Dranetz, Model No. 626-PA, harmonic distortion monitor and Series 626 disturbance analyzer or equivalent instrument to document results.
2. Provide diagnostic plug-in test card complete with instructions, multiposition selector switch, and meters or built-in diagnostic control panel or ROM-based processor for monitoring ac, dc, and digital signals to assist in troubleshooting and startup of drive.

3.03 MANUFACTURERS' SERVICES

A. Manufacturer's Representative present at Site or classroom designated by Owner, for minimum person-days listed below, travel time excluded:

1. 1 person-day for functional and performance testing and completion of Manufacturer's Certificate of Proper Installation.
2. 1 person-day for prestartup classroom or Site training and facility startup.
3. 1 person-day for post-startup training of Owner's personnel. Training shall not commence until an accepted detailed lesson plan for each training activity has been reviewed by Engineer.

B. See Section 01 43 33, Manufacturers' Field Services, and Section 01 91 14, Equipment Testing and Facility Startup.

END OF SECTION

SECTION 26 43 00
SURGE PROTECTIVE DEVICES

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American National Standards Institute (ANSI).
2. Department of Defense: MIL-STD-220C, Test Method Standard – Method of Insertion Loss Measurement.
3. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
   a. C62.41.1, IEEE Guide on the Surge Environment in Low-Voltage (1000 V and less) AC Power Circuits.
   b. C62.41.2, IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits.
   c. C62.45, IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and less) AC Power Circuits.
4. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
5. UL:
   a. 497A, Standard for Secondary Protectors for Communications Circuits.
   b. 1283, Standard for Electromagnetic Interference Filters.
   c. 1449, Standard for Surge Protective Devices.

1.02 SUBMITTALS

A. Action Submittals:

1. Product data on each suppressor type, indicating component values, part numbers, and conductor sizes. Include dimensional drawing for each, showing mounting arrangements.
2. Electrical single-line diagram showing location of each SPD.
3. Manufacturer’s UL certified test data and nameplate data for each surge protective device (SPD).

1.03 QUALITY ASSURANCE

A. UL Compliance and Labeling:

1. SPDs for Power and Signal Circuits: Comply with UL 1449 and complimentary listed to UL 1283 as an electromagnetic interference filter. Provide units listed and labeled by UL.
2. SPDs for Telephone Circuit Protection: Comply with UL 497A.

B. ANSI Compliance: Use SPD devices in compliance with the recommendations of IEEE C62.41.1, IEEE C62.41.2, and IEEE C62.45.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers and Products:

1. Eaton; SPD Series.
2. General Electric; Tranquell.
3. Square D; Surelogic.
4. Advanced Protection Technologies, Inc.
5. CITEL; MDS Series.

2.02 GENERAL

A. Unless indicated otherwise, provide direct bus-connected and factory-installed SPDs inside distribution equipment.

B. SPD Operating Conditions: Capable of performing at ambient temperatures between minus 40 degrees C and 60 degrees C, at relative humidity ranging from 0 percent to 95 percent, and at altitudes ranging from sea level to 12,000 feet.

C. Connect SPDs through a fused switch or circuit breaker as selected by manufacturer. Provide overcurrent protection to allow full surge handling capabilities and afford safety protection from thermal overloads and short circuits.

D. SPD Short Circuit Current Rating (SCCR): No less than the SCCR of distribution equipment.

E. Design SPD devices to protect all modes (L-L, L-N, L-G, N-G) of electrical system being used.

F. Power Filter: Include a high-frequency extended range power filter for each SPD complimentary listed to UL 1283 as an electromagnetic interference filter.

G. Provide SPDs with the following monitoring and diagnostics:

1. LED-type indication lights to show normal and failed status of each protected phase.
2. Surge event counter.
3. Form C dry contact which operates when unit fails.

H. Provide UL Type 2 SPDs.

I. EMI/RFI Noise Suppression: Minus 50dB attenuation at 100 kHz, tested per MIL-STD 220C.

J. Voltage Protection Rating (VPR):

Voltage Rating	L-N	N-G	L-G	L-L
208Y/120	800	800	800	1200
480Y/277	1200	1200	1200	2000
240 Δ	--	--	1200	1200

2.03 SERVICE ENTRANCE AND DISTRIBUTION SPD

A. Provide SPD meeting IEEE C62.41.1 and IEEE C62.41.2 Location in accordance with Category C.

1. Distribution:
   a. 160 kA per phase.
   b. 80 kA per mode.

B. Maximum Continuous Operating Voltage (MCOV): Not less than 115 percent of nominal system voltage.

C. Nominal Discharge Current (I_N): 20 kA.

2.04 PANELBOARD SPD

A. Provide SPD meeting IEEE C62.41.1 and IEEE C62.41.2 Location in accordance with Category B.

B. Surge Current Capacity:

1. Distribution: 120 kA per phase; 60 kA per mode.

C. Maximum Continuous Operating Voltage (MCOV): Not less than 125 percent of the nominal system voltage.

D. Nominal Discharge Current (I_N): 10 kA.

2.05 PAIRED CABLE DATA LINE INTERIOR SUPPRESSORS

A. Provide units meeting IEEE C62.41, Location Category A.

B. Use bi-polar 1,500-watt silicon avalanche diodes between protected conductor and earth ground.

C. Provide units with a maximum single impulse current rating of 80 amperes (10 by 1,000 microsecond-waveform).

D. Breakdown voltage shall not exceed 36 volts.

2.06 PAIRED CABLE DATA LINE EXTERIOR SUPPRESSORS

A. Provide units meeting IEEE C62.41, Location Category A.

B. Design Requirements: A hybrid design with a minimum of three stages, using solid-state components and operating bi-directionally.

C. Meet or exceed the following criteria:

1. Maximum single impulse current rating of 10,000 amperes (8 by 20 microsecond-waveform).
2. Pulse Life Rating: 3,000 amperes (8 by 20 microsecond-waveform); 2,000 occurrences.
3. Maximum clamping voltage at 10,000 amperes (8 by 20 microsecond current waveform), shall not exceed the peak of normal applied signal voltage by 200 percent.

PART 3 EXECUTION

3.01 APPLICATION REQUIREMENTS

A. Provide SPDs when indicated on Drawings or in the equipment specifications.

B. Provide factory-installed SPDs as integral components to new switchgear, switchboards, motor control centers, panelboards and transfer switches. Externally mounted SPDs are not acceptable for new distribution equipment.

C. Externally mounted SPDs are acceptable for SPDs added to existing equipment as described below.

D. Electronic Equipment Paired Cable Conductors: Install data line suppressors at the low voltage input and output of each piece of equipment, including telephone cable entrance.

1. Use secondary protectors on lines that do not exit the structure.
2. Use primary protectors on lines that exit and enter the structure.

3.02 GENERAL INSTALLATION REQUIREMENTS

A. Install suppressors according to manufacturer’s recommendations.

B. Install suppressors directly to the cabinet which houses the circuit to be protected so that the suppressor leads are straight and short, with conductors laced, running directly to the point of connection within the panel, without loops or bends. If bends are unavoidable, no bend may exceed 90 degrees and bending radius may not be less than 6 inches.

C. Provide connecting wires as short as possible with gently twisted conductors, tied together, to prevent separation.

1. Maximum Length: 24 inches.

D. Field Installed Conductors: As specified for building wire, not smaller than 8 AWG and not larger than 4 AWG. Provide device leads not longer than the maximum length recommended by manufacturer, unless specifically reviewed and approved by manufacturer.

E. Provide dedicated disconnecting means for SPD devices installed at main service entrance location, switchgear, and motor control centers. Provide dedicated 30-ampere to 60-ampere circuit breakers (size dependent upon wire size used) with number of poles as required, as disconnecting means for SPD devices. Provide circuit breakers with interrupting capacity equal to that specified for other breakers at that location.

END OF SECTION

SECTION 26 50 00
LIGHTING

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   b. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   c. A572/A572A, Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
   d. A588/A588M, Standard Specification for High-Strength Low-Alloy Structural Steel, with 50 ksi [345 MPa] Minimum Yield Point to 4-in. [100-mm] Thick.
   e. A595/A595M, Standard Specification for Steel Tubes, Low-Carbon or High-Strength Low-Alloy, Tapered for Structural Use.
   f. A615/A615M, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
   g. A1011/A1011M, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
   h. D6576, Standard Specification for Flexible Cellular Rubber Chemically Blown.
   i. G154, Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials.
2. American Wood Protection Association (AWPA): M6, Brands Used on Forest Products.
3. Canadian Standards Association (CSA).
4. Certified Ballast Manufacturer (CBM).
5. Federal Communications Commission (FCC).
6. Illuminating Engineering Society of North America (IESNA).
   a. HB-9, Lighting Handbook.
   b. LM-79, IES Electrical and Photometric Measurements of Solid-State Lighting Products.
   c. LM-80, IESNA Approved Method for Measuring Lumen Maintenance of LED Light Sources.

d. RP (Recommended Practices) Series.
e. TM-21, Projecting Long Term Lumen Maintenance of LED Light Sources.

7. Institute of Electrical and Electronics Engineers (IEEE): C62.41, Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
8. National Electrical Manufacturers Association (NEMA):
   a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
   b. ICS 6, Industrial Control and Systems: Enclosures.
9. National Energy Policy Act.
10. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC) – Softbound Version.
11. Rural Utilities Service (RUS): 1728F-700, Specification for Wood Poles, Stubs and Anchor Logs.
12. UL:
   a. 773, UL Standard for Safety Plug-In Locking Type Photocontrols for Use with Area Lighting - Fourth Edition; Reprint with Revisions Through and Including March 08, 2002.
   b. 844, Electric Lighting Fixtures for Use in Hazardous (Classified) Locations.
   c. 924, Emergency Lighting and Power Equipment.
   d. 1598, UL Standard for Safety Luminaires.
   e. 2108, UL Standard for Safety Low Voltage Lighting Systems - First Edition; Reprint with Revisions through and Including February 24, 2014.
   f. 8750, UL Standard for Safety Light Emitting Diode (LED) Equipment for Use in Lighting Products - First Edition; Reprint with Revisions Through and Including April 1, 2015.
13. U.S. Environmental Protection Agency and U.S. Department of Energy: Energy Star.

1.02 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. General:
      1) Provide catalog data sheets and pictures for all products listed below.
      2) Proposed Luminaire Substitutions (Interior and Exterior): Provide an electronic photometric file in standard ‘.ies’ file format per the Illumination Engineering Society of North America (IESNA) for any proposed luminaire substitution

not identified on the project Luminaire Schedule. Obtain file from the luminaire manufacturer or approved independent photometric testing laboratory. Include the proposed substitute luminaire with all options identified on the project Luminaire Schedule on Drawings.

b. Exterior Luminaires:
   1) Catalog data sheets with pictures. Luminaire material, finish, dimensions, and metal gauge.
   2) Lens material, pattern, and thickness. Filters.
   3) IESNA lighting classification (BUG rating).
   4) Isolux diagram.
   5) Lighting distribution data and lighting distribution classification type as defined in IESNA HB 9.
   6) Fastening details to wall, pendant, or pole.
   7) Ballast type, location, and method of fastening.
   8) For light poles, submit catalog sheet, wind loading, pole deflection with fixture attached, total weight, all accessories, complete dimensions, and finish.
   9) Documentation for Energy Star qualifications for equipment provided under this section.
   10) Brackets and supports.
   11) Pole foundations.

c. Lamps:
   1) Voltages.
   2) Watts.
   3) Correlated Color Temperature (CCT).
   4) Color Rendering Index (CRI).
   5) Published rated life (in hours). Provide number of hours per start and operating temperature for published rated life hours indicated.
   6) Published rated initial and mean lumens.
   7) Lumen maintenance curve.
   8) Lamp type (ANSI designation, dimensions, shape, and base).

d. LED Source Systems:
   1) General:
      a) IESNA LM-80 test reports.
      b) IESNA TM-21 ratings.
      c) Operating temperature range. Data sheet (chart/graph) describing life as a function of temperature.
      d) Warranty: Light engine and driver.
      e) Rated life.
      f) Surge protection.

g) Thermal control device, heat sink.
h) Enclosure and wiring information.
i) Operating voltage range.

2) Electronic Module/Light Engine:
a) Correlated Color Temperature (CCT).
b) Color Rendering Index (CRI).

3) Drivers:
a) Input Current Total Harmonic Distortion.
b) Power factor.
c) Sound rating.
d) Dimming system information.

e. Photoelectric Switches (Photocells):
1) Voltage.
2) Power consumption.
3) Load capacity (watts).
4) Contact ratings and configuration.
5) Time delay.
6) Light operating level controls.
7) Enclosure type and dimensions.
8) Mounting type.
9) Temperature range.
10) Features and options.

f. Seismic anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

1. Anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
2. Manufacturer’s printed installation instructions.
3. Operation and Maintenance Data as specified in Section 01 78 23, Operation and Maintenance Data.

1.03 QUALITY ASSURANCE

A. Authority Having Jurisdiction (AHJ):

1. Provide Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, provide material and equipment labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ to provide a basis for approval under NEC.

2. Provide materials and equipment manufactured within the scope of standards published by UL in conformance with those standards and with an applied UL listing mark.

B. Standard Products:

1. Provide materials and equipment of manufacturers regularly engaged in the production of products specified in this section and that are of equal material, design, and workmanship.
2. Provide products that have been in satisfactory commercial or industrial use for 2 years prior to Bid opening in similar applications under similar circumstances and of similar size. Provide products that have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period.
3. Material and Equipment Manufacturing Date: Do not use products manufactured more than 3 years prior to date of delivery to Site.
4. Provide assembled fixture, complete with lamps, in accordance with California Code of Regulations Title 24 requirements.

C. Preinstallation Meeting:

1. Occupancy Sensors: Arrange preinstallation meeting with manufacturer's factory authorized representative at Owner's facility, to verify placement of sensors and installation criteria.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Steel Poles:

1. Provide manufacturer's standard protection for the finish during shipment and installation. At minimum, spirally wrap each pole shaft with protective paper secured with tape, and ship small parts in boxes.
2. Do not store poles on ground.
3. Support poles so they are at least 1-foot above ground level and growing vegetation.
4. Do not remove factory-applied pole wrappings until just before installing pole.
5. Ship poles with bolt circle template, base cover, handhold cover, and shaft cap or tenon.

PART 2 PRODUCTS

2.01 LUMINAIRES

A. Specific requirements relative to execution of the Work of this section are located in Luminaire Schedule on Drawings.

B. Provide luminaires and components tested, listed, and labeled by UL, or other approved testing agency.

C. Provide luminaires with Illumination Engineering Society of North America (IESNA) formatted photometric files, ".ies" format, certified by the luminaire manufacturer for use with lighting software.

D. Luminaire Labels: External label per ANSI C136.15.

E. Provide luminaires rated by the manufacturer to start and operate to their full lumen capacity for rated life of the luminaire at the minimum low and maximum high ambient temperatures as defined in the Contract Documents at their installation location.

F. Feed-through type, or separate junction box.

G. Wire Leads: Minimum 18 AWG.

H. Component Access: Accessible and replaceable without removing luminaire from ceiling.

I. Soffit Installations (Interior or Exterior Damp Locations):

1. UL Labeled: SUITABLE FOR DAMP LOCATIONS.
2. Ballast: Removable, prewired.

J. Exterior Installations:

1. UL Labeled: SUITABLE FOR WET LOCATIONS.
2. Ballast: Removable, prewired.
3. When factory-installed photocells are provided, entire assembly shall have UL label.

2.02 LED SOURCE SYSTEMS

A. General:

1. Provide IESNA LM-80 test reports.
2. Provide Energy Star compliance for solid state luminaires.

3. Listed To: UL 8750 Standard for Safety for Light Emitting Diode (LED) Equipment for use in Lighting Products.
4. Provide RoHS compliant LED light source(s) and driver(s).
5. Rated operating temperature range as indicated on the Luminaire Schedule.
6. Warranty: 5 years minimum.

B. Electronic Module/Light Engine:

1. Mount all components to a single plate and factory prewired with quick-disconnect plugs.
2. Include a driver, thermal control device, thermal protector device, and surge protector device.
   a. Provide surge protector tested in accordance with IEEE/ANSI C62.41.2 to Category C Low.
3. Provide LEDs mounted to a metal-core circuit board and aluminum heat sink for optimal thermal management and long life.
4. Light Engine Rating per TM-21:100,000 at 25 degrees C, L70.
5. Correlated Color Temperature (CCT): As indicated on the Luminaire Schedule.
6. Color Rendering Index (CRI): Minimum of 80.

C. Drivers:

1. Expected life of 100,000 hours at 25 degrees C.
2. Provide drivers mounted in an all metal can.
3. Operating Voltage Range: 50/60-Hz input source, voltage range as indicated on the Luminaire Schedule with sustained variations of plus or minus 10 percent voltage with no damage to the driver.
4. Input Current Total Harmonic Distortion: Less than 20 percent up to 50 percent of full load rating.
5. Power Factor: Greater than 0.90 for primary application up to 50 percent of full load rating.
6. Sound Rating: Class A.
7. Comply with NEMA 410 for inrush current limits.

2.03 LIGHTING CONTROL

A. Photoelectric Switch (Photocell):

1. Automatic Solid State ON/OFF Switching Photo Control:
   a. Dry Contacts:
      1) Configuration: SPST.
      2) Rating: 1,800 VA tungsten.

3) Compatible with connected load device indicated on Drawings.

2. Housing: Self-contained, die-cast aluminum, unaffected by moisture, vibration, or temperature changes.
3. Mounting Type: Twist lock plug.
4. Setting: ON at dusk and OFF at dawn.
5. Time delay feature to prevent false switching.
6. Field adjustable to control operating light levels.
7. Integral surge protection.
8. Manufacturers:
   a. Tork.
   b. Intermatic.
   c. Paragon Electric Company.

2.04 POLES

A. General:

1. Design for wind load as specified in Section 01 61 00, Common Product Requirements, while supporting luminaires and other appurtenances. Use effective projected areas (EPA) of luminaires and appurtenances in calculations specific to the actual products proposed on each pole.
2. Poles 40 Feet and Shorter: One-piece construction.
3. Pole Height: As indicated on Luminaire Schedule on Drawings.
4. Handhole:
   a. Provide oval-shaped handhole having a minimum clear opening of 2.5 inches by 5 inches.
   b. Secure cover with stainless steel captive screws.
   c. Metal Poles: Provide an internal grounding connection accessible from handhole near bottom of each pole.
5. Do not install scratched, stained, chipped, or dented poles.

B. Steel Poles:

1. Minimum 11-gauge steel with minimum yield/strength of 48,000 psi and hot-dipped galvanized factory finish.
2. Provide pole grounding connection designed to prevent electrolysis when used with copper ground wire.
3. Square poles shall be hinged.
4. Tapered tubular members, either round in cross section or polygonal.
5. Provide one-piece pole shafts of welded construction with no bolts, rivets, or other means of fastening except as specifically approved.

6. Pole Markings: Approximately 3 feet to 4 feet abovegrade and include manufacturer, year of manufacture, top and bottom diameters, and length.
7. Base Covers: Structural quality hot-rolled carbon steel plate having a minimum yield of 36,000 psi.

2.05 BRACKETS AND SUPPORTS

A. Features:

1. Not less than 1-1/4 inch galvanized steel pipe secured to pole.
2. Slip-fitter or pipe-threaded brackets may be used, but coordinate brackets to luminaires provided. Provide identical brackets for use with one type of luminaire unless otherwise approved by Engineer.
3. Select brackets for pole-mounted street lights to correctly position luminaire no lower than mounting height indicated.
4. Mount brackets not less than 24 feet above street.
5. Provide special mountings or brackets as indicated on Drawings fabricated of metal which will not promote galvanic reaction with luminaire head.

2.06 POLE FOUNDATIONS

A. Anchor Bolts: Steel rod having a minimum yield strength of 50,000 psi; at minimum, galvanize the top 12 inches of the rod.

B. Concrete: As specified in Section 03 30 00, Cast-in-Place Concrete.

2.07 EQUIPMENT IDENTIFICATION

A. Manufacturer’s Nameplate: Provide each item of equipment with a nameplate bearing manufacturer’s name, address, model number, and serial number securely affixed in a conspicuous place; nameplate of distributing agent will not be acceptable.

B. Provide clear markings located to be readily visible to service personnel.

2.08 FACTORY FINISH

A. Provide electrical equipment with factory-applied painting systems that, at minimum, meet the requirements of NEMA 250 corrosion-resistance test.

PART 3 EXECUTION

3.01 LUMINAIRES

A. General:

1. Install in accordance with manufacturer’s recommendations.
2. Provide proper hangers, pendants, and canopies as necessary for complete installation and meeting specified seismic requirements.
3. Install plumb and level.
4. Install each luminaire outlet box with galvanized stud.

B. Mounting:

1. General:
   a. Coordinate mounting, fastening, and environmental conditions with Section 26 05 02, Basic Electrical Requirements.
   b. Refer to Fastener Schedule in Section 05 50 00, Metal Fabrications.
2. Pole Mounted: Provide cast-in-place concrete base.

3.02 LIGHTING CONTROL

A. Outdoor Luminaires: Photocells switch lights ON at dusk and OFF at dawn.

3.03 POLES

A. Electrical Installations: Conform to IEEE C2 and requirements specified herein.

B. Photocell Switch Aiming: Mount and aim switch according to manufacturer's recommendations.

C. Grounding: Ground noncurrent-carrying parts of equipment including metal poles, luminaires, mounting arms, brackets, and metallic enclosures as specified in Section 26 05 26, Grounding and Bonding for Electrical Systems. Where copper grounding conductor is connected to a metal other than copper, provide specially treated or lined connectors suitable for this purpose.

3.04 FIELD FINISHES

A. Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Paint as specified in Section 09 90 00, Painting and Coating.

3.05 FIELD QUALITY CONTROL

A. Upon completion of installation, verify equipment is properly installed, connected, and adjusted. Conduct an operating test to show equipment operates in accordance with the requirements of this section.

B. Coordinate lighting and controls installation and testing with commissioning as specified in Section 01 91 14, Equipment Testing and Facility Startup.

3.06 CLEANING

A. Remove labels and markings, except UL listing mark.

B. Wipe luminaires inside and out to remove construction dust.

C. Clean luminaire plastic lenses with antistatic cleaners only.

D. Touch up painted surfaces of luminaires and poles with matching paint ordered from manufacturer.

E. Replace defective lamps at time of Substantial Completion.

END OF SECTION

SECTION 31 09 17
DYNAMIC PILE TESTING

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM): D4945, Standard Test Method for High-Strain Dynamic Testing of Piles.
2. American Welding Society (AWS): D1.1, Structural Welding Code-Steel.

1.02 DEFINITIONS

A. High Strain Dynamic Testing (HSDT): Testing performed with Case-Goble Pile Driving Analyzer (PDA) to determine the drivability, pile toe and shaft friction capacity of specified piles, pile integrity and hammer performance. Gauges are attached to pile approximately 3 feet below pile head and connected with cable to monitoring station on ground away from pile. Gauges consist of two accelerometers, two strain transducers, and junction box.

B. Impact Stress: Peak stress at pile head on impact from driving train as determined from measurements using pile driving analyzer.

C. Production Piles: Piles incorporated into the Work, utilizing a uniform selection of materials and workmanship, and which are determined acceptable by Engineer based on observation and pile test results.

D. Test Pile: Pile constructed of same materials and workmanship, and installed as specified for production piles at one production pile location as shown on Drawings.

1.03 SUBMITTALS

A. Informational Submittals:

1. Qualifications: Testing agency.
2. Test equipment description and layout.
3. Test procedures.
4. Test record documents.

1.04 QUALIFICATIONS

A. Testing Agency: Independent, certified, and at least 5 years' experience in similar testing including installing instrumentation, performing testing, monitoring specified testing, analyzing data, and preparing test reports.

1.05 DELIVERY, STORAGE, AND HANDLING

A. As specified for production piles.

PART 2 PRODUCTS

2.01 TEST PILE

A. Use the production pile indicated on Drawings for the indicator test pile.

PART 3 EXECUTION

3.01 TEST PROCEDURES

A. Drive a minimum of one test pile with high strain dynamic testing at the production pile location indicated on Drawings prior to beginning production pile driving.

B. Attach HSDT instrumentation when pile is advanced no further than 30 feet above the estimated design tip penetration elevation.

C. Provide preliminary results of pile axial capacity based on preliminary Case Pile Wave Analysis Program (CAPWAP) data within 24 hours following testing for initial drive and restrike, followed by a written report with HSDT test results within 4 business days following completion of restrike dynamic testing.

3.02 RECORD DATA

A. Record the following for each test pile driven and tested:

1. High Strain Dynamic Testing Report for Indicator Pile: In accordance with referenced standard for test performed.
2. Driving record data.
3. Pile length.
4. Hammer make and model.
5. Cushion type and thickness.
6. Number of hammer blows-per-foot of penetration.
7. Resistance in blows-per-inch of last 12 inches of final driving.

8. Hammer stroke, and rate of operation during driving.
9. Description of cushion changes, pile welding between drives, etc.
10. Unusual occurrence(s) during driving.

3.03 TEST RECORD DOCUMENTS

A. Make available to Engineer at Site.

B. Test procedures.

C. Updated versions of documentation required for testing.

D. Certifications of calibration.

E. Testing record data.

3.04 HIGH STRAIN DYNAMIC TESTING

A. Testing Equipment:

1. Contractor: Provide dynamic monitoring equipment, including Pile Driving Analyzer (PDA), and all ancillary equipment necessary to conduct the high strain dynamic testing and conforming to ASTM D4945. PDA shall be manufactured by Pile Dynamics Inc., Cleveland, OH.
    a. Protect PDA monitoring equipment from wind, rain, and sun throughout test period.

B. Pile Driving Equipment: Use same hammer, driving system, and ancillary equipment to drive test pile and production piling. Maintain and operate driving equipment in accordance with manufacturer’s instructions.

C. Test Piles: Perform dynamic test on at least one indicator pile at the location shown.

D. Test Pile Preparation: Mark entire length of each test pile at 1-foot intervals and number marks consecutively starting at pile toe for the purpose of recording penetration resistance and depth of pile penetration. Make accurate marks using a continuous measuring tape and add numbering clearly visible for monitoring personnel. Upon request, perform additional marks at 1-inch intervals for selected feet.

E. Testing: Perform in accordance with ASTM D4945.

F. Test Pile Installation:

1. Meet requirements for production piles.
2. Maintain pile orientation vertical during driving:
   a. Keep hammer concentric with driving train in axial alignment on pile.
   b. Do not use hammer to limit deviation of pile during driving by exerting lateral forces or striking at an angle.
   c. Pipe Piles: If damage to pile butt occurs whereby the hammer may not strike pile uniformly and axially, provide a fresh cut at the butt and check pile for proper fit.
3. Terminate impact driving upon Engineer's request:
   a. Drive the test piles to at least the elevation shown on Drawings.
   b. Engineer will establish tentative termination penetration resistance based on pile ultimate capacity requirements, using wave equation analysis and the Pile Hammer Data Sheet Submittal.
4. Provide a stable and suitable means or device to indicate penetration of the test piles, visible to Engineer and at a safe distance from pile driver.
5. If requested by Engineer, throttle back diesel hammer to operate at a reduced energy level as needed to protect test piles at initial stage of impact driving.

G. Restriking Test Piles:

1. If the required driving resistance is not achieved at the estimated pile tip elevation, perform a restrike with dynamic monitoring on the test pile.
2. Minimum time between restriking and end of initial driving shall be 48 hours.
3. Mount driving train on pile prior to attaching PDA gauges. Assist with gauge removal after completing the restrike but prior to removing pile driving train.

3.05 DAMAGED, MISPLACED, OR OTHERWISE REJECTED PILES

A. Test piles found damaged, necked, or otherwise unfit for use that are located at production pile locations shall be replaced.

B. Remove from Site and replace with conforming piles.

END OF SECTION

SECTION 31 10 00
SITE CLEARING

PART 1 GENERAL

1.01 DEFINITIONS

A. Clearing: Removal of interfering or objectionable material lying on or protruding above ground surface.

B. Grubbing: Removal of vegetation and other organic matter including stumps, buried logs, and roots greater than 2-inch caliper to a depth of 6 inches below subgrade.

C. Interfering or Objectionable Material: Trash, rubbish, and junk; vegetation and other organic matter, whether alive, dead, or decaying; topsoil.

D. Project Limits: Areas, as shown or specified, within which Work is to be performed.

E. Stripping: Removal of topsoil with visible organics.

1.02 SUBMITTALS

A. Action Submittals: Drawings clearly showing clearing, grubbing, and stripping limits.

1.03 QUALITY ASSURANCE

A. Obtain Engineer’s approval of staked clearing, grubbing, and stripping limits, prior to commencing clearing, grubbing, and stripping.

1.04 SCHEDULING AND SEQUENCING

A. Prepare Site only after adequate erosion and sediment controls are in place. Limit areas exposed uncontrolled to erosion during installation of temporary erosion and sediment controls to maximum of 1 acre.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. Clear, grub, and strip areas actually needed for Site improvements within limits shown or specified.

B. Do not injure or deface vegetation that is not designated for removal.

3.02 LIMITS

A. As follows, but not to extend beyond Project limits.

1. Excavation 5 feet beyond top of cut slopes.
2. Fill: 5 feet beyond toe of permanent fill.
3. Excavated Material Disposal: 5 feet beyond perimeter.
4. Structures: 15 feet outside of new structures.
5. Roadways: Clearing, grubbing, and stripping 5 feet from roadway shoulders.

B. Remove rubbish, trash, and junk from entire area within Project limits.

3.03 CLEARING

A. Clear areas within limits shown or specified.

B. Fell trees so that they fall away from facilities and vegetation not designated for removal.

C. Cut off shrubs, brush, weeds, and grasses to within 1 inch of ground surface.

3.04 GRUBBING

A. Grub areas within limits shown or specified.

3.05 STRIPPING

A. Do not remove topsoil until after clearing and grubbing is completed.

B. Strip areas within limits to minimum depths shown or specified. Do not remove subsoil with topsoil.

3.06 TREE REMOVAL OUTSIDE CLEARING LIMITS

A. Remove Within Project Limits:

1. Dead, dying, leaning, or otherwise unsound trees that may strike and damage Project facilities in falling.
2. Trees designated on Project Drawings, if any.

B. Cut stumps off flush with ground, remove debris, and if disturbed, restore surrounding area to its original condition.

3.07 DISPOSAL

A. Clearing, Grubbing, and Stripping Debris:

1. Dispose of debris offsite.
2. Burning of debris onsite will not be allowed.
3. Limit offsite disposal of clearing and grubbing debris to locations that are approved by federal, state, and local authorities, and that will not be visible from Project.

B. Strippings:

1. Dispose of strippings that are unsuitable for topsoil or that exceed quantity required for topsoil offsite.
2. Stockpile topsoil in sufficient quantity to meet Project needs. Dispose of excess strippings as specified for clearing and grubbing.

END OF SECTION

SECTION 31 23 13
SUBGRADE PREPARATION

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM): D1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).

1.02 DEFINITIONS

A. Optimum Moisture Content: As defined in Section 31 23 23, Fill and Backfill.

B. Prepared Ground Surface: Ground surface after completion of clearing and grubbing, stripping of topsoil, excavation to grade, and scarification and compaction of subgrade.

C. Relative Compaction: As defined in Section 31 23 23, Fill and Backfill.

D. Subgrade: Layer of existing soil after completion of clearing, grubbing, stripping of topsoil prior to placement of fill, roadway structure or base for floor slab.

E. Unsuitable Material: Soil with organics, expansive clay, or other deleterious materials that are not suitable to support the applied loads.

1.03 SEQUENCING AND SCHEDULING

A. Complete applicable Work specified in Section 02 41 00, Demolition; Section 31 10 00, Site Clearing; and Section 31 23 16, Excavation, prior to subgrade preparation.

1.04 QUALITY ASSURANCE

A. Notify Engineer when subgrade is ready for compaction or whenever compaction is resumed after a period of extended inactivity.

1.05 ENVIRONMENTAL REQUIREMENTS

A. Prepare subgrade when unfrozen and free of ice and snow.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. Keep subgrade free of water, debris, and foreign matter during compaction.

B. Bring subgrade to proper grade and cross-section and uniformly compact surface.

C. Do not use sections of prepared ground surface as haul roads. Protect prepared subgrade from traffic.

D. Maintain prepared ground surface in finished condition until next course is placed.

3.02 COMPACTION

A. Under Earthfill: Compact upper 6 inches to minimum of 90 percent relative compaction as determined in accordance with ASTM D1557.

B. Under Pavement Structure or Concrete Slabs On Grade: Compact the upper 6 inches to minimum of 95 percent relative compaction as determined in accordance with ASTM D1557.

C. Beneath Earthfill placed on Levee Slope:

1. Perform clearing, grubbing, and stripping in accordance with Section 31 10 00, Site Clearing.
2. Cut into existing slope between 12 inches to 24 inches horizontally prior to placement of each 6-inch maximum thick earthfill lift to create a stair-stepped connection between the subsequent fill and the existing levee embankment.

3.03 MOISTURE CONDITIONING

A. Dry Subgrade: Add water, then mix to make moisture content uniform throughout.

B. Wet Subgrade: Aerate material by blading, discing, harrowing, or other methods, to hasten drying process.

3.04 CORRECTION

A. Soft or Loose Subgrade:

1. Adjust moisture content and recompact, or
2. Overexcavate as specified in Section 31 23 16, Excavation, and replace with suitable material from the excavation, as specified in Section 31 23 23, Fill and Backfill.

B. Unsuitable Material: Overexcavate as specified in Section 31 23 16, Excavation, and replace with suitable material from the excavation, as specified in Section 31 23 23, Fill and Backfill.

END OF SECTION

SECTION 31 23 16
EXCAVATION

PART 1 GENERAL

1.01 QUALITY ASSURANCE

A. Provide adequate survey control to avoid unauthorized overexcavation.

1.02 WEATHER LIMITATIONS

A. Material excavated when frozen or when air temperature is less than 32 degrees F shall not be used as fill or backfill until material completely thaws.

B. Material excavated during inclement weather shall not be used as fill or backfill until after material drains and dries sufficiently for proper compaction.

1.03 SEQUENCING AND SCHEDULING

A. Demolition: Complete applicable Work specified in Section 02 41 00, Demolition, prior to excavating.

B. Clearing, Grubbing, and Stripping: Complete applicable Work specified in Section 31 10 00, Site Clearing, prior to excavating.

C. Excavation Support: Install and maintain as necessary to support sides of excavations and prevent detrimental settlement and lateral movement of existing facilities, adjacent property, and completed Work.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. Excavate to lines, grades, and dimensions shown and as necessary to accomplish Work. Excavate to within tolerance of plus or minus 0.1 foot, except where dimensions or grades are shown or specified as maximum or minimum. Allow for forms, working space, granular base, topsoil, and similar items, wherever applicable. Trim to neat lines where concrete is to be deposited against earth.

B. Do not overexcavate without written authorization of Engineer.

C. Remove or protect obstructions as shown and as specified in Section 01 50 00, Temporary Facilities and Controls, Article Protection of Work and Property.

3.02 UNCLASSIFIED EXCAVATION

A. Excavation is unclassified. Complete all excavation regardless of the type, nature, or condition of the materials encountered.

3.03 CONTROL OF WATER IN EXCAVATION

A. Remove water entering open excavation and discharge away from excavation. Control water to prevent ponded water in excavations during periods when necessary to properly accomplish Work.

B. Provide surface drainage away from open excavation to prevent surface water flow into excavation.

C. Obtain discharge permit for water disposal from authorities having jurisdiction.

D. Treat water collected by water control operations, as required by regulatory agencies, prior to discharge.

E. Discharge water as required by discharge permit and in manner that will not cause erosion or flooding, or otherwise damage existing facilities, completed Work, or adjacent property.

F. Remove solids from treatment facilities and perform other maintenance of any required treatment facilities as necessary to maintain their efficiency.

3.04 TRENCH WIDTH

A. Minimum Width of Trenches: As shown on Drawings.

1. Increase trench widths by thicknesses of sheeting.

B. Maximum Trench Width: Unlimited, unless otherwise shown or specified, or unless excess width will cause damage to existing facilities, adjacent property, or completed Work.

3.05 STOCKPILING EXCAVATED MATERIAL

A. Stockpile excavated material that is suitable for use as fill or backfill until material is needed.

B. Confine stockpiles to within easements, rights-of-way, and approved work areas. Do not obstruct roads or streets.

C. Do not stockpile excavated material adjacent to trenches and other excavations, unless excavation side slopes and excavation support systems are designed, constructed, and maintained for stockpile loads.

D. Do not stockpile excavated materials near or over existing facilities, adjacent property, or completed Work, if weight of stockpiled material could induce excessive settlement.

3.06 DISPOSAL OF SPOIL

A. Dispose of excavated materials, which are unsuitable or exceed quantity needed for fill or backfill, offsite.

B. Dispose of debris resulting from removal of underground facilities as specified in Section 02 41 00, Demolition, for demolition debris.

C. Dispose of debris resulting from removal of organic matter, trash, refuse, and junk as specified in Section 31 10 00, Site Clearing, for clearing and grubbing debris.

END OF SECTION

SECTION 31 23 23
FILL AND BACKFILL

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. C117, Standard Test Method for Materials Finer Than 75-Micrometers (No. 200) Sieve in Mineral Aggregates by Washing.
   b. C136, Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
   c. D75, Standard Practice for Sampling Aggregates.
   d. D1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).
   e. D6938, Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.02 DEFINITIONS

A. Borrow Material: Material from required excavations or from designated borrow areas on or near Site.

B. Completed Course: A course or layer that is ready for next layer or next phase of Work.

C. Earth Fill: Fill materials required to raise existing grade in areas other than under structures or pavements.

D. Imported Material: Materials obtained from sources offsite, suitable for specified use.

E. Influence Area:

1. Area within planes sloped downward and outward at 60-degree angle from horizontal measured from:
   a. 1 foot outside outermost edge at base of foundations or slabs.
   b. 1 foot outside outermost edge at surface of roadways or shoulder.
   c. 0.5 foot outside exterior at spring line of pipes or culverts.

F. Lift: Loose (uncompacted) layer of material.

G. Optimum Moisture Content:

1. Determined in accordance with ASTM Standard specified to determine maximum dry density for relative compaction.
2. Determine field moisture content on basis of fraction passing 3/4-inch sieve.

H. Prepared Ground Surface: Ground surface after completion of required demolition, clearing and grubbing, stripping of topsoil, excavation to grade, and subgrade preparation.

I. Relative Compaction:

1. Ratio, in percent, of as-compacted field dry density to laboratory maximum dry density as determined in accordance with ASTM D1557.
2. Apply corrections for oversize material to either as-compacted field dry density or maximum dry density, as determined by Engineer.

J. Selected Backfill Material: Materials available onsite that Engineer determines to be suitable for specific use.

K. Structural Fill: Fill materials as required under structures, pavements, and other facilities.

L. Well-Graded:

1. A mixture of particle sizes with no specific concentration or lack thereof of one or more sizes.
2. Does not define numerical value that must be placed on coefficient of uniformity, coefficient of curvature, or other specific grain size distribution parameters.
3. Used to define material type that, when compacted, produces a strong and relatively incompressible soil mass free from detrimental voids.

1.03 SUBMITTALS

A. Informational Submittals:

1. Manufacturer’s data sheets for compaction equipment.
2. Certified test results from independent testing agency.
3. Elevation survey results for fill behind retaining wall.

B. Action Submittals: Settlement Monitoring Survey Reports.

1.04 QUALITY ASSURANCE

A. Notify Engineer when:

1. Structure is ready for backfilling, and whenever backfilling operations are resumed after a period of inactivity.
2. Soft or loose subgrade materials are encountered wherever site fill is to be placed.
3. Fill material appears to be deviating from Specifications.

1.05 SEQUENCING AND SCHEDULING

A. Complete applicable Work specified in Section 02 41 00, Demolition; Section 31 10 00, Site Clearing; Section 31 23 13, Subgrade Preparation; and Section 31 23 16, Excavation, and prior to placing fill or backfill.

B. Backfill against concrete structures only after concrete has attained compressive strength, specified in Section 03 30 00, Cast-in-Place Concrete. Obtain Engineer's acceptance of concrete work and attained strength prior to placing backfill.

C. Backfill around water-holding structures only after completion of satisfactory leakage tests as specified in Section 03 30 00, Cast-in-Place Concrete.

D. Backfill around buried tanks only after tank is set in position, securely anchored, and ready to be backfilled and Engineer provides authorization to backfill.

E. Do not place granular base, subbase, or surfacing until after subgrade has been prepared as specified in Section 31 23 13, Subgrade Preparation.

F. Perform settlement monitoring as specified in Article Settlement Monitoring, after fill is placed to within 1 foot of final grade prior to installation of 30-inch RW pipeline.

PART 2 PRODUCTS

2.01 SOURCE QUALITY CONTROL

A. Gradation Tests:

1. As necessary to locate acceptable sources of imported material.
2. During production of imported material, test at the start of production and submit results.

2.02 EARTH FILL

A. Excavated material from required excavations free from rocks larger than 3 inches, from roots and other organic matter, ashes, cinders, trash, debris, and other deleterious materials.

B. Provide imported material of equivalent quality, if required to accomplish Work.

2.03 STRUCTURAL FILL

A. Excavated material from required excavations, or imported material, free from rocks larger than 3 inches, from roots and other organic matter, ashes, cinders, trash, debris, and other deleterious materials.

B. Well-graded from coarse to fine and containing sufficient fines to bind material when compacted, but with maximum of 35 percent passing the No. 200 sieve.

C. Nonplastic or low plasticity material (Liquid Limit less than 35, Plasticity Index less than 12).

D. Provide imported material of equivalent quality, if required to accomplish Work.

2.04 WATER FOR MOISTURE CONDITIONING

A. Free of hazardous or toxic contaminates, or contaminants deleterious to proper compaction.

2.05 CRUSHED ROCK

A. Crushed, Angular Gravel: Uniformly graded between 1 inch to 3 inches.

B. Maximum Particle Size: Nominal 3-inch.

C. Maximum Percent Passing the 1-inch Sieve: 20 percent.

D. Maximum Percent Passing the No. 4 Sieve: 10 percent.

2.06 DRAIN ROCK

A. Crushed, Angular Gravel: Uniformly graded between 1/4 inch to 1 inch.

B. Maximum Particle Size: Nominal 1-inch.

C. Maximum Percent Passing the No. 4 Sieve: 10 percent.

D. Maximum Percent Passing the No. 40 Sieve: 5 percent.

2.07 GEOTEXTILE (FOR RIPRAP BEDDING AND WRAPPING DRAIN ROCK BEHIND RETAINING WALL)

A. Pervious sheet of polyester, polypropylene, or polyethylene fabricated into stable network of fibers that retain their relative position with respect to each other. Geotextile shall be nonwoven, composed of continuous or discontinuous (staple) fibers held together through needle-punching, spun-bonding, thermal-bonding, or resin-bonding.

B. Geotextile Edges: Selvaged or otherwise finished to prevent outer material from pulling away from geotextile.

C. Physical Properties:

1. Conform to requirements in following Table 1:

Table 1
Physical Property Requirements for Nonwoven Geotextile

Property	Requirement	Test Method
Nominal Weight	10 ounces/sq. yard	ASTM D5261
Water Permittivity	0.8 $sec.^{-1}$, Minimum	ASTM D4491
Apparent Opening Size (AOS)	80 to 100 U.S. Standard Sieve Size	ASTM D4751
Grab Tensile Strength, Machine Direction	250 lb/in, Minimum	ASTM D4632
Grab Elongation, Machine Direction	50 percent, Minimum	ASTM D4632
CBR Puncture Strength	600 lb, Minimum	ASTM D6241
Trapezoid Tear Strength	100 lb, Minimum	ASTM D4533

2.08 BASE COURSE ROCK

A. As specified in Section 32 11 23, Aggregate Base Courses.

PART 3 EXECUTION

3.01 GENERAL

A. Keep placement surfaces free of water, debris, and foreign material during placement and compaction of fill and backfill materials.

B. Place and spread fill and backfill materials in horizontal lifts of uniform thickness, in a manner that avoids segregation, and compact each lift to specified densities prior to placing succeeding lifts. Slope lifts only where necessary to conform to final grades or as necessary to keep placement surfaces drained of water.

C. During filling and backfilling, keep level of fill and backfill around each structure even.

D. If pipe, conduit, ductbank, or cable is to be laid within fill or backfill:

1. Fill or backfill to an elevation 2 feet above top of item to be laid.
2. Excavate trench for installation of item.
3. Install bedding, if applicable, as specified in Section 31 23 23.15, Trench Backfill.
4. Install item.
5. Backfill envelope zone and remaining trench, as specified in Section 31 23 23.15, Trench Backfill, before resuming filling or backfilling specified in this section.

E. Tolerances:

1. Final Lines and Grades: Within a tolerance of 0.1 foot unless dimensions or grades are shown or specified otherwise.
2. Grade to establish and maintain slopes and drainage as shown. Reverse slopes are not permitted.

F. Settlement: Correct and repair any subsequent damage to structures, pavements, curbs, slabs, piping, and other facilities, caused by settlement of fill or backfill material.

3.02 FILL UNDER AND AROUND STRUCTURES

A. Behind Retaining Wall:

1. Place drain rock for 3 feet wide and 5 feet high immediately behind the wall at bottom of wall.

2. Place geotextile between structural fill and drain rock, and continue geotextile to overlap a minimum of 18 inches along contact of drain rock with concrete.
3. Place drain rock and structural fill in maximum lift thickness of 8 inches across entire area of fill.
4. Compact Drain Rock with minimum 3 passes of a vibratory plate compactor. Compact structural fill as specified for under facilities.
5. Place fill up to within 18 inches of final grade as shown prior to excavating for pipeline installation.
6. Perform settlement monitoring in accordance with Article Settlement Monitoring, prior to excavating for pipeline installation.

B. Under Facilities: Within influence area beneath structures, slabs, pavements, piping, conduits, ductbanks, and other facilities, backfill with structural fill, unless otherwise shown. Place structural fill in lifts of 8-inch maximum thickness and compact each lift to minimum of 95 percent relative compaction as determined in accordance with ASTM D1557.

C. Other Areas: Backfill with earthfill to lines and grades shown, with proper allowance for topsoil thickness where shown. Place in lifts of 8-inch maximum thickness and compact each lift to minimum 90 percent relative compaction as determined in accordance with ASTM D1557.

D. Fill Placement up against Levee Slope or on Sloping Ground that is Steeper than 12 Percent:

1. Clear or excavate horizontal bench at toe of fill slopes to allow fill placement in lifts within 3 percent of level.
2. Cut into existing ground slope as the fill placement proceeds to create a stepped interface between the fill and native ground.
3. Cut a bench into existing slope a minimum of 12 inches horizontally, up to a maximum of 24 inches, before placing each horizontal lift of earthfill.
4. Place earthfill in horizontal lifts of 6-inch maximum compacted thickness, compact each lift to minimum of 90 percent relative compaction as determined in accordance with ASTM D1557.
5. Moisture condition earth fill between 0 percent to 3 percent above the optimum moisture content as determined with ASTM D1557, prior to compaction.
6. Maximum Vertical Edge of Cut Bench: 2 feet.
7. Minimum Width of Fill Lift: At least as wide as the compaction equipment.

3.03 SITE TESTING BY OWNER

A. Gradation:

1. One sample from each 500 yards of material placed or more often as determined by Engineer, if variation in gradation is occurring, or if material appears to depart from Specifications.
2. If test results indicate material does not meet Specification requirements, terminate material placement until corrective measures are taken.
3. Remove material placed in Work that does not meet Specification requirements.

B. In-Place Density Tests:

1. In accordance with ASTM D6938. During placement of materials, test as follows:
   a. Earth Fill: One per 250 cubic yards, and at least two per vertical foot of fill placed each day.
   b. Base Course Rock: One per 1,000 square feet of area placed for each lift.
   c. Structural Fill: One per 200 cubic yards, and at least two per vertical foot of fill placed each day.

3.04 SETTLEMENT MONITORING

A. Install settlement monitoring markers or monuments on top surface of fill subgrade within 1 foot of locations shown on Drawings.

B. Protect monuments in place until receiving approval from Engineer for discontinuation of survey, embed in concrete base if necessary to protect from construction traffic.

C. Survey northing, easting, and elevations within 1 day after monument installation, at 2 days, and weekly thereafter.

D. Submit a Settlement Monitoring Survey Report within 2 days after each survey. Include the date, time, coordinates, and elevation of all prior survey results.

E. Obtain written confirmation from Engineer that settlement has sufficiently subsided prior to installation of 30-inch RW pipeline. The preliminary estimate of the settlement period is three to 4 weeks.

3.05 GRANULAR BASE, SUBBASE, AND SURFACING

A. Place and Compact as specified in Section 32 11 23, Aggregate Base Courses.

3.06 REPLACING OVEREXCAVATED MATERIAL

A. Replace excavation carried below grade lines shown or established by Engineer as follows:

1. Beneath Footings: Concrete of strength equal to that of respective footing, as specified in Section 03 30 00, Cast-in-Place Concrete.
2. Beneath Fill or Backfill: Same material as specified for overlying fill or backfill.
3. Beneath Slabs-On-Grade: Structural fill.
4. Trenches:
    a. Unauthorized Overexcavation: Either aggregate base course as specified in Section 32 11 23, Aggregate Base Courses, or Controlled Low Strength Material, as specified in Section 31 23 23.15, Trench Backfill.

3.07 ACCESS ROAD SURFACING

A. Place and compact aggregate base course as specified in Section 32 11 23, Aggregate Base Courses. Place and compact asphalt concrete as specified in Section 32 12 16, Asphalt Paving.

END OF SECTION

SECTION 31 23 23.15
TRENCH BACKFILL

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Public Works Association (APWA): Uniform Color Code.
2. ASTM International (ASTM):
   a. C33/C33M, Standard Specification for Concrete Aggregates.
   b. C94/C94M, Standard Specification for Ready-Mixed Concrete.
   c. C117, Standard Test Method for Materials Finer than 75 Micrometer (No. 200) Sieve in Mineral Aggregates by Washing.
   d. C136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
   e. C150/C150M, Standard Specification for Portland Cement.
   f. C618, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
   g. C1012/C1012M, Standard Test Method for Length Change of Hydraulic-Cement Mortars Exposed to a Sulfate Solution.
   h. D1140, Standard Test Methods for Amount of Material in Soils Finer than No. 200 (75 micrometer) Sieve.
   i. D1557, Standard Test Methods for Laboratory Compaction Characteristics of Soil using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).
   j. D2487, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
   k. D4318, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
   l. D4832, Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders.
3. National Electrical Manufacturers Association (NEMA): Z535.1, Safety Colors.

1.02 DEFINITIONS

A. Base Rock: Granular material upon which manhole bases and other structures are placed.

B. Bedding Material: Granular material upon which pipes, conduits, cables, or ductbanks are placed.

C. Imported Material: Material obtained by Contractor from source(s) offsite.

D. Lift: Loose (uncompacted) layer of material.

E. Pipe Zone: Backfill zone that includes full trench width and extends from prepared trench bottom to an upper limit above top outside surface of pipe, conduit, cable or ductbank.

F. Prepared Trench Bottom: Graded trench bottom after excavation and installation of stabilization material, if required, but before installation of bedding material.

G. Relative Compaction: The ratio, in percent, of the as-compacted field dry density to the laboratory maximum dry density as determined by ASTM D1557. Corrections for oversize material may be applied to either as-compacted field dry density or maximum dry density, as determined by Engineer.

H. Selected Backfill Material: Material available onsite that Engineer determines to be suitable for a specific use.

1.03 SUBMITTALS

A. Action Submittals:

1. Shop Drawings: Manufacturer’s descriptive literature for marking tapes.

B. Informational Submittals:

1. Catalog and manufacturer’s data sheets for compaction equipment.
2. Certified Gradation Analysis: Submit not less than 30 days prior to delivery for imported materials or anticipated use for excavated materials, except for trench stabilization material that will be submitted prior to material delivery to Site.
3. Controlled Low Strength Material: Certified mix design and test results. Include material types and weight per cubic yard for each component of mix.

PART 2 PRODUCTS

2.01 MARKING TAPE

A. Nondetectable:

1. Inert polyethylene, impervious to known alkalis, acids, chemical reagents, and solvents likely to be encountered in soil.

2. Thickness: Minimum 4 mils.
3. Width: 3 inches.
4. Identifying Lettering: Minimum 1-inch high, permanent black lettering imprinted continuously over entire length.
5. Manufacturers and Products:
    a. Reef Industries; Terra Tape.
    b. Christy's; Non-detectable Tape.
    c. Presco; Non-detectable Tape.

B. Detectable:

1. Solid aluminum foil, visible on unprinted side, encased in protective high visibility, inert polyethylene plastic jacket.
2. Foil Thickness: Minimum 0.35 mils.
3. Laminate Thickness: Minimum 5 mils.
4. Width: 3 inches.
5. Identifying Lettering: Minimum 1-inch high, permanent black lettering imprinted continuously over entire length.
6. Joining Clips: Tin or nickel-coated furnished by tape manufacturer.
7. Manufacturers and Products:
    a. Reef Industries; Terra Tape, Sentry Line Detectable.
    b. Christy's; Detectable Tape.
    c. Presco; Detectable Tape.

C. Color: In accordance with APWA Uniform Color Code.

Color*	**Facility**
Red	Electric power lines, cables, conduit, and lightning cables
Orange	Communicating alarm or signal lines, cables, or conduit
Yellow	Gas, oil, steam, petroleum, or gaseous materials
Green	Sewers and drain lines
Blue	Potable water
Purple	Reclaimed water, irrigation, and slurry lines
*As specified in NEMA Z535.1, Safety Color Code.	

2.02 TRENCH STABILIZATION MATERIAL

A. Clean gravel or crushed rock, angular, and not from river run or bank run, reasonably well-graded from coarse to fine, free from clay balls, organic materials, or debris.

B. Maximum Particle Size: 3-inch.

C. Maximum Percent Passing the No. 200 Sieve: 8 percent.

2.03 BEDDING MATERIAL AND PIPE ZONE MATERIAL

A. Unfrozen, friable, and no clay balls, roots, or other organic material.

B. Clean or gravelly sand with less than 5 percent passing No. 200 sieve, as determined in accordance with ASTM D1140, or gravel or crushed rock with maximum 3/4-inch particle size.

C. Controlled Low Strength Material (CLSM) may be used for Bedding and Pipe Zone Material.

2.04 CONTROLLED LOW STRENGTH MATERIAL (CLSM)

A. A workable, flowable mixture of cement, water, and fine aggregate.

B. Select and proportion ingredients to obtain compressive strength between 50 psi and 150 psi at 28 days in accordance with ASTM D4832.

C. Materials:

1. Cement: ASTM C150/C150M, Type I or Type II.
2. Aggregate: ASTM C33/C33M, Size 8 or 9, or fine aggregate.
3. Fly Ash (Pozzolan):
    a. Class F or Class C fly ash in accordance with ASTM C618, except as modified herein:
        1) ASTM C618, Table 1, Loss on Ignition: Unless permitted otherwise, maximum 3 percent.
4. Water: Clean, potable, containing less than 500 ppm of chlorides.

2.05 GRAVEL SURFACING ROCK

A. As specified in Section 32 11 23, Aggregate Base Courses.

2.06 SOURCE QUALITY CONTROL

A. Perform gradation analysis in accordance with ASTM C136 for:

1. Trench stabilization material.
2. Bedding and pipe zone material.

B. Certify Laboratory Performance of Mix Designs: Controlled low strength material.

PART 3 EXECUTION

3.01 TRENCH PREPARATION

A. Water Control:

1. Promptly remove and dispose of water entering trench as necessary to grade trench bottom and to compact backfill and install manholes, pipe, conduit, direct-buried cable, or ductbank. Do not place concrete, lay pipe, conduit, direct-buried cable, or ductbank in water.
2. Remove water in a manner that minimizes soil erosion from trench sides and bottom.
3. Provide continuous water control until trench backfill is complete.

B. Remove foreign material and backfill contaminated with foreign material that falls into trench.

3.02 TRENCH BOTTOM

A. Firm Subgrade: Grade with hand tools, remove loose and disturbed material, and trim off high areas and ridges left by excavating bucket teeth. Allow space for bedding material if shown or specified.

B. Soft Subgrade: If subgrade is encountered that may require removal to prevent pipe settlement, notify Engineer. Engineer will determine depth of overexcavation, if any required.

3.03 TRENCH STABILIZATION MATERIAL INSTALLATION

A. Where soft subgrade was overexcavated, rebuild trench bottom with trench stabilization material.

B. Place material over full width of trench in 6-inch lifts to required grade, providing allowance for bedding thickness.

C. Compact each lift so as to provide a firm, unyielding support for the bedding material prior to placing succeeding lifts.

3.04 BEDDING

A. Furnish imported bedding material.

B. Place over full width of prepared trench bottom in two equal lifts when required depth exceeds 8 inches.

C. Hand grade and compact each lift to provide a firm, unyielding surface.

D. Minimum Thickness:

1. Pipe 30 Inches and Smaller: 6 inches.
2. Conduit: 3 inches.
3. Ductbanks: 3 inches.

E. Check grade and correct irregularities in bedding material. Loosen top 1 inch to 2 inches of compacted bedding material with a rake or by other means to provide a cushion before laying each section of pipe, conduit, direct-buried cable, or ductbank.

F. Install to form continuous and uniform support except at bell holes, if applicable, or minor disturbances resulting from removal of lifting tackle.

G. Bell or Coupling Holes: Excavate in bedding at each joint to permit proper assembly and inspection of joint and to provide uniform bearing along barrel of pipe or conduit.

3.05 BACKFILL PIPE ZONE

A. Upper limit of pipe zone shall not be less than following:

1. Pipe: 12 inches, unless shown otherwise.
2. Conduit and Ductbank: 3 inches, unless shown otherwise.

B. Restrain pipe, conduit, cables, and ductbanks as necessary to prevent their movement during backfill operations.

C. Place material simultaneously in lifts on both sides of pipe and, if applicable, between pipes, conduit, cables, and ductbanks installed in same trench.

1. Pipe 10-Inch and Smaller Diameter: First lift less than or equal to 1/2 pipe diameter.
2. Pipe Over 10-Inch Diameter: Maximum 6-inch lifts.

D. Thoroughly tamp each lift, including area under haunches, with handheld tamping bars supplemented by “walking in” and slicing material under haunches with a shovel to ensure voids are completely filled before placing each succeeding lift.

E. Do not use power-driven impact compactors to compact pipe zone material. After full depth of pipe zone material has been placed as specified, compact material by a minimum of three passes with a vibratory plate compactor.

F. Controlled Low Strength Material (CLSM):

1. Support pipe on sandbags or otherwise approved material to prevent flexure of the pipe and allow CLSM to flow under the pipe.
2. Discharge from truck mounted drum type mixer into trench.
3. Place in lifts as necessary to prevent uplift (flotation) of new and existing facilities.

3.06 MARKING TAPE INSTALLATION

A. Continuously install marking tape along centerline of buried piping, on top of last lift of pipe zone material, unless shown otherwise. Coordinate with piping installation drawings.

1. Detectable Marking Tape: Install with nonmetallic piping and waterlines.
2. Nondetectable Marking Tape: Install with metallic piping.

3.07 BACKFILL ABOVE PIPE ZONE

A. General:

1. Process excavated material to meet specified gradation requirements.
2. Adjust moisture content as necessary to obtain specified compaction.
3. Do not allow backfill to free fall into trench or allow heavy, sharp pieces of material to be placed as backfill until after at least 2 feet of backfill has been provided over top of pipe.
4. Do not use power driven impact type compactors for compaction until at least 4 feet of backfill is placed over top of pipe.
5. Backfill to grade with proper allowances for surfacing, and pavement thicknesses, wherever applicable.
6. Backfill with Structural Fill as specified in Section 31 23 23, Fill and Backfill.
7. Place in lifts not exceeding thickness of 8 inches. Mechanically compact each lift to a minimum of 95 percent relative compaction prior to placing succeeding lifts.

3.08 MAINTENANCE OF TRENCH BACKFILL

A. After each section of trench is backfilled, maintain surface of backfilled trench even with adjacent ground surface until final surface restoration is completed.

B. Gravel Surfacing Rock: Add gravel surfacing rock where applicable and as necessary to keep surface of backfilled trench even with adjacent ground surface, and grade and compact as necessary to keep surface of backfilled

trenches smooth, free from ruts and potholes, and suitable for normal traffic flow.

C. Asphaltic Pavement: Replace settled areas or fill with asphalt as specified in Section 32 12 16, Asphalt Paving.

D. Other Areas: Add excavated material where applicable and keep surface of backfilled trench level with adjacent ground surface.

3.09 SETTLEMENT OF BACKFILL

A. Settlement of trench backfill, or of fill, or facilities constructed over trench backfill will be considered a result of defective compaction of trench backfill.

END OF SECTION

SECTION 31 37 00
RIPRAP

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. C136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
   b. C535, Standard Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

1.02 DEFINITIONS

A. Refer to applicable definitions in Section 31 23 23, Fill and Backfill.

1.03 SUBMITTALS

A. Action Submittals:

1. Shop Drawings: Description and location of proposed sources of riprap.

B. Informational Submittals:

1. Quarry Certificate of Conformance and supporting documentation showing proposed riprap meets Standard Specification gradation and materials requirements as specified.
2. Certified Test Results:
   a. Riprap:
      1) Gradation.
      2) Abrasion resistance.
      3) Bulk density or specific gravity.
3. Trip tickets showing source, type, and weight of each load of material delivered to Site.

1.04 QUALITY ASSURANCE

A. Riprap Source: Quarry that has produced riprap and has performed satisfactorily on other projects for at least 5 years.

B. Site Visit: Make available for Engineer to visit quarry site to observe materials proposed for riprap.

1.05 SCHEDULING AND SEQUENCING

A. Complete subgrade preparation as specified in Section 31 23 13, Subgrade Preparation, prior to placing riprap.

PART 2 PRODUCTS

2.01 GEOTEXTILE RIPRAP BEDDING

A. As specified in Section 31 23 23, Fill and Backfill.

2.02 AGGREGATE RIPRAP BEDDING

A. Gravel with Cobbles or Crushed Rock with Cobble-Sized Pieces:

1. Gradation, as determined in accordance with ASTM C136:
   a. Well-graded from coarse to fine.
   b. All pieces pass a 6-inch square opening.
   c. Minimum 85 percent by weight passes 4-inch square opening.
   d. Between 20 percent to 50 percent by weight passes the 1-inch sieve.
   e. Minimum 10 percent by weight passes No. 4 U.S. standard sieve.
2. Abrasion Resistance: Maximum 35 percent wear when tested in accordance with ASTM C535.

B. Free of roots and other organic or deleterious matter.

2.03 RIPRAP

A. Hard and durable quarry stone free from fractures, bedding planes, pronounced weathering, and earth or other adherent coatings.

B. Abrasion Resistance: Maximum 35 percent wear as determined in accordance with ASTM C535.

C. Bulk Density of Stone: Minimum 155 pounds per dry cubic foot, or minimum specific gravity of 2.5.

D. Gradation: Smaller pieces shall generally fill voids between larger pieces without either excess or deficiency of one or more sizes of stone.

Approximate Weight for Stone Size (lbs)	Stone Size (Inches)	Percent Passing
160	15	100
25	8	75-95
12	6	45-80
5	4	15-45
1	2	0-10

PART 3 EXECUTION

3.01 PLACING GEOTEXTILE

A. Lay and maintain geotextile smooth and free of tension, folds, wrinkles, or creases.

B. Orient geotextile with long dimension of each sheet parallel to direction of slope.

C. Overlap joints a minimum of 18 inches. Overlap with upstream sheet of geotextile over the downstream sheet.

D. Secure geotextile with pins and washers or staples specifically manufactured for securing geotextiles over soil. Place pins or staples within 6 inches from free edges or midway between edges at overlapping joints. Install additional pins or staples across each geotextile sheet as necessary to prevent slippage of geotextile or to prevent wind from blowing geotextile out of position.

3.02 PLACING RIPRAP AND AGGREGATE RIPRAP BEDDING ON GEOTEXTILE

A. Place riprap over geotextile to uniform thickness shown. Place riprap from bottom to top of slope.

B. Limit height of riprap fall onto geotextile to prevent damage.

C. Intermix different sizes of pieces to eliminate segregation and to fill voids between larger pieces with smaller pieces and work surface free from irregularities.

D. Place and grade riprap in a manner that avoids disturbance, displacement, or damage to the geotextile.

E. If geotextile is damaged, repair prior to proceeding by removing riprap and placing additional piece of geotextile over damaged geotextile, extending at least 24 inches in all directions beyond damaged area. Secure geotextile patch with heat fusion or pins or staples prior to placing riprap.

END OF SECTION

SECTION 31 41 00
SHORING

PART 1 GENERAL

1.01 SUMMARY

A. This section specifies temporary shoring systems required between the Junction Box and the Garden Highway to accomplish the excavation work without encroaching on the Garden Highway. Any Drawings that show conceptual shoring locations, or implied types, are shown schematically, and it is not intended that schematic shoring be shown for all locations where it may be required.

B. The Contractor shall design, construct, maintain, and monitor all temporary shoring systems as part of their construction means and methods and are solely responsible for performance of such systems.

1.02 SUBMITTALS

A. Informational Submittals:

1. Excavation Support Plan:
   a. Must be prepared and stamped by a professional engineer licensed in the State of California.
   b. Must be updated as necessary to adjust shoring methods according to any measured movements to ensure such movements do not impact existing or finished construction.
2. Movement measurement data and reduced results indicating movement trends.
3. Review of excavation support plan shall be only for compliance with topics included preparation or performance by a registered professional, and similar specified requirements, and not for the accuracy or the adequacy of the plan or facilities, which together with all other matters of health and safety shall be solely the responsibility of Contractor.

1.03 QUALITY ASSURANCE

A. During excavation, perform daily surveys to monitor movement of the top of shoring system and the edge of Garden Highway asphalt concrete pavement closest to the Junction Box. Provide weekly surveys after excavation depth is reached until excavation is backfilled or until three consecutive measurements show no movement is occurring.

B. Stop excavation if measured cumulative movement of Garden Highway pavement is greater than 1/4 inch horizontally or vertically. Update excavation plan to ensure movements of Garden Highway pavement is stopped and impacts are remediated prior to further excavation.

C. If cumulative movement of top of shoring system is more than 30 percent greater than design estimate, stop work until the excavation support plan can be reviewed, updated, and approved by the engineer who prepared the plan.

D. Submit records to Engineer within 24 hours of completion of weekly or daily surveys.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. Design, provide, and maintain shoring, sheeting, and bracing as necessary to support the sides of excavations and to prevent detrimental settlement and lateral movement of existing facilities, adjacent property, and completed Work.

B. Before beginning excavation, install and survey monitoring points identified in the excavation support plan. Adequately protect existing structures, utilities, and other facilities. The repair of or compensation for damage to existing facilities will be at no additional cost to NMWC.

C. All welding will conform to the applicable provisions of ANSI/AWS D1.1.

D. Place K-rail between excavation and Garden Highway to protect traffic from the open excavation.

3.02 EXCAVATION SUPPORT PLAN

A. Prepare excavation support plan addressing following topics:

1. Details of shoring, bracing, sloping, or other provisions for protection of existing facilities, finished products, and worker protection from hazards of caving ground.
2. Design assumptions and calculations.
3. Methods and sequencing of installing excavation support.
4. Proposed locations of stockpiled excavated material.
5. Minimum lateral distance from the top of shoring or crest of slopes for vehicles and stockpiled excavated materials.

6. Estimate of shoring deflection.
7. Movement Monitoring Points:
    a. Survey control.
    b. Location of monitoring points.
8. Anticipated difficulties and proposed resolutions.

3.03 REMOVAL OF EXCAVATION SUPPORT

A. Remove excavation support in a manner that will maintain support as excavation is backfilled.

B. Do not begin to remove excavation support until support can be removed without damage to existing facilities, completed Work, or adjacent property.

C. Remove excavation support in a manner that does not leave voids in the backfill.

3.04 TRENCHES

A. For trench excavation exceeding 5 feet in depth, provide adequate safety system meeting requirements of California Labor Code Section 6707, applicable local construction safety orders, and federal requirements.

B. At any time Contractor's personnel are not present with the immediate vicinity of the Work, open trench excavations will be plated, barricaded, or fenced as necessary to protect the public and worker safety.

END OF SECTION

SECTION 31 62 16
STEEL PILES

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Concrete Institute (ACI): 318/318R, Building Code Requirements for Structural Concrete and Commentary.
2. American Petroleum Institute (API): Spec 5L, Specification for Line Pipe.
3. American Water Works Association (AWWA): C200, Steel Water Pipe—6 in. (50 mm) and Larger.
4. American Welding Society (AWS): D1.1, Structural Welding Code—Steel.
5. ASTM International (ASTM):
    a. A36, Standard Specification for Carbon Structural Steel.
    b. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
    c. A139, Standard Specification for Electric-Fusion (ARC)-Welded Steel Pipe (NPS 4 and Over).
    d. A252, Standard Specification for Welded and Seamless Steel Pipe Piles.
    e. A572, Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
    f. A1011/A1011M, Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.

1.02 DEFINITIONS

A. Design Position: The location of the centroid of the pile at cutoff elevation (x, y, and z coordinates) as shown.

B. Dynamic Monitoring: Monitoring performed with Case-Goble Pile Driving Analyzer (PDA). Gauges are attached to pile approximately 3 feet below pile head and connected with cable to monitoring station on ground away from pile. Gauges consist of two accelerometers and two strain transducers.

C. Elevations: Referenced to Project vertical datum.

D. Fixed Leads: Leads that are pinned to crane boom at top and equipped with hydraulic spotter at bottom capable of spotting pile to its correct position and maintaining alignment during driving. Degree of rigidity and strength acceptable will be subject to review of Engineer.

E. Impact Stress: Stress transferred to pile head at impact from driving train, as determined from measurements using Pile Driving Analyzer.

F. Obstruction: Sudden and significant increase of penetration resistance and deviation of pile out of tolerance resulting from encountering a subsurface or physical condition.

G. Practical Refusal: Penetration resistance of at least 120 blows per foot, or 25 blows per inch for 2 consecutive inches, whichever comes first, and to continue driving pile would be impractical. These criteria apply only for hammer sizes and operation as specified.

H. Rated Hammer Energy:

1. Diesel Hammers: Product of rated stroke times ram weight.

I. Restriking: Positioning driving train and driving already installed pile after some nominal waiting period (as specified) after initial installation. This definition applies to redriving piles selected by Engineer for determining appropriate driving criteria requirements or for checking pile integrity. Restriking may require mobilizing crane and driving train from one pile to another location at opposite ends of structure(s).

J. Set: Pile penetration in inches per blow.

K. Sweep: Deviation from straightness measured along two perpendicular faces of pile while not subject to bending forces.

L. Swinging Leads: Pile driving leads that are not pinned at the top and do not have a hydraulic spotter to position the leads.

M. Termination Penetration Resistance: Penetration resistance (blow count) at which driving may be terminated, as established by Engineer.

N. Transferred Hammer Energy: Energy transferred to pile head from driving train impact, as determined from measurements using Pile Driving Analyzer.

1.03 SUBMITTALS

A. Action Submittals:

1. Splice Design Details and Calculations: AWS D1.1 Appendix E; include documentation establishing each welder is currently qualified in the proposed welding procedure.
2. Pipe Pile Driving Plan:
   a. Manufacturer's literature for crane, pile hammer, and auxiliary equipment.
   b. Proposed method(s) to align and maintain pile alignment, including type of leads to be used with details on methods and equipment to be used to measure alignment.
   c. Pile driving schedule and sequence including material submittals, initial Site work, material delivery, staging, template installation, driving, and filling with concrete.

B. Informational Submittals:

1. Production pile driving schedule and sequence.
2. Piling Installer Qualifications.
3. Welder Qualifications and Certifications: Site welding.
4. Manufacturer's Certification of Compliance: Manufactured products.
5. Certified Test Results: Concrete mix design, including certified minimum 28-day compressive strength.
6. Complete Pile Hammer Data Sheet, attached as Supplement to this Specification. Refer to Part 3, Article Supplements.
7. Daily Log and Record: At end of each working day, submit two copies of each record for every pile constructed that day.

1.04 QUALIFICATIONS

A. Piling Installer: Minimum of 5 years of past successful experience on ten projects of steel pipe pile installation, including a minimum of three projects requiring installation of pipe piles in a flowing river or stream.

B. Site Welders: Current qualification in proposed welding procedure(s) in accordance with AWS D1.1.

1.05 STORAGE AND HANDLING

A. Do not subject piles to damage by impact bending stresses in transporting, storing, or handling them.

1.06 SEQUENCING AND SCHEDULING

A. Production Pile Driving: Begin after installation of templates to ensure production piles are constructed within driving tolerances, and after successful completion of testing as specified in Section 31 09 17, Dynamic Pile Testing. Modified pile driving criteria will be provided by the Engineer according to the Dynamic Pile Testing Results within approximately 3 business days following receipt of the test report. Production piles which are installed prior to receipt of modified pile driving criteria are subject to additional driving if determined to be necessary by the Dynamic Pile Testing results.

PART 2 PRODUCTS

2.01 PILES

A. Pipe Piles: Minimum size and wall thickness shown manufactured to ASTM A252, Grade 3, with physical and chemical requirements that meet ASTM A572 Grade 50.

B. Drive one test pile at the production pile location as indicated on Drawings. The test pile, if found acceptable to Engineer, will be left in place as part of the foundations system of the permanent facility.

2.02 PILE SPLICES

A. Meet requirements of AWS D1.1, and provide equal stress strain behavior in bending, tension, compression, and torsion as unspliced segments of pile.

B. Premanufactured: Engineer’s prior approval required.

2.03 CONCRETE

A. As specified in Section 03 30 00, Cast-in-Place Concrete.

B. Evaluation and Acceptance of Concrete:

1. In accordance with ACI Standard Building Code Requirements for Reinforced Concrete (ACI 318/318R), Section 4.8, Evaluation and Acceptance of Concrete, and as specified in Section 03 30 00, Cast-in-Place Concrete, except as follows:
   a. Investigation of low strength test results, ACI Section 4.84, will not apply.

2. If concrete does not meet above requirements, provide additional piling to ensure structural design load-carrying capacity.
   a. Engineer will determine number of extra piles required and will base this determination on actual 28-day compressive strength attained, location and required load-carrying capacity of piles in question, and calculated load-carrying capacity of piling based on following equation:

      Maximum Axial Load-Carrying Capacity = $0.35\ F_Y A_S + 0.33\ f'_C A_C$

      Where:

      F_Y = yield stress of steel, and $0.35\ F_Y$ is not to exceed 12.6 ksi for pipe piles

      A_S = Cross-sectional area of steel in pile (minimum cross-sectional area for piles with varying cross-section)

      f'_C = actual 28-day compressive strength of concrete

      A_C = cross-sectional area of concrete in pile

   b. Costs associated with furnishing and installing additional piles due to low strength concrete, including required modifications to pile cap, shall be borne by Contractor.

2.04 CONICAL POINTS

A. Provide commercially available conical points specifically manufactured for use with steel pipe piles.

B. Furnish and weld to bottom of each pipe pile.

C. ASTM A36 grade steel.

D. Mill Tolerance: Manufacturer’s standard.

PART 3 EXECUTION

3.01 PILE DRIVING EQUIPMENT

A. Pile Driving Hammer and Driving System:

1. Diesel hammers capable of continuous operation at all fuel and/or trip valve settings, and not overstress or otherwise cause damage to pile during installation.
2. Size and type to consistently deliver an effective dynamic energy sufficient to drive pile to required ultimate pile capacity and minimum toe elevation.
3. Minimum Hammer Rated Energy:
   a. Diesel Hammers: Operable at minimum of 40,000 foot-pounds to 60,000 foot-pounds.

B. Hammer Cushion/Capblock: Manufactured from stable and predictable material.

1. Manufacturers and Products:
   a. Metex Corp; Aluminum-Micarta, Force 10.
   b. Penn State Metal Fabricators; Aluminum and Conbest.

C. Helmet: Seat onto pile and bear evenly and concentrically with minimum play upon pile.

D. Pile Head: Free to rotate.

E. Pile Driving Leads:

1. Degree of rigidity and strength acceptable will be subject to the Engineer’s review.
2. Fixed Leads: Provide with hydraulic spotter.
3. Swinging Leads:
   a. Driving Template: Capable of maintaining alignment and position of leads and pile during driving within tolerances specified herein.
   b. Of sufficient length so that lowering the leads during driving is not necessary.
4. Of sufficient length so use of follower is not necessary.
5. Straight and parallel, not deviating from straight line by more than 1/2 inch over 15-foot length.
6. Easily adjustable to permit axial driving without interruption if piles deviate from required alignment.

3.02 PREPARATION

A. Make allowance for upheaval of excavation bottom due to driving.

B. Use templates with sufficient contact points to ensure required degree of accuracy.

C. Do not drive piles within 200 feet of structural concrete less than 7 days old.

D. Do not cut lifting holes into piles.

3.03 INSTALLATION

A. Notify Engineer 7 days in advance of and perform driving in presence of Engineer.

B. Welding: Meet requirements of AWS D1.1.

C. Pile Bottom: Drive each pile closed toe using conical point. Attach conical point by means of continuous fillet weld around pile circumference, or as recommended by manufacturer.

D. Splicing:

1. Do not splice without Engineer present.
2. Number: Maximum of one splice per pile.
3. Preparation: Square ends of both pile sections to be joined.
    a. Tolerance: Pile ends shall not be out of square by more than 1/16 inch.
4. Pre-Manufactured Splices or Couplers: If used, install in accordance with manufacturer’s recommendations. All splices shall be welded.
5. Spliced Pile: Straight, deviation in pile alignment shall be less than 1 inch in 50 feet.

E. Pile Marking: At 1-foot intervals from bottom of pile for purpose of recording driving resistance and depth of penetration of pile. Use continuous measuring tape when marking pile.

F. Pile Driving:

1. Perform in presence of Engineer, with pile marking visible from a safe location on shore.
2. Maintain hammer concentric with driving train in axial alignment on pile. Do not use hammer to limit deviation of pile during driving by

exerting lateral forces or striking at angle. Where pile orientation is essential, take special care to maintain orientation during driving.

3. Impact driving may be terminated when a minimum toe elevation shown on Drawings is reached and required ultimate capacity has been obtained.
    a. Engineer will relate ultimate capacity to a penetration resistance (blow count) based on results of dynamic testing and Contractor's driving train, using information contained on Pile Hammer Data Sheet.
4. Provide means or reference suitable to indicate penetration of piles which is visible to Engineer at reasonable and safe distance from pile driver.
5. Drive piles continuously, and without voluntary interruption, to termination penetration resistance or to refusal driving resistance.
    a. Termination penetration resistance shall only apply after minimum toe elevation has been achieved.
    b. If refusal driving resistance is obtained above minimum toe elevation, preboring, jetting, or other methods acceptable to Engineer may be required to advance pile.
6. Specified values of driving resistance shall not apply until set resulting from interruption in driving or change in hammer cushion has been overcome, after either 50 blows or 3 feet of advancement.
7. Redrive piles that are raised during process of driving adjacent piles.
8. Pulling piles into alignment or position will not be permitted.
9. After driving, temporarily cover top of pile to prevent mud, sediment, debris, or other foreign matter from entering the pile.

G. Driving Tolerances:

1. Not more than 1 percent from vertical.
2. Centroid of pile at cutoff elevation shall not vary from design position shown by more than 3 inches after driving.

3.04 PILE CUTOFF

A. Cut square at required elevation with tools that will not damage area below cut surface.

3.05 PLACING CONCRETE IN PIPE PILES

A. Fill pipe piles with concrete.

B. Place as specified in Section 03 30 00, Cast-in-Place Concrete, except:

1. Do not place concrete in pile without prior approval of Engineer.

2. Prior to Placing Concrete:
   a. Confer with Engineer to determine if restriking is required.
   b. Inspect interior of each pile and dewater and clean each pile of water and mud.
3. Concrete may drop freely for entire pile length provided contact with the sides of the pipe pile or reinforcing cage (if required) is avoided.
4. Only upper 10 feet of concrete in pile will require consolidation with mechanical vibrators.

3.06 FIELD QUALITY CONTROL

A. Dynamic Monitoring: Plan, coordinate, and accomplish in accordance with Section 31 09 17, Dynamic Pile Testing, on one pile as indicated on Drawings.

B. Daily Log and Record:

1. Document for each pile showing as a minimum:
   a. Pile identification/location.
   b. Weather/groundwater conditions.
   c. Date and time start and complete driving.
   d. Respective depths of penetration.
   e. Pile toe and cutoff elevations.
   f. Driving resistance for each foot of driving over entire pile length.
   g. Equipment used.
   h. Installation method.
   i. Final pile head position (x, y, z coordinates) after cut off indicating if pile is installed within the specified tolerances.
   j. Nature and location of obstructions encountered.
   k. Other pertinent pile driving behavior.

3.07 SUPPLEMENTS

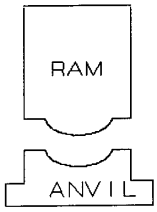
A. The supplement listed below, following “End of Section,” is a part of this Specification.

1. Hammer Data Sheet.

END OF SECTION

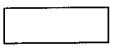
HAMMER DATA SHEET

Contract No.:	Structure Name and/or No.:
Project:	
Pile Driving CONTRACTOR or Subcontractor:	
County:	Piles Driven By:



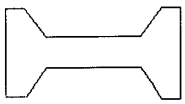
HAMMER

Manufacturer:	Model:
Type:	Serial No.
Rated Energy: @	Length of Stroke
Modifications:	



CAP BLOCK

Material:	
Thickness:	Area:
Modulus of Elasticity - E	(psi)
Coefficient of Restitution - e	

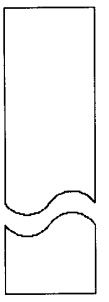


HELMET

ALL COMPONENTS	Weight:

CUSHION

Cushion Material:	
Thickness:	Area:
Modulus of Elasticity - E	(psi)
Coefficient of Restitution - e	



PILE

Pile Type:	Weight/ft
Length in Leads:	
Wall Thickness:	Taper:
Design Pile Capacity:	(Tons)
Description of Splice:	

Tip Treatment Description:

NOTE: If mandrel is used to drive pile, attach separate manufacturer's detail sheet(s), including weight and dimensions.

Submitted By:_____ Date:_____

SECTION 32 11 23
AGGREGATE BASE COURSES

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. C29, Standard Test Method for Bulk Density (Unit Weight) and Voids in Aggregate.
   b. C88, Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
   c. C117, Standard Method of Test for Materials Finer Than 75μm (No. 200) Sieve in Mineral Aggregates by Washing.
   d. C131, Standard Specification for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
   e. C183, Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates.
   f. D1557, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lb/ft^3 (2700 kN-m/m^3)).
   g. D1883, Test Method for CBR (California Bearing Ratio) of Laboratory Compacted Soils.
   h. D2216, Standard Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.
   i. D2419, Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
   j. D2844, Standard Specification for Resistance R-Value and Expansion Pressure of Compacted Soils.
   k. D4318, Standard Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils.
   l. D4791, Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate.
   m. D6938, Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.02 DEFINITIONS

A. Completed Course: Compacted, unyielding, free from irregularities, with smooth, tight, even surface, true to grade, line, and cross-section.

B. Completed Lift: Compacted with uniform cross-section thickness.

C. Base Course: Crushed aggregate or similar as specified placed and compacted on prepared subgrade or subbase course.

D. Gravel Surfacing: Aggregate used for construction of low-volume access and staging area that can be easily graded and compacted.

E. Standard Specifications: When referenced in this section, shall mean California Department of Transportation (Caltrans) Standard Specifications, 2023.

1.03 SUBMITTALS

A. Informational Submittals:

1. Certified Test Results on Source Materials: Submit copies from commercial testing laboratory 20 days prior to delivery of materials to Project showing materials meeting the physical qualities specified.

PART 2 PRODUCTS

2.01 BASE COURSE

A. As specified for Class 2 Aggregate Base, 3/4-inch maximum, in Section 26-1.02B, of the Standard Specifications.

B. Clean, hard durable, pit run gravel or crushed stone graded from coarse to fine containing enough fines to bind material when compacted.

2.02 GRAVEL SURFACING

A. As specified for base course rock.

B. Physical Qualities: Same as for base course.

2.03 SOURCE QUALITY CONTROL

A. Perform tests necessary to locate acceptable source of materials meeting specified requirements.

B. Final approval of aggregate material will be based on test results of installed materials.

C. Should separation of coarse from fine materials occur during processing or stockpiling, immediately change methods of handling materials to correct uniformity in grading.

PART 3 EXECUTION

3.01 SUBGRADE PREPARATION

A. As specified in Section 31 23 13, Subgrade Preparation.

B. Obtain Engineer's acceptance of subgrade before placing base course or surfacing material.

C. Do not place base course or surfacing materials on soft, muddy, or frozen subgrade.

3.02 EQUIPMENT

A. In accordance with Section 26-1.03 of the Standard Specifications.

3.03 HAULING AND SPREADING

A. In accordance with Section 26-1.03 of the Standard Specifications.

3.04 CONSTRUCTION OF COURSES

A. Construction of Courses: In accordance with Section 26 of the Standard Specifications, except as modified hereinafter.

B. Base Course:

1. Maximum Completed Lift Thickness: 6 inches.
2. Completed Course Total Thickness: As shown.
3. Spread lift on preceding course to required cross-section.
4. Lightly blade and roll surface until thoroughly compacted.
5. Blade or broom surface to maintain true line, grade, and cross-section.

C. Gravel Surfacing:

1. Maximum Completed Lift Thickness: 6 inches.
2. Completed Course Total Thickness: As shown.
3. Spread on preceding course in accordance with cross-section shown.
4. Blade lightly and roll surface until material is thoroughly compacted.

3.05 ROLLING AND COMPACTION

A. In accordance with Section 26-1.03E of the Standard Specifications, except as modified hereinafter.

B. Commence rolling at outer edges and continue toward center; do not roll center of road first.

C. Apply water as needed to obtain specified densities.

D. Place and compact each lift to the required density before succeeding lift is placed.

E. Surface Defects: Remedy by loosening and rerolling. Reroll entire area, including surrounding surface, until thoroughly compacted.

F. Finished surface shall be true to grade and crown before proceeding with surfacing.

3.06 SURFACE TOLERANCES

A. Blade or otherwise work surfacing as necessary to maintain grade and cross-section at all times, and to keep surface smooth and thoroughly compacted.

B. Finished Surface of Untreated Aggregate Base Course: Within plus or minus 0.05 foot of grade shown at any individual point.

C. Gravel Surfacing: Within 0.05 foot from lower edge of 10-foot straightedge placed on finished surface, parallel to centerline.

D. Overall Average: Within plus or minus 0.05 foot from crown and grade specified.

3.07 DRIVEWAY RESURFACING

A. Replace gravel surfacing on driveways that were gravel surfaced prior to construction.

B. Provide compacted gravel surfacing to depth equal to original, but not less than 4 inches.

C. Leave each driveway in as good or better condition as it was before start of construction.

3.08 FIELD QUALITY CONTROL

A. In-Place Density Tests: Provide Engineer at least 2 days' advance notification prior to testing.

B. Show proof that areas meet specified requirements before identifying density text locations.

C. Provide field in-place density tests on finished compacted base in accordance with AASHTO T191, or ASTM D2167 or ASTM D5195.

3.09 CLEANING

A. Remove excess material from the Work area. Clean stockpile and staging areas of all excess aggregate.

END OF SECTION

SECTION 32 12 16
ASPHALT PAVING

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Association of State Highway and Transportation Officials (AASHTO):
    a. M17, Standard Specification for Mineral Filler for Bituminous Paving Mixtures.
    b. M81, Standard Specification for Cut-Back Asphalt (Rapid Curing Type).
    c. M82, Standard Specification for Cut-Back Asphalt (Medium Curing Type).
    d. M140, Standard Specification for Emulsified Asphalt.
    e. M156, Standard Specification for Requirements for Mixing Plants for Hot-mixed, Hot-laid Bituminous Paving Mixes.
    f. T166, Standard Method of Test for Bulk Specific Gravity (Gmb) of Compacted Hot Mix Asphalt (HMA) Mixtures Using Saturated Surface-Dry Specimens.
    g. T176 Standard Method of Test for Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test.
    h. T209, Standard Method of Test for Theoretical Maximum Specific Gravity (Gmm) and Density of Hot Mix Asphalt (HMA).
    i. T245, Standard Method of Test for Resistance to Plastic Flow of Asphalt Mixtures Using Marshall Apparatus.
    j. T246, Standard Method of Test for Resistance to Deformation and Cohesion of Hot Mix Asphalt (HMA) by Means of Hveem Apparatus.
    k. T247, Standard Method of Test for Preparation of Test Specimens of Hot Mix Asphalt (HMA) by Means of California Kneading Compactor.
    l. T283, Standard Method of Test for Resistance of Compacted Hot Mix Asphalt (HMA) to Moisture-Induced Damage.
    m. T304, Standard Method of Test for Uncompacted Void Content of Fine Aggregate.
    n. T312, Standard Method of Test for Preparing and Determining the Density of Hot Mix Asphalt (HMA) Specimens by Means of a Superpave Gyratory Compactor.

2. Asphalt Institute (AI):
   a. Manual Series No. 2 (MS-2), Mix Design Methods for Asphalt Concrete.
   b. Superpave Series No. 2 (SP-2), Superpave Mix Design.
3. ASTM International (ASTM):
   a. D75, Standard Method of Test for Sampling of Aggregates.
   b. D140, Standard Method of Test for Sampling Bituminous Materials.
   c. D979, Standard Method of Test for Sampling Bituminous Paving Mixtures.
   d. D2041, Standard Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures.
   e. D2489, Standard Method of Test for Determining Degree of Particle Coating of Asphalt Mixtures.
   f. D4318, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
   g. D4791, Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate.
   h. D5821, Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate.
   i. E329 REV A, Standard Specification for Agencies Engaged in Construction Inspection Testing, or Special Inspection.

1.02 DEFINITIONS

A. Combined Aggregate: All mineral constituents of asphalt concrete mix, including mineral filler and separately sized aggregates.

B. Maximum Aggregate Size: One sieve size larger than the nominal aggregate size.

C. Nominal Aggregate Size: One sieve size larger than the first sieve that retains more than 10 percent aggregate.

D. Prime Coat: Low viscosity cutback or emulsified asphalt applied to granular base in preparation of paving to coat and bond loose materials, harden the surface, plug voids, prevent moisture migration, and provide adhesion.

E. Reclaimed Asphalt Pavement (RAP): Removed and/or processed pavement materials containing binder and aggregate.

F. Seal Coat: Term used for various applications of emulsified asphalt, with or without sand or aggregate, to protect the asphalt surface from aging due to wear, degradation from the sun, wind, and water. Also used to improve skid

resistance and aesthetics. The term seal coat can be used to define fog seal, slurry seal, chip seal or sand seal, depending on application.

G. Standard Specifications: California Department of Transportation (Caltrans) Standard Specifications, 2023.

H. Tack Coat: Thin layer of emulsified asphalt applied to hard surfaces, including new pavement lifts, to promote adhesion and bonding.

1.03 DESIGN REQUIREMENTS

A. Prepare asphalt concrete mix design, meeting the following design criteria, tolerances, and other requirements of Section 39-2 of the Standard Specifications and this Specification.

1.04 SUBMITTALS

A. Informational Submittals:

1. Test Report for Asphalt Cement:
   a. Submit minimum 10 days prior to start of production.
   b. Show appropriate test method(s) for each material and the test results.
2. Manufacturer’s Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements, for the following materials:
   a. Aggregate: Gradation, source test results as defined in Section 39-2.02B(4)(a) and 39-2.02B(4)(b) of the Standard Specifications.
   b. Asphalt for Binder: Type, grade, and viscosity-temperature curve.
   c. Prime Coat: Type and grade of asphalt.
   d. Tack Coat: Type and grade of asphalt.
   e. Additives.
   f. Mix: Conforms to job-mix formula.
3. Statement of qualification for independent testing laboratory.
4. Test Results:
   a. Mix design.
   b. Asphalt concrete core.
   c. Gradation and asphalt content of uncompacted mix.

1.05 QUALITY ASSURANCE

A. Qualifications:

1. Independent Testing Laboratory: In accordance with ASTM E329 REV A.
2. Asphalt concrete mix formula shall be prepared by approved certified independent laboratory under the supervision of a certified asphalt technician.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Temperature: Do not apply asphalt materials or place asphalt mixes when ground temperature is lower than 50 degrees F (10 degrees C) or air temperature is lower than 40 degrees F (4 degrees C). Measure ground and air temperature in shaded areas away from heat sources or wet surfaces.

B. Moisture: Do not apply asphalt materials or place asphalt mixes when application surface is wet.

PART 2 PRODUCTS

2.01 MATERIALS

A. Prime Coat: Cutback asphalt, conform to Section 39-2 of the Standard Specifications.

B. Tack Coat:

1. Emulsified Asphalt for Tack Coat or Seal Coat: Conform to Section 37 of the Standard Specifications.

C. Sand for Blotter Material or Sand Seal: Clean, dry, with 100 percent passing No. 4 (4.75-millimeter) sieve, and a maximum of 10 percent passing No. 200 (75 μm) sieve.

2.02 ASPHALT CONCRETE MIX

A. General:

1. Mix formula shall not be modified except with written approval of Engineer.
2. Source Changes:
   a. Should material source(s) change, establish new asphalt concrete mix formula before new material(s) is used.

b. Perform check tests of properties of plant-mix bituminous materials on first day of production and as requested by Engineer to confirm that properties are in compliance with design criteria.
c. Make adjustments in gradation or asphalt content as necessary to meet design criteria.

B. Asphalt Concrete: Type A Hot Mix Asphalt as specified in Section 39-2.02 of the Standard Specifications.

C. Composition: Hot-plant mix of aggregate, mineral filler if required, and paving grade asphalt cement. The several aggregate fractions shall be sized, uniformly graded, and combined in such proportions that resulting mixture meets grading requirements of mix formula.

D. Aggregate:

1. General: As specified in Section 39-2.02B of the Standard Specifications; RAP material may be used up to a maximum of 15 percent by total weight.

E. Mineral Filler: In accordance with AASHTO M17.

F. Asphalt Cement: Paving Grade PG 64-10 as specified in Section 92 of the Standard Specifications.

PART 3 EXECUTION

3.01 GENERAL

A. Traffic Control:

1. In accordance with Section 01 50 00, Temporary Facilities and Controls.
2. Minimize inconvenience to traffic, but keep vehicles off freshly treated or paved surfaces to avoid pickup and tracking of asphalt.

B. Driveways: Repave driveways from which pavement was removed. Leave driveways in as good or better condition than before start of construction.

3.02 LINE AND GRADE

A. Provide and maintain intermediate control of line and grade, independent of underlying base, to meet finish surface grades and minimum thickness.

B. Shoulders: Construct to line, grade, and cross-section shown.

3.03 APPLICATION EQUIPMENT

A. In accordance with Section 39 of the Standard Specifications.

3.04 PREPARATION

A. Prepare subgrade as specified in Section 31 23 13, Subgrade Preparation.

B. Existing Roadway:

1. Modify profile by grinding, milling, or overlay methods as approved, to provide meet lines and surfaces and to produce smooth riding connection to existing facility.
2. Remove existing material to a minimum depth of 1 inch (25 millimeters).
3. Paint edges of meet line with tack coat prior to placing new pavement.

C. Thoroughly coat edges of contact surfaces (curbs, manhole frames) with emulsified asphalt or asphalt cement prior to laying new pavement. Prevent staining of adjacent surfaces.

3.05 PAVEMENT APPLICATION

A. General: Place asphalt concrete mixture on approved, prepared base in conformance with Section 39 of the Standard Specifications.

B. Tack Coat:

1. Prepare material, as specified in Section 37 of the Standard Specifications, prior to application.
2. Apply uniformly to clean, dry surfaces avoiding overlapping of applications.
3. Do not apply more tack coat than necessary for the day’s paving operation.
4. Touch up missed or lightly coated surfaces and remove excess material.
5. Application Rate:
   a. 0.05 gallon per square yard to 0.15 gallon per square yard (0.25 liter per square meter to 0.70 liter per square meter) of asphalt (residual if diluted emulsified asphalt).

C. Pavement Mix:

1. Prior to Paving:
   a. Sweep primed surface free of dirt, dust, or other foreign matter.

b. Patch holes in primed surface with asphalt concrete pavement mix.
c. Blot excess prime material with sand.

2. Place asphalt concrete pavement mix in one single lift.
3. Compacted Lift Thickness:
   a. Minimum: Twice maximum aggregate size, but in no case less than 1 inch (25 millimeters).
   b. Maximum: 4 inches (100 millimeters).
4. Total Compacted Thickness: As shown.
5. Sequence placement so that meet lines are straight and edges are vertical.
6. Collect and dispose of segregated aggregate from raking process. Do not scatter material over finished surface.
7. Joints:
   a. Offset edge of each layer a minimum of 6 inches (150 millimeters) so joints are not directly over those in underlying layer.
   b. Offset longitudinal joints in roadway pavements so longitudinal joints in wearing layer coincide with pavement centerlines and lane divider lines.
   c. Form transverse joints by cutting back on previous day's run to expose full vertical depth of layer.
8. Succeeding Lifts: Apply tack coat to pavement surface between each lift.
9. After placement of pavement, seal meet line by painting a minimum of 6 inches (150 millimeters) on each side of joint with cutback or emulsified asphalt. Cover immediately with sand.

D. Compaction:

1. Roll until roller marks are eliminated and minimum density of 95 percent of mix design unit weight at optimum asphalt content is obtained.
2. Joint Compaction:
   a. Place top or wearing layer as continuously as possible.
   b. Pass roller over unprotected end of freshly laid mixture only when placing of mix is discontinued long enough to permit mixture to become chilled.
   c. Cut back previously compacted mixture when Work is resumed to produce slightly beveled edge for full thickness of layer.
   d. Cut away waste material and lay new mix against fresh cut.

E. Tolerances:

1. General: Conduct measurements for conformity with crown and grade immediately after initial compression. Correct variations immediately by removal or addition of materials and by continuous rolling.
2. Completed Surface or Wearing Layer Smoothness:
   a. Uniform texture, smooth, and uniform to crown and grade.
   b. Maximum Deviation: 1/8 inch from lower edge of a 12-foot (3.6-meter) straightedge, measured continuously parallel and at right angle to centerline.
   c. If surface of completed pavement deviates by more than twice specified tolerances, remove and replace wearing surface.
3. Transverse Slope Maximum Deviation: (1/4 inch in 12 feet (3.6 meters) from rate of slope shown.
4. Finished Grade:
   a. Perform field differential level survey on maximum 50-foot grid and along grade breaks.
   b. Maximum Deviation: 0.02 foot (6 millimeters) from grade shown.

F. Seal Coat:

1. General: Apply seal coat of paving grade or emulsified asphalt to finished surface at longitudinal and transverse joints, joints at abutting pavements, areas where asphalt concrete was placed by hand, patched surfaces, and other areas as directed by Engineer.
2. Preparation:
   a. Surfaces that are to be sealed shall be maintained free of holes, dry, and clean of dust and loose material.
   b. Seal in dry weather and when temperature is above 35 degrees F (2 degrees C).
3. Application:
   a. Fill cracks over 1/16 inch (1.5 millimeters) in width with asphalt-sand slurry or approved crack sealer prior to sealing.
   b. When sealing patched surfaces and joints with existing pavements, extend minimum 6 inches (150 millimeters) beyond edges of patches.

3.06 PAVEMENT OVERLAY

A. Preparation:

1. Remove fatty asphalt, grease drippings, dust, and other deleterious matter.

2. Surface Depressions: Fill with asphalt concrete mix, and thoroughly compact.
3. Damaged Areas: Remove broken or deteriorated asphalt concrete and patch as specified in Article Patching.
4. Portland Cement Concrete Joints: Remove joint filler to minimum 1/2 inch (12 millimeters) below surface.

B. Application:

1. Tack Coat: As specified in this section.
2. Place and compact asphalt concrete as specified in Article Pavement Application.
3. Place first layer to include widening of pavement and leveling of irregularities in surface of existing pavement.
4. When leveling irregular surfaces and raising low areas, the actual compacted thickness of any one lift shall not exceed 2 inches (50 millimeters).
5. Actual compacted thickness of intermittent areas of 120 square yards (100 square meters) or less may exceed 2 inches (50 millimeters), but not 4 inches (100 millimeters).
6. Final wearing layer shall be of uniform thickness, and meet grade and cross-section as shown.

3.07 PATCHING

A. Preparation:

1. Remove damaged, broken, or unsound asphalt concrete adjacent to patches. Trim to straight lines exposing smooth, sound, vertical edges.
2. Prepare patch subgrade as specified in Section 31 23 13, Subgrade Preparation.

B. Application:

1. Patch Thickness: 3 inches (75 millimeters) or thickness of adjacent asphalt concrete, whichever is greater.
2. Place asphalt concrete mix across full width of patch in layers of equal thickness.
3. Spread and grade asphalt concrete with hand tools or mechanical spreader, depending on size of area to be patched.

C. Compaction:

1. Roll patches with power rollers capable of providing compression of 200 pounds per linear inch to 300 pounds per linear inch (350 Newtons

per linear centimeter to 525 Newtons per linear centimeter). Use hand tampers where rolling is impractical.

2. Begin rolling top course at edges of patches, lapping adjacent asphalt surface at least one-half the roller width. Progress toward center of patch overlapping each preceding track by at least one-half width of roller.
3. Make sufficient passes over entire area to remove roller marks and to produce desired finished surface.

D. Tolerances:

1. Finished surface shall be flush with and match grade, slope, and crown of adjacent surface.
2. Tolerance: Surface smoothness shall not deviate more than plus 1/4 inch (6 millimeters) or minus 0 inch when straightedge is laid across patched area between edges of new pavement and surface of old surfacing.

3.08 FIELD QUALITY CONTROL

A. General: Provide services of approved certified independent testing laboratory to conduct tests.

B. Field Density Tests:

1. Perform tests from cores or sawed samples in accordance with AASHTO T166.
2. Measure with properly operating and calibrated nuclear density gauge in accordance with ASTM D2950.
3. Maximum Density: In accordance with ASTM D2041, using sample of mix taken prior to compaction from same location as density test sample.

C. Testing Frequency:

1. Quality Control Tests:
   a. Asphalt Content, Aggregate Gradation: Once per every 500 tons (400 mg) of mix or once every 4 hours, whichever is greater.
   b. Mix Design Properties, Measured Maximum (Rice's) Specific Gravity: Once every 1,000 tons (900 mg) or once every 8 hours, whichever is greater.
2. Density Tests: Once every 500 tons (450 mg) of mix or once every 4 hours, whichever is greater.

END OF SECTION

SECTION 32 31 13
CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. A121, Standard Specification for Metallic-Coated Carbon Steel Barbed Wire.
   b. A313/A313M, Standard Specification for Stainless Steel Spring Wire.
   c. A392, Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric.
   d. A491, Standard Specification for Aluminum-Coated Steel Chain-Link Fence Fabric.
   e. A497/A497M, Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete.
   f. A615/A615M, Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
   g. A780, Standard Specification for Repair of Damaged and Uncoated Areas of Hot-Dipped Galvanized Coatings.
   h. A824, Standard Specification for Metallic-Coated Steel Marcelled Tension Wire for Use with Chain Link Fence.
   i. A1011/A1011M, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
   j. C94/C94M, Standard Specification for Ready-Mixed Concrete.
   k. C150, Standard Specification for Portland Cement.
   l. C387, Standard Specifications for Packaged, Dry, Combined Materials for Mortar and Concrete.
   m. F552, Standard Terminology Relating to Chain Link Fencing.
   n. F567, Standard Practice for Installation of Chain-Link Fence.
   o. F626, Standard Specification for Fence Fittings.
   p. F668, Standard Specification for Polyvinyl Chloride (PVC) and Other Organic Polymer-Coated Steel Chain-Link Fence Fabric.
   q. F900, Standard Specification for Industrial and Commercial Swing Gates.
   r. F934, Standard Specification for Standard Colors for Polymer-Coated Chain Link Fence Materials.

s. F1043, Standard Specification for Strength and Protective Coatings on Metal Industrial Chain Link Fence Framework.
t. F1083, Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures.
u. F1183, Standard Specifications for Aluminum Alloy Chain Link Fence Fabric.
v. F1184, Standard Specifications for Industrial and Commercial Horizontal Slide Gates.
w. F1379, Standard Terminology Relating to Barbed Tape.
x. F1911, Standard Practice for Installation of Barbed Tape.
y. F1916, Standard Specification for Selecting Chain Link Barrier Systems with Coated Chain Link Fence Fabric and Round Posts for Detention Applications.

2. Institute of Electrical and Electronic Engineers (IEEE), Inc.: C2, National Electrical Safety Code.
3. National Electrical Manufacturers Association (NEMA): 250, Enclosures for Electrical Equipment (1,000 volts max.).

1.02 DEFINITIONS

A. Terms as defined in ASTM F552.

1.03 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Product Data: Include construction details, material descriptions, dimensions of individual components, and finishes for chain link fences and gates.
      1) Fence, gate posts, rails, and fittings.
      2) Chain link fabric.
      3) Gates and hardware.

B. Informational Submittals:

1. Manufacturer’s recommended installation instructions.
2. Evidence of Supplier and installer qualifications.

1.04 QUALITY ASSURANCE

A. Design, supply of equipment and components, installation, and on-call service shall be product of individual company with record of installations meeting requirements specified.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Site in undamaged condition. Store materials off the ground to provide protection against oxidation caused by ground contact.

1.06 SCHEDULING AND SEQUENCING

A. Complete necessary Site preparation and grading before installing chain link fence and gates.

B. Interruption of Existing Utility Service: Notify owner of utility 72 hours prior to interruption of utility services. Do not proceed with interruption of utility service without written permission from utility owner.

PART 2 PRODUCTS

2.01 GENERAL

A. Match style, finish, and color of each fence component with that of other fence components.

2.02 CHAIN LINK FENCE FABRIC

A. PVC-coated or Polymer-coated galvanized fabric conforming to ASTM F668, Class 1 or Class 2a over metallic-coated steel wire.

1. Color: Black, complying with ASTM F934.

B. Height: 96 inches, unless otherwise shown.

C. Core Wire Gauge: No. 9.

D. Pattern: 1-inch diamond-mesh.

E. Diamond Count: Manufacturer’s standard and consistent for fabric furnished of same height.

F. Loops of Knuckled Selvages: Closed or nearly closed with space not exceeding diameter of wire.

G. Wires of Twisted Selvages:

1. Twisted in a closed helix three full turns.
2. Cut at an angle to provide sharp barbs that extend minimum 1/4-inch beyond twist.

2.03 POSTS

A. General:

1. Strength and Stiffness Requirements: ASTM F1043, heavy industrial fence, except as modified in this section.
2. Round Steel Pipe, Schedule 40: ASTM F1083.
3. Roll-Formed Steel Shapes: Roll-formed from ASTM A1011/A1011M, Grade 45, High-Strength Low-Alloy steel.
4. Lengths: Manufacturer's standard with allowance for minimum embedment below finished grade of 34 inches.
5. Protective Coatings:
   a. Zinc Coating: ASTM F1043, Type A external and internal coating.
6. Color Coating: ASTM F1043, minimum 10 mils thickness over zinc coating to match color of chain link fabric.

B. Line Posts:

1. Round Steel Pipe:
   a. Outside Diameter: 2.375 inches.
   b. Weight: 3.65 pounds per foot.

C. End, Corner, Angle, and Pull Posts:

1. Round Steel Pipe:
   a. Outside Diameter: 2.875 inches.
   b. Weight: 5.79 pounds per foot.

D. Posts for Removable Fence Panels: As specified for end, corner, angle, and pull posts.

E. Posts for Swing Gates 8 Feet High and Under:

1. ASTM F900.
2. Round Steel Pipe for gate leaf width up to 18 feet:
   a. Outside Diameter: 6.625 inches.
   b. Weight: 18.02 pounds per foot.

F. Posts for Swing Gates Over 8 Feet High: As recommended by fence manufacturer.

2.04 TOP AND BRACE RAILS

A. Galvanized Round Steel Pipe:

1. ASTM F1083.
2. Outside Diameter: 1.66 inches.
3. Weight: 2.27 pounds per foot.

B. Protective Coatings: As specified for posts.

C. Color Coating: ASTM F1043, minimum 10-mil thickness over zinc coating to match color of chain link fabric.

D. Strength and Stiffness Requirements: ASTM F1043, top rail, heavy industrial fence.

2.05 FENCE FITTINGS

A. General: In conformance with ASTM F626, except as modified by this article.

B. Post and Line Caps: Designed to accommodate passage of top rail through cap, where top rail required.

C. Tension and Brace Bands: No exceptions to ASTM F626.

D. Tension Bars:

1. One-piece.
2. Length not less than 2 inches shorter than full height of chain link fabric.
3. Provide one bar for each gate and end post, and two for each corner and pull post.

E. Truss Rod Assembly: 3/8-inch diameter, steel, hot-dip galvanized after threading rod and turnbuckle or other means of adjustment.

F. Tie Wires, Clips, and Fasteners: According to ASTM F626.

2.06 TENSION WIRE

A. Zinc-coated steel marcelled tension wire conforming to ASTM A824, Type II, Class 2.

2.07 BARBED TAPE

A. Series 430 stainless steel hardened to Rockwell (30N) 35-40 minimum; 0.025-inch thick by 1-inch wide before fabrication, die stamped to produce clusters of four pointed needle-sharp barbs at 4 inches on center, minimum 1.2 inches long, offset in alternate directions 0.15 to 0.45 inch.

B. Permanently cold clench stainless steel strip to minimum 230 degrees F around core wire.

C. Core wire: 0.098-inch diameter, high-tensile-strength stainless steel complying with ASTM A313/A313M.

D. Stainless steel strip between barb clusters shall be 1/4-inch wide minimum after cold clenching to create a flange extending out from the wire, tapering off adjacent to the barb cluster to allow maximum barb penetration.

E. Fabrication:

1. Continuous coils of barbed tape as defined in ASTM F1379 for the following characteristics:
   a. Configuration: Double coil.
   b. Style: Concertina pattern.
   c. Coil Diameters: 24-inch inner coil and 30-inch outer coil, plus or minus 2 inches, when coil compressed.
   d. Coil Loop Spacing: 12 inches.

F. Clips: Stainless steel, 0.065-inch thick by 0.375-inch wide; capable of withstanding a minimum pull load of 200 pounds for a minimum of 30 seconds without separation, or other damage.

G. Tie Wires: Stainless steel, 0.065-inch diameter.

2.08 GATES

A. General:

1. Gate Operation: Opened and closed easily by one person.
2. Metal Pipe and Tubing: Galvanized steel. Comply with ASTM F1043 and ASTM F1083 for materials and protective coatings.
3. Frames and Bracing: Fabricate members from round galvanized steel tubing with outside dimension and weight according to ASTM F900.
4. Gate leaves more than 8-feet wide shall have intermediate tubular members and diagonal truss rods to provide rigid construction, free from sag or twist.

5. Gate Fabric Height: Same as for adjacent fence height.
6. Welded Steel Joints: Paint with zinc-based paint.
7. Chain Link Fabric: Attached securely to gate frame at intervals not exceeding 15 inches.
8. Latches: Arranged for padlocking so padlock will be accessible from both sides of gate.

B. Swing Gates: Comply with ASTM F900 for single or double swing gate types.

1. Leaf Width: As shown.
2. Hinges: Offset type, malleable iron.
   a. Furnished with large bearing surfaces for clamping in position.
   b. Designed to swing either 180 degrees outward, 180 degrees inward, or 90 degrees in or out, as shown, and not twist or turn under action of gate.
3. Latches: Plunger bar arranged to engage stop, except single gates of openings less than 10 feet wide may each have forked latch.
4. Gate Stops: Mushroom type or flush plate with anchors, suitable for setting in concrete.
5. Locking Device and Padlock Eyes: Integral part of latch, requiring one padlock for locking both leaves of double gate.
6. Hold-Open Keepers: Designed to automatically engage gate leaf and hold it in open position until manually released.

2.09 CONCRETE

A. Provide as specified in Section 03 30 00, Cast-in-Place Concrete.

2.10 FENCE GROUNDING

A. Conductors: Bare, solid wire for 6 AWG and smaller; stranded wire for 4 AWG and larger.

1. Material above Finished Grade: Copper.
2. Material on or below Finished Grade: Copper.
3. Bonding Jumpers: Braided copper tape, 1-inch wide, woven of 30 AWG bare copper wire, terminated with copper ferrules.

B. Connectors and Grounding Rods: Comply with UL 467.

1. Connectors for Below-Grade Use: Exothermic welded type.
2. Grounding Rods: Copper-clad steel.

PART 3 EXECUTION

3.01 GENERAL

A. Install chain link fences and gates in accordance with ASTM F567, except as modified in this section, and in accordance with fence manufacturer's recommendations, as approved by Engineer. Erect fencing in straight lines between angle points.

B. Provide necessary hardware for a complete fence and gate installation.

C. Any damage to galvanized surfaces, including welding, shall be repaired with paint containing zinc dust in accordance with ASTM A780.

D. Drainage Crossings: Where the chain-link fence must cross drainage ditches or swales, the main fence shall be carried across a ditch or swale with additional fence added below.

1. Frames and Bracing: The fence added below shall be fabricated with galvanized round steel pipe conforming to the requirements for top and brace rails.
2. The construction of the frame shall be welded or assembled with corner fittings. The frame shall be rigid and to the extent necessary to maintain a 2-inch clearance between bottom of the frame and finish grade. If necessary to maintain rigidity, attach to the frame a series of 3/8-inch diameter galvanized steel pipe stakes that are embedded a minimum of 2 feet to the sides and bottom of the ditch.
3. Attach chain link fabric securely to frame at intervals not exceeding 12 inches.

3.02 PREPARATION

A. Clear area on either side of fence to the extent specified in Section 31 10 00, Site Clearing. Eliminate ground surface irregularities along fence line to the extent necessary to maintain a 2-inch clearance between bottom of fabric and finish grade.

B. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

3.03 POST SETTING

A. Drill or hand-excavate holes for posts to diameters and spacing indicated, in firm, undisturbed soil. Driven posts are not acceptable. Postholes shall be clear of loose materials. Waste materials from postholes shall be removed from Site or regraded into slopes onsite.

B. Posthole Depth:

1. Minimum 3 feet below finished grade.
2. 2 inches deeper than post embedment depth below finish grade.

C. Set posts with minimum embedment below finished grade of 34 inches and with top rail at proper height above finished grade. Verify posts are set plumb, aligned, and at correct height and spacing. Brace posts, as necessary, to maintain correct position and plumbness until concrete sets.

D. Backfill postholes with concrete to 2 inches above finished grade. Vibrate or tamp concrete for consolidation. Protect above ground portion of posts from concrete splatter.

E. Before concrete sets, crown and finish top of concrete to readily shed water.

F. Terminal Posts: Locate terminal end, corner, and gate posts per ASTM F567 and terminal pull posts at changes in horizontal or vertical alignment of 15 degrees or more.

G. Line Posts: Space line posts uniformly at 10 feet on centers between terminal end, corner, and gate posts.

3.04 POST BRACING

A. Install according to ASTM F567, maintaining plumb position, and alignment of fencing. Install braces at gate, end, pull, and corner posts diagonally to adjacent line posts to ensure stability. Install braces on both sides of corner and pull posts.

1. Locate horizontal braces at mid-height of fabric or higher, on fences with top rail, and 2/3-fabric height on fences without top rail. Install so posts are plumb when diagonal truss rod assembly is under proper tension.

3.05 TOP RAILS

A. Install according to ASTM F567, maintaining plumb position and alignment of fencing. Run rail continuously through line post caps and terminating into rail end attached to posts or posts caps fabricated to receive rail at terminal posts. Install top rail sleeves with springs at 105 feet maximum spacing to permit expansion in rail.

3.06 BARBED TAPE SUPPORTING ARMS

A. Barbed tape supporting arms shall be installed as indicated and as recommended by manufacturer. Bolt or rivet supporting arm to top of post in a manner to prevent easy removal with hand tools. Angle single arms to outside of fence.

3.07 TENSION WIRE

A. Install according to ASTM F567 and ASTM F1916, maintaining plumb position and alignment of fencing. Pull wire taut, without sags. Fasten fabric to tension wire with tie wires at a maximum spacing of 24 inches on center.

B. Install tension wire within 6 inches of bottom of fabric and tie to each post with not less than same diameter and type of wire.

3.08 CHAIN LINK FABRIC

A. Do not install fabric until concrete has cured minimum 7 days.

B. Install fabric with twisted and barbed selvage at top.

C. Apply fabric to outside of enclosing framework. Pull fabric taut to provide a smooth and uniform appearance free from sag, without permanently distorting fabric diamond or reducing fabric height. Tie fabric to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.

D. Splicing shall be accomplished according to ASTM F1916 by weaving a single picket into the ends of the rolls to be joined.

E. Leave 2 inches between finish grade or surface and bottom selvage, unless otherwise indicated.

F. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts with tension bands spaced not more than 15 inches on center.

G. Tie Wires: Fasten ties to wrap a full 360 degrees around rail or post and a minimum of one complete diamond of fabric. Twist ends of tie wire three full twists, and cut off protruding ends to preclude untwisting by hand.

1. Maximum Spacing: Tie fabric to line posts at 12 inches on center and to brace and top rails at 24 inches on center.

3.09 BARBED TAPE

A. Install barbed tape uniformly on top of the barbed wire and V-shaped supporting arms in the configuration shown on Drawings. Secure each loop to arms or single strand of barbed wire to prevent movement or displacement according to ASTM F1911.

3.10 GATES

A. Install gates according to manufacturer’s written instructions, level, plumb and secure for full opening without interference. Attach fabric and hardware to gate using tamper-resistant or concealed means. Adjust hardware for smooth operation and lubricate where necessary so gates operate satisfactorily from open or closed position.

B. Set gate stops in concrete to engage center drop rod or plunger bar.

3.11 ELECTRICAL GROUNDING

A. Ground fences at a maximum interval of 1,000 feet in accordance with applicable requirements of IEEE C2, National Electrical Safety Code.

B. Protection at Crossings of Overhead Electrical Power Lines: Ground fence at location of crossing and at a maximum distance of 150 feet on each side of crossing.

C. Grounding Method: At each grounding location, drive a grounding rod vertically until top is 6 inches below finished grade. Connect rod to fence with 6 AWG conductor. Connect conductor to each fence component at grounding location.

3.12 FIELD QUALITY CONTROL

A. Post and Fabric Testing: Test fabric tension and line post rigidity according to ASTM F1916.

B. Gate Tests:

1. Prior to acceptance of installed gates, demonstrate proper operation of gates under each possible open and close condition specified.
2. Adjust gate to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range.
3. Confirm that latches and locks engage accurately and securely without forcing and binding.

3.13 MANUFACTURER'S SERVICES

A. Provide manufacturer's representative at Site in accordance with Section 01 43 33, Manufacturers' Field Services, to train Owner's personnel to adjust, operate, and maintain gates.

3.14 CLEANUP

A. Remove excess fencing materials and other debris from Site.

END OF SECTION

SECTION 33 05 01
CONVEYANCE PIPING—GENERAL

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Concrete Institute (ACI): 301, Specifications for Structural Concrete.
2. American Water Works Association (AWWA):
   a. C110/A21.10, Ductile-Iron and Gray-Iron Fittings.
   b. C115/A21.15, Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
   c. C207, Steel Pipe Flanges for Waterworks Service - Sizes 4 in. Through 144 in. (100 mm Through 3,600 mm).
   d. C210 Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines.
   e. C213, Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines.
   f. C217, Petrolatum and Petroleum Wax Tape Coatings for the Exterior of Connections and Fittings for Steel Water Pipelines.
   g. C219, Bolted, Sleeve-Type Couplings for Plain-End Pipe.
   h. C221, Fabricated Steel Mechanical Slip-Type Expansion Joints.
   i. C606, Grooved and Shouldered Joints.
3. ASTM International (ASTM):
   a. A497/A497M, Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete.
   b. A615/A615M, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
   c. C94/C94M, Standard Specification for Ready-Mixed Concrete.
   d. C150/C150M, Standard Specification for Portland Cement.
   e. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
4. NSF International (NSF):
   a. NSF/ANSI 61, Drinking Water System Components - Health Effects.
   b. NSF/ANSI 372, Drinking Water System Components - Lead Content.

1.02 SUBMITTALS

A. Action Submittals:

1. Detailed pipe fabrication drawings showing pipe details, special fittings and bends, dimensions, coatings, and other pertinent information.
2. Layout drawing showing location of each pipe section and each special length.
3. Pipe pressure class.
4. Product Data: Manufacturer's data for couplings, saddles, gaskets, and other pipe accessories. Indicate maximum rated working pressure and test pressure for each item.

B. Informational Submittals: Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements.

1.03 DELIVERY, STORAGE, AND HANDLING

A. In accordance with manufacturer's recommendations and as specified in individual Specification(s) following this section.

B. Marking at Plant: Mark each pipe and fitting at plant. Include date of manufacture, manufacturer's identification, specification standard, diameter of pipe and other information required for type of pipe.

C. Pipe, specials, and fittings received at Project Site in damaged condition will not be accepted.

D. Gasket Storage: Store rubber gaskets in cool, well ventilated place, and do not expose to direct rays of sun. Do not allow contact with oils, fuels, petroleum, or solvents.

E. Store and support pipe securely to prevent accidental rolling and to avoid contact with mud, water, or other deleterious materials.

F. Handling:

1. Pipe shall be handled with proper equipment in a manner to prevent distortion or damage. Use of hooks, chains, wire ropes, or clamps that could damage pipe, damage coating or lining, or kink and bend pipe ends is not permitted.
2. Use heavy canvas, or nylon slings of suitable strength for lifting and supporting materials.
3. Lifting pipe during unloading or lifting into trench shall be done using two slings placed at quarter point of pipe section. Pipe may be lifted

using one sling near center of pipe, provided pipe is guided to prevent uncontrolled swinging and no damage will result to pipe or harm to workers. Slings shall bear uniformly against pipe.

4. Pipe and fittings shall not be stored on rocks or gravel, or other hard material that might damage pipe. This includes storage area and along pipe trench.

PART 2 PRODUCTS

2.01 PIPE

A. As specified herein and per individual specification(s) following this section.

B. Stainless Steel Pipe and Fittings:

1. Pipe: Schedule 40S, ASTM A312/A312M, Grade TP304/304L dual-marked, seamless, pickled and passivated.
2. Fittings:
   a. Threaded: Forged, ASTM A182/A182M, Grade F304, conforming to MSS SP-114 Class 1000.
   b. Butt Welded: ASTM A403/A403M, Grade WP304/304L-S dual-marked, conforming to ASME B16.9, annealed, pickled and passivated; fitting wall thickness to match adjoining pipe; long radius elbows, unless shown otherwise.
3. Unions: Threaded forged, ASTM A182/A182M, Grade F304, CL 3000, integral ground seats, AAR design meeting the requirements of MSS SP-83.
4. Flanges: Stainless steel, AWWA C228, Class SD, 304/304L or ASTM A182/A182M, Grade F304/304L, ASME B16.5 Class 150, flat face, weld neck, threaded, blind, or slip-on. Weld slip-on flanges inside and outside. Weld neck bore to match internal pipe diameter.
5. Flange Bolting: AWWA C228, Type 316 stainless steel, ASTM A193/A193M Grade B8M heavy hex head or stud bolts, ASTM A194/A194M Grade 8M heavy hex head nuts. Torque bolts per gasket manufacturer recommendations.
6. Gaskets: Full face, 1/8 inch thick, homogeneous black rubber (EPDM), hardness 60-80 (Shore A), rated to 250 degrees F continuous and conforming to ASME B16.21 and ASTM D1330, Steam Grade.
7. Thread Lubricant: 100 percent virgin PTFE Teflon tape.

C. Galvanized Steel Pipe and Malleable Iron Fittings:

1. Pipe: Galvanized carbon steel, ASTM A106/A106M, Grade B seamless or ASTM A53, Grade B seamless or ERW, standard weight, with threaded ends.

2. Fittings: ASME B16.3, Class 150.
3. Unions: ASME B16.39, Class 150.
4. Thread Lubricant: Teflon tape.

2.02 JOINTS

A. As specified in the individual specification(s) following this section.

2.03 COUPLINGS

A. General:

1. Design and construct in accordance with AWWA C219.
2. Service: Raw river water.
3. Rated Pressure: 150 psig.
4. Test Pressure: 1.5 times the Rated Pressure.
5. Lined and coated with fusion-bonded epoxy in accordance with AWWA C213.
6. Coordinate coupling design with outside diameter of mating pipe.

B. Coupling Materials:

1. End Rings and Center Sleeve: Carbon steel in accordance with AWWA C219.
2. Flanges: Carbon steel in accordance with AWWA C207.
3. Packing Gland Bolting: Stainless steel in accordance with AWWA C219.
4. Packing Gland Gaskets: Suitable for service and in accordance with AWWA C219.

C. For Pipe with Plain-Ends:

1. Bolted, Sleeve-type Couplings:
   a. Inner Sleeve:
      1) Length: 10 inches.
      2) Minimum Thickness: 1/4-inch.

D. For Pipe with Flanged Ends:

1. Dismantling Joints:
   a. Flange Type: AWWA C207, Class D.
   b. Fully restrained using tie bars that span through flange bolt holes.
   c. Studs and nuts to seal gland gasket shall be separate and independent of the tie-bar restraint system.

d. Manufacturers and Products:
   1) Romac; DJ400.
   2) Smith Blair, Inc.; Model 975.

2.04 STEEL FLANGES, FLANGE GASKETS, AND BOLTING MATERIALS

A. As specified in the individual specification(s) following this section.

2.05 PIPE LOCATING TAPE

A. As specified in Section 31 23 23.15, Trench Backfill.

2.06 PIPE BEDDING AND PIPE ZONE MATERIAL

A. As specified in Section 31 23 23.15, Trench Backfill.

2.07 TRENCH STABILIZATION MATERIAL

A. As specified in Section 31 23 23.15, Trench Backfill.

PART 3 EXECUTION

3.01 GENERAL

A. Notify Engineer at least 2 weeks prior to field fabrication of pipe or fittings.

B. Furnish feeler gauges of proper size, type, and shape for use during installation for each type of pipe furnished.

C. Distributing Materials: Place materials along trench only as will be used each day, unless otherwise approved by Engineer. Placement of materials shall not be hazardous to traffic or to general public, obstruct access to adjacent property, or obstruct others working in area.

3.02 EXAMINATION

A. Verify size, material, joint types, elevation, and horizontal location of existing pipeline to be connected to new pipeline or new equipment.

B. Inspect size and location of structure penetrations to verify adequacy of wall pipes, sleeves, and other openings.

C. Damaged Coatings and Linings: Repair using coating and lining materials in accordance with manufacturer’s instructions.

3.03 PREPARATION OF TRENCH

A. Prepare trench as specified in Section 31 23 16, Excavation.

3.04 INSTALLATION

A. General:

1. Join pipe and fittings in accordance with manufacturer's instructions, unless otherwise shown or specified.
2. Install individual pipe lengths in accordance with approved lay diagram. Misplaced pipe shall be removed and replaced.
3. Inspect pipe and fittings before installation, clean ends thoroughly, remove foreign matter and dirt from inside.
4. Flanged Joints:
    a. Install perpendicular to pipe centerline.
    b. Bolt Holes: Straddle vertical centerline, aligned with connecting equipment flanges or as shown on Drawings.
    c. Use torque-limiting wrenches to provide uniform bearing and proper bolt tightness.
    d. Flange Type: Use flat-faced flange when joining with flat-faced ductile or cast iron flange.
5. Couplings:
    a. Install in accordance with manufacturer's written instructions.
    b. Before coupling, clean pipe holdback area of oil, scale, rust, and dirt.
    c. Do not remove pipe coating. If damaged, repair before joint is made.
    d. Clean gaskets before installation.
    e. If necessary, lubricate with coupling manufacturer's recommended gasket lubricant for installation on pipe ends.
    f. Tighten coupling bolts progressively, drawing up bolts on opposite sides gradually until bolts have uniform tightness.

B. Buried Pressure Pipe:

1. Placement:
    a. Keep trench dry until pipe laying and joining is completed.
    b. Exercise care when lowering pipe into trench to prevent twisting or damage to pipe.
    c. Measure for grade at pipe invert, not at top of pipe.
    d. Excavate trench bottom and sides of ample dimensions to permit proper joining, welding, visual inspection, and testing of entire joint.

e. Prevent foreign material from entering pipe during placement.
f. Close and block open end of last laid pipe section when placement operations are not in progress and at close of day's work.
g. In general, lay pipe upgrade with bell ends pointing in direction of laying.
h. Deflect pipe at joints for pipelines laid on a curve using unsymmetrical closure of spigot into bell. If joint deflection of standard pipe lengths will not accommodate horizontal or vertical curves in alignment, provide:
    1) Shorter pipe lengths.
    2) Special mitered joints.
    3) Standard or special fabricated bends.
i. Check gasket position with feeler gauge to assure proper seating.
j. After joint has been made, check pipe alignment and grade.
k. Place sufficient pipe zone material to secure pipe from movement before next joint is installed.
l. Prevent uplift and floating of pipe prior to backfilling.

2. Tolerances:
    a. Deflection From Horizontal Line: Maximum 1 inch.
    b. Deflection From Vertical Line: Maximum 1 inch.
    c. Joint Deflection: Maximum of 75 percent of manufacturer's recommendation.
3. Cover Over Top of Pipe: Minimum 3 feet, unless otherwise shown.
4. Disposal of Excess Excavated Material: As specified in Section 31 23 16, Excavation.

3.05 THRUST RESTRAINT

A. Restrain all joints.

3.06 CORROSION PROTECTION

A. Buried Pipe: As specified in the individual specifications following this section.

B. Notify Engineer at least 3 days prior to start of surface preparation, coating application, and corrosion protection work.

3.07 PLACEMENT OF PIPE LOCATING TAPE

A. Place pipe locating tape in accordance with Section 31 23 23.15, Trench Backfill.

3.08 PIPE BEDDING AND ZONE MATERIAL

A. Place pipe bedding and pipe zone material in accordance with Section 31 23 23.15, Trench Backfill.

3.09 FIELD QUALITY CONTROL

A. Pressure Leakage Testing:

1. As specified herein and per individual specification(s) following this section.
2. Hydrostatically test new galvanized steel piping systems with water to test pressure indicated on Piping Schedule. Minimum test duration shall be 30 minutes. No leakage is allowed.

3.10 CLEANING

A. Following assembly and testing, and prior to final acceptance, flush pipelines with water at 2.5 fps minimum flushing velocity until foreign matter is removed. Dispose of water and flushed foreign matter.

B. If impractical to flush large diameter pipe at 2.5 fps, clean pipe in-place from inside by brushing and sweeping, then flush or blow line at lower velocity.

C. Remove accumulated debris through blowoffs 2 inches and larger or by removing spools and valves from piping.

END OF SECTION

SECTION 33 05 01.01
WELDED STEEL PIPE AND FITTINGS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Society of Mechanical Engineers (ASME):
   a. B16.9, Factory-Made Wrought Buttwelding Fittings.
   b. B36.10M, Welded and Seamless Wrought Steel Pipe.
   c. BPVC SEC VIII, Div. 1, Rules for Construction of Pressure Vessels.
   d. BPVC SEC IX, Welding and Brazing Qualifications.
2. American Society for Nondestructive Testing Inc. (ASNT):
   SNT-TC-1A, Recommended Practice for Personnel Qualification and Certification in Nondestructive Testing.
3. American Water Works Association (AWWA):
   a. C200, Steel Water Pipe - 6 In. (150 mm) and Larger.
   b. C206, Field Welding of Steel Water Pipe.
   c. C207, Steel Pipe Flanges for Waterworks Service - Sizes 4 In. Through 144 In. (100 mm Through 3,600 mm.
   d. C208, Dimensions for Fabricated Steel Water Pipe Fittings.
   e. M11, Steel Pipe - A Guide for Design and Installation.
4. American Welding Society (AWS):
   a. A2.4, Standard Symbols for Welding, Brazing, and Nondestructive Examination.
   b. A3.0M/A3.0, Standard Welding Terms and Definitions Including Terms for Adhesive Bonding, Brazing, Soldering, Thermal Cutting, and Thermal Spraying.
   c. D1.1/D1.1M, Structural Welding Code - Steel.
   d. QC 1, Standard for AWS Certification of Welding Inspectors.
5. ASTM International (ASTM):
   a. A20/A20M, Standard Specification for General Requirements for Steel Plates for Pressure Vessels.
   b. A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
   c. A106/A106M, Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
   d. A234/A234M, Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.

e. A370, Standard Test Methods and Definitions for Mechanical Testing of Steel Products.
f. A435/A435M, Standard Specification for Straight-Beam Ultrasonic Examination of Steel Plates.
g. A516/A516M, Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service.
h. A770/A770M, Standard Specification for Through-Thickness Tension Testing of Steel Plates for Special Applications.
i. A1018/A1018M, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Carbon, Commercial, Drawing, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
j. E329, Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.
k. E1255, Standard Practice for Radioscopy.

6. International Organization for Standardization (ISO): 9001:2000, Quality Management Systems - Requirements.
7. Lloyd's Registry.
8. NSF International (NSF): 61, Drinking Water System Components - Health Effects.
9. Steel Pipe Fabricators Association (SFPA).

1.02 DEFINITIONS

A. Fittings: Including, but not limited to fittings, closure pieces, bends, reducers, tees, wyes, bifurcations, crosses, outlets, manifolds, nozzles, wall sleeves, bulkheads, and other piping and appurtenances fabricated from steel plate, sheet, or coils as required to provide the Work, complete. Fittings shall include piping above ground or inside structures.

B. Acronyms:

1. CJP: Complete Joint Penetration.
2. CWI: Certified Welding Inspector.
3. MT: Magnetic Particle Testing.
4. NDE: Nondestructive Examination.
5. NDT: Nondestructive Testing.
6. PJP: Partial Joint Penetration.
7. PQR: Procedure Qualification Record.
8. PT: Liquid Penetrant Testing.
9. RT: Radiographic Testing.
10. UT: Ultrasonic Testing.
11. VT: Visual Testing.

12. WPQ: Welder/Welding Operator Performance Qualification.
13. WPS: Welding Procedure Specification.

1.03 DESIGN REQUIREMENTS

A. Fittings:

1. Design reinforcement, unless otherwise shown.
2. Design in accordance with AWWA M11, AWWA C200, and AWWA C208 as modified herein, and this Specification.

B. Pipe Layout:

1. Design in accordance with AWWA M11:
   a. General:
      1) Base stationing and elevation convention as shown on Drawings.
      2) Maximum Laying Lengths:
         a) Not limited, unless specifically shown on Drawings.
         b) Select lengths to accommodate installation operation.
   b. Include, as minimum:
      1) Specific number, location, and direction of each pipe, joint, and fitting. Number each pipe in installation sequence.
      2) Station and centerline elevation at changes in grade or horizontal alignment.
      3) Elements of curves and bends, both in horizontal and vertical alignment.
      4) Location of mitered pipe sections, beveled ends for alignment conformance, and butt straps.
      5) Location of closures, cutoff sections for length adjustment, temporary access manways, vents, and weld lead outlets for construction convenience.
         a) Provide for adjustment in pipe laying headings and to conform to indicated stationing.
         b) Changes in location or number will require Engineer approval.
      6) Location of bulkheads, both those shown and as required, for hydrostatic testing of pipeline.

C. Welding Procedure Specification (WPS):

1. Qualified by testing in accordance with ASME BPVC SEC IX for shop welds and/or prequalified in accordance with AWS D1.1/D1.1M for field welds.

2. PQRs conducted on unlisted base metal (most coil products are unlisted base metals) to be production welded as required in the referenced welding Code shall be traceable to heat lots.
3. Written WPS required for welds, both shop and field.

D. Stulling (Strutting): Design for pipe and fittings such that over-deflection and damage is avoided during handling, storage, and installation, including backfill and compaction.

1.04 SUBMITTALS

A. Action Submittals:

1. Shop Drawings showing pipe layout.
2. Material list and steel reinforcement schedules for materials specified.
3. Fabrication Information:
   a. Pipe and fitting details for temporary and permanent facilities indicating:
      1) Cylinder thickness.
      2) Manufacturing tolerances.
      3) Maximum angular deflection limitations of field joints.
      4) Closure sections and cutoffs for field length adjustment.
      5) Bulkheads, including details for removal of test bulkheads and repair of lining.
      6) Weld lead outlets and plugs.
      7) Stulling size, spacing, and layout.
   b. Welded joint details including:
      1) Butt joints.
      2) Miter-cut ends for alignment conformance.
      3) Lap joints.
      4) Special thermal control joints required for control of temperature stresses.
      5) Butt strap joints.
4. Welding Data (Shop and Field Welding):
   a. Show on a weld map, complete information regarding base metal specification designation location, type, size, and extent of welds with reference called out for WPS and NDE numbers in tail of welding symbol.
   b. Distinguish between shop and field welds.
   c. Indicate, by welding symbols or sketches, details of welded joints and preparation of base metal. Provide complete joint welding details showing bevels, groove angles, and root openings for all welds.

d. Welding and NDE symbols shall be in accordance with AWS A2.4.
e. Welding terms and definitions shall be in accordance with AWS A3.0M/A3.0.
f. Submit welding data together with Shop Drawings as a complete package.

5. Product data for the following:
   a. Welded Steel Pipe and Fittings:
      1) Material data.
      2) Chemical and physical test reports showing data consistent with specified requirements for each heat of steel proposed for use.
   b. Flanges, Flange Gaskets and Bolting Materials:
      1) Manufacturer's catalog and material data.
      2) Indicate maximum rated working pressure and test pressure for each flange joint system.
      3) Gasket manufacturer's recommended bolt torque and tightening sequence.
6. Shop and Field Linings and Coatings: In accordance with Section 09 90 00, Painting and Coating.

B. Informational Submittals:

1. Certificates: Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements.
2. Pipe Manufacturer's written Quality Assurance/Control Plan.
3. Statements of Qualification:
   a. Pipe manufacturer.
   b. Fittings fabricator.
   c. Contractor's Shop Inspector.
   d. Contractor's Field Inspector.
   e. NDT Quality Control Personnel.
4. Procedures:
   a. Shop and field welding information; at a minimum include complete welding code paper trail with linkage to Shop Drawings.
   b. Welder Qualifications and Welding Procedure Specifications in accordance with Section 05 05 23, Welding, and as specified below:
      1) Provide complete joint dimensions and details showing bevels, groove angles, root face, and root openings for all welds.
      2) Written NDT procedures.

3) Written description of proposed sequencing of events or special techniques such as:
a) Controlling pipe wall temperature stress during installation.
b) Minimizing distortion of steel.
c) Monitoring pipeline temperatures during installation.
c. Written weld repair procedures for the Work.
5. Shop and Field Linings and Coatings: In accordance with Section 09 90 00, Painting and Coating.
6. Reports:
a. Source Quality Control Test Reports:
1) Hydrostatic testing.
2) Nondestructive weld testing.
b. Field Quality Control Test Reports:
1) Weld tests, including re-examination of repaired welds, on each weld joint for the following tests, as applicable:
a) RT.
b) UT.
7. Field Testing Plan:
a. Submit at least 15 days prior to testing and include following information at a minimum:
1) Testing dates.
2) Piping system and sections to be tested.
3) Method of isolation.
4) Method of conveying water from source to system being tested.
5) Calculation of maximum allowable leakage for piping sections to be tested.
8. Design calculations prepared by a licensed professional engineer in the state of the Work for fittings, including opening reinforcement details of collars, wrappers, crotch plates; and harnessed joint assemblies.
9. Pipe manufacturer’s design engineer’s certification of training of Contractor’s pipe installation crews.

1.05 QUALITY ASSURANCE

A. Qualifications:

1. Pipe Manufacturer:
a. Experienced in fabricating pipe of similar diameters, lengths, and wall thickness required for the Work.
b. Steel Pipe Fabricators Association (SPFA), Lloyd’s Registry Certification, or ISO 9001:2000 Certification.

c. Demonstrate current production capability for volume of work required for Project.
d. Experience shall include successful fabrication to AWWA C200 standards of at least 100,000 linear feet of 30-inch diameter or larger pipe, with wall thickness of 0.375 inches or greater, within past 5-year period.
e. Experience shall be applicable to fabrication plant facilities and personnel, not company or corporation that currently owns fabrication facility or employs personnel.

2. Fittings Fabricator:
   a. Experienced in fabricating fittings of similar diameters and wall thickness required for the Work.
   b. Steel Pipe Fabricators Association (SPFA), Lloyd's Registry Certification, or ISO 9001:2000 Certification.
   c. Demonstrate current production capability for volume of work required for this Project.
   d. Experience shall include successful fabrication to AWWA C200 and AWWA C208 standards of at least 100 fittings of 30-inch or larger pipe, with wall thickness 0.375 inch or greater, within past 5-year period.
   e. Experience shall be applicable to fabrication shop facilities and personnel, not company or corporation that currently owns fabrication facility or employs personnel.
3. Welders and Welding Operators:
   a. Shop Welders: In accordance with ASME BPVC SEC IX.
   b. Field Welders: In accordance with AWS D1.1/D1.1M.
4. Contractor's Inspector for Shop and Field Welding:
   a. In accordance with AWS QC 1, with knowledge of welding code for the Work.
   b. After receiving CWI qualification, at least one Shop CWI and one Field CWI shall have 5 years' minimum professional experience related to welding inspection similar to the Work. Other CWIs may work under the supervision of 5-year CWI, provided they have 1 year of related professional experience after receiving CWI qualification.
5. NDT Quality Control Personnel:
   a. In accordance with requirements of ASNT SNT-TC-1A, NDT Level II.
   b. After receiving NDT qualification, at least one NDT person shall have 5 years minimum professional experience related to NDT inspection similar to the Work. Other NDT personnel may work under the supervision of 5-year NDT, provided they have 1 year of related professional experience after receiving NDT qualification.

B. Contractor's Shop Inspector:

1. In accordance with AWWA C200.
2. Responsibilities:
   a. Verify conformance to use of specified materials and their proper storage.
   b. Monitor conformance to approved WPS.
   c. Monitor conformance to approved NDT procedure specifications.
   d. Monitor conformance of WPQ.
   e. Provide 100 percent visual inspection before, during, and after shop welding.
   f. Coordinate NDT work and review test results.
   g. Maintain records and prepare report confirming results of inspection and testing.

C. Contractor's Field Inspector:

1. In accordance with AWWA C206 and AWS D1.1/D1.1M.
2. Responsibilities:
   a. Verify conformance to use of specified materials and their proper storage.
   b. Monitor conformance to approved WPS.
   c. Monitor conformance to approved NDT procedure specifications.
   d. Monitor conformance of WPQ.
   e. Provide 100 percent VT before, during, and after field welding.
   f. Coordinate NDT work and review test results.
   g. Maintain records and prepare report confirming results of inspection and testing.

D. Inspection of Coating and Lining Application: Qualified manufacturer's technical representative shall visit pipe coating and lining shop at beginning of application process to verify proper workmanship associated with coating and lining application and as may be required to resolve shop or field problems. Submit written report of visit to Engineer.

1.06 DELIVERY, HANDLING, AND STORAGE

A. Pipe Marking:

1. Legibly mark installation sequence number on pipe and fittings in accordance with piping layout. Standard pipe sections do not need sequence number labeled provided wall thickness is clearly marked.
2. Fittings shall be marked at each end with notation "TOP FIELD CENTERLINE".

3. The word “TOP” shall be painted or marked on outside top spigot of each fitting.
4. Mark “TOP MATCH POINT” for compound bends per AWWA C208 so end rotations can be easily oriented in field.

B. Delivery:

1. Securely bulkhead or otherwise seal ends of pipe and fittings prior to loading at manufacturing site.
2. Pipe ends shall remain sealed until installation.
3. Damage to pipe and fittings, including linings and coatings, found upon delivery to Site shall be repaired to Engineer’s satisfaction or removed from Site and replaced.

C. Storage:

1. Support pipe securely to prevent accidental rolling and to avoid contact with mud, water, or other deleterious materials.
2. Support on sand or earth berms free of rock exceeding 3 inches in diameter.

1.07 SEQUENCING AND SCHEDULING

A. Notify Engineer in writing of the following:

1. Pipe Manufacturing: Not less than 14 days prior to starting.
2. Not less than 5 days prior to start of each of the following:
   a. Welding.
   b. Coating application.
   c. Lining application.
   d. Shop hydrostatic testing.

PART 2 PRODUCTS

2.01 GENERAL

A. Pipe Manufacturer:

1. Pipe and fabricated fittings shall be responsibility of one main Supplier.
2. If pipe and fabricated fittings are manufactured by separate Suppliers, one main Supplier shall be responsible for formally managing other Supplier. The one main Supplier is responsible for coordination and management of production of all pipe and fittings work of both Suppliers, including, but not limited to:
   a. Qualifications.

b. Submittals.
c. Dimensional consistency between pipe and fittings.
d. Fabrication.
e. Quality assurance.
f. Quality control.
g. Reporting.
h. Shop lining.
i. Shop coating.
j. Shop testing.
k. Field services.
l. Delivery schedule.
m. Warranties or guarantees.

B. Pipe Size: Unless shown otherwise, for pipe 30 inches in diameter and smaller, diameter shown shall be per ASME B36.10M. According to this standard, pipe size shall be the nominal outside diameter for 14-inch diameter pipe and larger, and pipe size shall be the nomincal inside diameter for 12-inch diameter pipe and smaller.

C. Steel pipe and fittings shall be manufactured, tested, inspected, and marked to comply with AWWA C200 and additional requirements of these Contract Documents.

D. In lieu of collar reinforcement, pipe or fittings with outlets may be fabricated in their entirety of steel plate having thickness equal to sum of pipe wall plus required reinforcement.

2.02 PIPE BARREL

A. Steel:

1. Provide steel coils for spiral welded steel pipe or steel plate for straight seam welded steel pipe per AWWA C200 and as follows:
   a. Specified Minimum Yield Strength: 36,000 psi.
   b. Specified Minimum Tensile Strength: 53,000 psi.
   c. Minimum Elongation in 2-inch Gauge Length: 21 percent.
   d. Steel Quality as follows:
      1) Coils: Continuous cast process, fully-killed, fine grained practice conforming to physical, manufacturing and testing requirements of ASTM A1018/A1018M, SS Grade 36, Type 1.
      2) Plate:
         a) Fully-killed, conforming to ASTM A20/A20M, fine grained practice conforming to physical,

manufacturing and testing requirements of ASTM A516/A516M, Grade 70.

b) Steel Chemistry: Conform to ASTM A516/A516M, Grade 70. Steel plates that are 3/4-inch thick or greater shall be normalized.

2. Wall Thickness: Unless shown otherwise, use standard weight in accordance with ASME B36.10M.

2.03 FITTINGS

A. Fabrication:

1. Shop fabricate. No field fabrication will be allowed, unless approved by Engineer.
2. Fabricate from materials or straight pipe in conformance with specified requirements and dimensions of AWWA C208, unless otherwise indicated.

B. Wall Thickness:

1. General:
   a. Refer to ASME B36.10M for definitions of wall thickness for standard weight pipe and nominal pipe size (NPS).
   b. Reinforce to withstand either internal pressures, both circumferential and longitudinal, or external loading conditions, whichever is greater.
   c. Minimum Plate Thickness: The greater of adjacent mainline pipe, thickness shown, thickness calculated as hereinafter specified, or as shown in Table 1.

Table 1

Nominal Pipe Diameter (inches)	Pipe Manifolds Piping Above Ground Piping in Structures	Bends Reducers
24 and Under	Standard Weight	Standard Weight
Over 24	3/8 inch	3/8 inch

C. Bends, Unless Otherwise Indicated:

1. Minimum Radius: 2.5 times pipe diameter or as indicated on Drawings.
2. Maximum Miter Angle: 11-1/4 degrees on each section resulting in a maximum deflection angle of 22.5 degrees per miter weld as recommended in AWWA C208.

3. Bevels: Vary bevels on miters to provide a constant weld groove angle. For 11-1/4-degree miter, (22.5-degree miter weld) bevels must vary from 18.75 degrees on OD of bend to 41.25 degrees on ID of bend to provide a constant 60-degree groove angle for CJP welding.
4. Complete joint penetration (CJP) welds on miter welds.

D. Outlets:

1. 24 Inches and Smaller: Fabricate from ASTM A53/A53M, Type E or S, Grade B, standard weight steel pipe.
2. Larger than 24 Inches: Fabricate from ASTM A106/A106M, Grade B, standard weight pipe.
3. Fabricate collar or wrapper reinforcement using same steel as specified for main pipe barrel.

E. Steel Butt-Weld Fittings:

1. 24 Inches and Smaller: In accordance with ASME B16.9 conforming to ASTM A234/A234M.
2. Standard weight.
3. Taper pipe wall at welds at 4:1 for connection to pipe of different wall thickness.
4. Coordinate difference in diameter convention between fittings and AWWA C200 and AWWA C208 pipe and fittings to provide complete piping system as shown.

2.04 JOINTS

A. Shop Welded:

1. Fabricate in accordance with AWWA C200 as modified herein.
2. Complete joint penetration (CJP) butt joints shall be used for longitudinal, girth, and spiral welds, unless otherwise indicated.
3. Lengths of pipe shall not be shop-joined using lap joints.

B. Preparation of Joints for Field Welding:

1. Butt Joint Welded:
   a. Plain ends beveled as required by AWWA C200 and Contractor’s field WPS.
   b. Provide protection for factory beveled pipe ends so ends are not damaged during transport.
2. Lap Joint Welded:
   a. Single fillet lap joints in preparation for field welding shall be in accordance with AWWA C200.

b. For pipe 30 inches in diameter and larger, provide one of the following:
   1) Tack weld four metal tabs at equal intervals around inside circumference of bell ends to indicate location at which spigot end has reached maximum penetration into bell. Remove stops after welding of joint.
   2) Paint a 3/4-inch wide white stripe on outside circumference of spigot end of pipe. Side of stripe furthest from pipe end shall indicate location at which spigot end has reached maximum penetration into bell. Side of stripe closest to end of pipe will indicate limit of maximum joint pull.

C. Miter-End Cuts:

1. Welded Lap Joints:
   a. As shown on Drawings.
   b. Moderate deflections and long radius curves may be made using miter-end cuts.
   c. Use only with rubber gasket joints or lap welded joints, unless specifically approved in writing by Engineer.
   d. Maximum Total Allowable Angle: 5 degrees per pipe joint.
   e. Provide miter-cut that is cold expanded square with face of miter-cut on bell ends only.
   f. Mitering of spigot ends will not be permitted.
2. Welded Butt Joints:
   a. Maximum Total Allowable Angle: 2.5 degrees per pipe joint.
   b. Minimum Pipe Wall Thickness: 3/8 inch.
   c. Welded Butt joints shall be CJP.

2.05 FLANGES, FLANGE GASKETS, AND BOLTING MATERIALS

A. Flange Type: AWWA C207, Class D.

B. Flange Gaskets: Full-face, 1/8-inch thick, homogeneous black rubber (EPDM), hardness 60-80 (Shore A), rated to minimum 275 degrees F, conforming to ASME B16.21 and ASTM D1330. NSF 61 approved for potable water service.

C. Flange Bolting: ASTM A307, Grade B hex head or stud bolts; ASTM A563, Grade A heavy hex nuts and ASTM F436 hardened steel washers at nuts and bolt heads. Torque bolts per gasket manufacturer’s recommendations.

2.06 STULLING (STRUTTING)

A. Materials:

1. Shop-Lined Pipe: Wood stulls and wedges.
2. Unlined Pipe: Steel or wood.

B. Install stulling for pipe and fittings in accordance with approved submittal and as soon as practical after pipe is fabricated or, for shop-lined pipe, after lining has been applied.

C. Install stulling in manner that will not harm lining.

2.07 COATINGS

A. General:

1. Notify Engineer at least3 days prior to application of coating products.
2. Holdback of and coating from field-welded joints shall be as follows:
   a. For lap welded joints, butt strap joints, and flex couplings, 8 inches.
   b. For butt weld, 6 inches.

B. In accordance with Section 09 97 13.01, Pipeline Tape Coating.

C. Aboveground or Exposed Pipe Coating: In accordance with Section 09 90 00, Painting and Coating.

D. Field-Applied Interior Joint Protection:

1. Materials conforming to AWWA C602.
2. Do not use pozzolanic material in mortar mix.
3. Admixtures shall contain no calcium chloride.
4. Wire mesh conforming to AWWA C205.

2.08 SOURCE QUALITY CONTROL

A. Shop Hydrostatic Pressure Test:

1. In accordance with AWWA C200 Section 5.2, except as follows:
   a. General: Unless specified otherwise, testing of pipe and fittings shall be performed before lining and coating is applied.
   b. Pipe: Maintain test pressure for minimum of 5 minutes.

c. Fittings:
   1) Except as otherwise specified herein, no additional shop hydrostatic test will be required on fittings fabricated from successfully tested straight pipe.
   2) If fabricated from untested straight pipe, test to minimum pressure equal to field test pressure.
   3) Maintain test pressure for a length of time as required to perform a visual inspection of welds.
   4) No leakage is allowed.

B. Shop Nondestructive Testing:

1. Welds: 100 percent visually examined by Contractor's Shop Inspector to criteria in ASME BPVC SEC VIII, Division 1.
2. CJP Welds: Spot radiographically or radioscopically examine pipe in accordance with ASME BPVC SEC VIII, Div. 1, Paragraph UW-52. Welds that, in opinion of Engineer, cannot readily be radiographed, shall be 100 percent ultrasonically examined in accordance with Paragraph UW-53.
3. Fillet Welds: 100 percent examine using magnetic particle inspection method in accordance with ASME BPVC SEC VIII, Division 1, Appendix 6.
4. Air test collars and wrappers in accordance with AWWA C206.

PART 3 EXECUTION

3.01 INSTALLATION

A. General:

1. Joints and related work for field assembly of fittings shall conform to requirements for straight pipe, unless otherwise shown.
2. Inspect pipe and fittings before installation. Clean ends thoroughly, remove foreign matter and dirt from inside.
3. Make minor field adjustments by pulling standard joints.
   a. Maximum Allowable Angle: 75 percent of manufacturer's recommended or angle which results from 3/4-inch pull out from normal joint closure, whichever is less.
   b. Maximum Allowable Gap: 1/8 inch between bell and spigot at weld location.
4. Horizontal deflections or fabricated angles shall fall on alignment, as shown within tolerances below.

5. Vertical deflections shall fall on alignment, and pipe angle point locations shall match those indicated on Drawings within tolerances below.
6. For field-welded joints, pipe 30 Inches in Diameter and Larger:
    a. Ensure maximum penetration of spigot end into bell end is achieved through use of shop-welded tabs on inside circumference of bell end or by use of a paint stripe.
    b. If welded metal tabs are used, remove tabs prior to welding inside of joint.
7. Stulling:
    a. Maintain stulling in place until pipe is completely backfilled and compacted.
    b. Reinstall stulls that were temporarily removed to facilitate interior welding prior to backfilling.
8. Pipeline Alignment Tolerances:
    a. Plan: 1-inch.
    b. Elevation: 1-inch.

3.02 WELDING

A. Perform welding only in presence of Contractor's Field Inspector.

B. Conform to AWS D1.1/D1.1M, AWWA C206, approved welding procedures, and referenced welding codes. In case of conflict AWS D1.1/D1.1M shall govern.

C. Preheat and Interpass temperature requirements for unlisted base metals shall be determined according to AWS D1.1/D1.1M, Annex XI Guideline on Alternative Methods for Determining Preheat.

D. Rejectable weld defects shall be repaired or redone, and retested until sound weld metal has been deposited in accordance with appropriate welding codes.

E. Field-welded joints shall be complete joint penetration welded butt joints, or welded lap joints and shall conform to AWS D1.1, AWWA C206, approved welding procedures, and referenced welding codes.

3.03 REPAIR OF SHOP-APPLIED COATINGS

A. Exterior surfaces of steel pipe and fittings shall be inspected upon delivery to Site and just prior to backfilling trench.

B. In accordance with coating system provided:

1. Section 09 97 13.01, Pipeline Tape Coating.
2. Section 09 90 00, Painting and Coating.

3.04 COATING OF FIELD-WELDED JOINTS

A. In accordance with coating system provided:

1. Section 09 97 13.01, Pipeline Tape Coating.
2. Section 09 90 00, Painting and Coating.

3.05 FIELD QUALITY CONTROL

A. Field Welding:

1. All welds, 100 percent inspection, shall be VT inspected by Contractor's Field Inspector and marked to indicate acceptance or rejection.
2. Test butt-strap or double-welded lap joint welds by pressurizing connection between the two fillet welds in accordance with AWWA C206.
    a. Apply air or other Engineer-approved gas into connection between the two fillet welds.
    b. Paint welds with soap solution.
    c. Mark leaks indicated by escaping gas bubbles.
    d. Close threaded openings with flush pipe plugs or by welding them.
3. CJP Welds:
    a. Inspect100 percent of butt joint welds with full circumference RT.
    b. Inspect100 percent of other groove welds with UT.
4. Inspect 100 percent of lap joint welds with PT or MT.
5. Weld Acceptance:
    a. If, in the opinion of Engineer, inspections indicate inadequate quality of welds, percentage of welds inspected shall be increased.
    b. Welds to be inspected, if less than 100 percent rate, shall be selected at random by Engineer.
    c. VT: Perform VT per AWS D1.1/D1.1M Paragraph 6.9, Visual Inspection, Statically Loaded Nontubular Connections.
    d. UT: Perform UT of CJP groove welds in accordance with AWS D1.1/D1.1M, Paragraph 6.13.1.
    e. RT: Perform RT of CJP butt joint welds in accordance with AWS D1.1/D1.1M, Paragraph 6.12.1.

f. PT or MT:
   1) Perform on fillet and PJP groove welds in accordance with AWS D1.1/D1.1M, Paragraph 6.10.
   2) Acceptance shall be in accordance with VT standards specified above.
g. Remove in manner that permits proper and complete repair by welding.
h. Caulking or peening of defective welds is not permitted.
i. Retest unsatisfactory welds.

B. Hydrostatic Testing:

1. Pipeline:
   a. General:
      1) Notify Engineer in writing 5 days prior to testing. Perform testing in presence of Engineer.
      2) Test newly installed pipelines. Using water as test medium, pipes shall successfully pass a leakage test prior to acceptance.
      3) Furnish testing equipment and perform tests in manner satisfactory to Engineer. Testing equipment shall provide observable and accurate measurements of make-up water under specified conditions.
      4) Isolate new pipelines that are connected to existing pipelines.
      5) Conduct field hydrostatic test on buried piping after trench has been completely backfilled. Testing may, as approved by Engineer, be done prior to placement of asphaltic concrete or roadway structural section.
      6) Contractor may, if field conditions permit and as determined by Engineer, partially backfill trench and leave joints open for inspection and conduct an initial service leak test. Final field hydrostatic test shall not, however, be conducted until backfilling has been completed as specified above.
      7) Supply of temporary water shall be as stated in Section 01 50 00, Temporary Facilities and Controls.
      8) Dispose of water used in testing in accordance with federal, state, and local requirements.
   b. Procedure:
      1) Maximum filling velocity shall not exceed 0.25 foot per second, calculated based on the full area of pipe.
      2) Expel air from pipe system during filling. Expel air through air release valve or through corporation stop installed at high points and other strategic points.

3) Test Pressure: As shown on Piping Schedule.
4) Apply and maintain specified test pressure with hydraulic force pump. Valve off piping system when test pressure is reached.
5) Maintain hydrostatic test pressure continuously for 2 hours minimum, adding additional make-up water only as necessary to restore test pressure.
6) Determine actual make-up water by measuring quantity of water necessary to maintain specified test pressure for duration of test.
7) If measured make-up water exceeds allowable or if leaks are visible, repair defective pipe section and repeat hydrostatic test.

c. Allowable Make-up Water: For pipe with welded joints, no make-up water is allowed.

3.06 MANUFACTURER'S SERVICES

A. Manufacturer's representative available at Site for installation assistance and training of pipe installation crews.

1. Coordinate pipe manufacturer's representative services.
2. Pipe manufacturer's representative shall visit Site and instruct, guide, and provide procedures for pipe handling, laying, and jointing at start of pipe installation by each crew.

END OF SECTION

SECTION 33 05 16.13
PRECAST CONCRETE UTILITY STRUCTURE

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards that may be referenced in this section:

1. American Association of State Highway and Transportation Officials (AASHTO): HB-17, Standard Specifications for Highway Bridges, Division 1 Section 3, Division I Design-Loads (Part A, Part B, Part C).
2. ASTM International (ASTM):
   a. A497/A497M, Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete.
   b. A615/A615M, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
   c. C387/C387M, Standard Specification for Packaged, Dry, Combined Materials for Mortar and Concrete.
   d. C478, Standard Specification for Precast Reinforced Concrete Manhole Sections.
   e. C857, Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.
   f. C858, Standard Specification for Underground Precast Concrete Utility Structures.
   g. D4101, Standard Specification for Propylene Injection and Extrusion Materials.
3. Occupational Safety and Health Administration (OSHA):
   a. 29 CFR 1910.27, Fixed Ladders.
   b. 29 CFR 1926.502, Fall Protection Systems Criteria and Practices.

1.02 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Detailed drawings showing complete information for fabrication including, but not limited to:
      1) Member dimensions and cross sections; location, size, and type of reinforcement, including additional reinforcement.
      2) Layout dimensions and identification of each precast unit.
      3) Welded connections indicated by AWS standard symbols.
      4) Details of connections, joints, accessories, and openings or inserts.

5) Watertight joint details.
6) Location and details of anchorage devices.
7) Access door details.

b. Structural calculations signed by a California Civil or Structural Engineer.

c. Product Data:
1) Precast concrete items; show materials of construction by ASTM reference and grade.
2) Joint sealants.
3) Pipe Penetrations.
4) Manhole frame and cover.
5) Manhole frame to structure anchor bolts.

B. Informational Submittals:

1. Manufacturer's data for lifting devices for handling and erection.
2. Manufacturer's certification that vault design and manufacture comply with referenced standards.
3. Manufacturer's laboratory test reports.
4. Field Quality control reports.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Store each unit in a manner that will prevent cracking, distortion, warping, straining and other physical damage, and in a manner to keep marking visible.

B. Lift and support each unit only at designated lifting points and supporting points as shown on Shop Drawings.

PART 2 PRODUCTS

2.01 VAULT MANUFACTURERS

A. Materials, equipment, and accessories specified in this section shall be products of:

1. Oldcastle Precast.
2. Jensen Precast.
3. Hanson Pipe and Precast.

2.02 PRECAST CONCRETE VAULTS

A. Design Requirements:

1. In the event of a conflict between or among standards, the more stringent standard shall govern.
2. Comply with ACI 350-20 Code Requirements for Environmental Engineering Concrete Structures, except as modified herein.
3. Reinforcing Steel:
   a. Deformed Bars: ASTM A615/A615M, Grade 60.
   b. Welded Wire Fabric: ASTM A497/A497M.
4. Nominal Dimensions: As shown on Drawings.
5. Construction: Rigid type and behave monolithically. Do not use panel-type vaults.
6. Design Loads: As defined on Drawings General Structural Notes.
   a. Groundwater Level: At ground surface. Designed to avoid flotation with a factor of safety equal to 1.2.
   b. Live Loads: AASHTO Design Truck or Design Tandem loading, whichever governs, plus impact.
7. Design shall accommodate additional stresses or loads that may be imposed during factory precasting, transporting, erection, and placement.
8. Blockouts for penetrations shall be as shown on Drawings. Coordinate dimensions with pipe diameters detailed on Drawings and specified pipe sealing method.
9. Sealant:
   a. Nonswelling preformed joint sealants to provide a lasting, watertight bond.
   b. Manufacturer and Product: Henry Company; RAM-NEK.
10. Mortar: Comply with Category I grout as specified in Section 03 62 00, Grouting.

B. Mark each member or element to indicate location in the structure, top surface, and date of fabrication.

2.03 ACCESSORIES

A. Grade Adjustment (top of structure to manhole frame):

1. Precast concrete rings manufactured in accordance with ASTM C478.
2. Grout/Mortar: Comply with Category I grout as specified in Section 03 62 00, Grouting.

B. Manhole Frame and Cover:

1. Castings:
   a. Tough, close-grained gray iron, sound, smooth, clean, free from blisters, blowholes, shrinkage, cold shuts, and defects.
   b. Cast Iron: ASTM A48/A48M Class 30B.
   c. Ductile Iron: ASTM A536, Grade 60-40-12.
   d. Plane or grind bearing surfaces to ensure flat, true surfaces.
   e. Cast or drilled holes for frame to structure anchor bolts.
2. Cover:
   a. Size: As shown on Drawings.

C. Pipe Connections to Vault:

1. Flexible Joint:
   a. In accordance with ASTM C923.
   b. Demonstrated history of providing watertight seal between pipe and manhole. Upon request manufacturer shall provide written guarantee.
   c. Accommodate 10 degrees minimum of deflection.
   d. Manufacturers and Products:
      1) Compression Seal: A-LOK Products, Inc., Tullytown, PA; Z-LOK, QUIK-LOK.
      2) Boot Type: NPC, Inc., Milford, New Hampshire; Kor-N-Seal flexible rubber boot with stainless steel accessories.

PART 3 EXECUTION

3.01 GENERAL

A. Possible Settlement: If subgrade is encountered that may require removal to prevent structure settlement, notify Engineer. Engineer will determine depth of overexcavation and means of stabilizing subgrade prior to structure installation.

B. Place 6-inch minimum thickness of imported crushed aggregate material, unless otherwise shown, on undisturbed earth or modified subgrade; thoroughly compact with a mechanical vibrating or power tamper. Meet requirements of Article Excavation and Backfill.

3.02 EXCAVATION AND BACKFILL

A. Remove and keep water clear from excavation during construction.

B. Excavation: As specified in Section 31 23 16, Excavation.

C. Backfill: As specified in Section 31 23 23, Fill and Backfill, and Section 31 23 23.15, Trench Backfill.

3.03 INSTALLATION

A. Concrete Base:

1. Place on prepared subgrade.
2. Properly locate, ensure firm bearing throughout, and plumb first section.

B. Sections:

1. Carefully inspect precast sections to be joined.
2. Thoroughly clean ends of sections to be joined.
3. Do not use sections with chips or cracks.

C. Joints:

1. Fill joints between precast sections per manufacturer's recommendation.
2. Joints shall be watertight to prevent entrance of groundwater.
3. Joint Finish: Dry pack interior of joints to provide smooth finish.

D. Setting Precast Vault: Install vault to elevations shown on Drawings.

E. Manhole Frame and Cover:

1. Grade Rings:
   a. Provide on manholes to place frame and cover at final specified grade.
   b. Install to height not exceeding 6 inches.
2. Frame:
   a. Set frames in three equally spaced beads of butyl sealant that run full circumference of frame.
   b. Anchor frame to manhole.
3. Cover: Install in accordance with manufacturer's recommendations.

F. Watertight construction below grade with no open cracks or spalls. Cracking and defective areas of concrete shall be repaired per requirements of Section 03 30 00, Cast-in-Place Concrete.

3.04 PIPE CONNECTION TO VAULT

A. Install products in accordance with manufacturer's instructions. Grout pipe connections flush with interior and exterior walls.

3.05 FIELD QUALITY CONTROL

A. Prior to backfilling vault, confirm watertight construction using one of the following methods.

1. Vacuum Test:
   a. Conduct in accordance with ASTM C1244.
   b. Conduct tests in presence of Engineer.
2. Hydrostatic Testing:
   a. Plug inlets and outlets, and fill vault with water to height determined by Engineer.
   b. Water for hydrostatic test must be provided by Contractor.
   c. Perform tightness tests in accordance with ACI 350.1.
   d. Acceptance Criteria:
      1) Acceptance shall be based on Part 1.
      2) Part 1, Qualitative: If moisture is observed on structure surfaces, exterior to contained liquid, where moisture can be picked up on a dry hand, containment structure is noncompliant.
   e. After testing has been completed, dispose of test water in a manner approved by Owner.
   f. Repair leaks that do not meet leakage test, or do not meet specified requirements from visual inspection and retest.

END OF SECTION

SECTION 35 79 19
MECHANICALLY CLEANED WEDGEWIRE FISH SCREENS

PART 1 GENERAL

1.01 GENERAL

A. Section includes performance requirements and Work necessary to fabricate, furnish, install, adjust, and test the mechanically cleaned wedgewire fish screens with retrieval tracks, lifting mechanisms, slide gates and control panel. The specific design and fabrication details for the screen and cleaning system shall be the responsibility of the fish screen manufacturer (Manufacturer).

B. The Drawings only show general arrangement and construction requirements for the fish screens, retrieval tracks, slide gates and control panel locations. They are not all inclusive and they do not constitute a complete design or a complete list of all equipment or accessories. The specific design and fabrication details for the screen and cleaning system shall be the responsibility of the Manufacturer.

C. Manufacturer shall coordinate all details of the equipment with other related parts of the Work, including verification that all structures, piping, wiring, and equipment components are compatible. Manufacturer shall be responsible for all structural and other alterations in the Work required to accommodate equipment differing in dimensions or other characteristics from that indicated on Drawings or Specifications.

D. All equipment shall be designed, fabricated, and assembled in accordance with recognized and referenced engineering and shop practice standards. Individual parts shall be manufactured to standard sizes and thicknesses so that repair parts can be installed in the field. Equipment shall not have been in service at any time prior to delivery, except as required by tests.

E. Except where otherwise specified, structural and miscellaneous fabricated steel used in equipment shall conform to AISC standards. All structural members covered under this Specification shall be designed for shock or vibratory loads. Unless otherwise specified, all carbon steel which will be submerged, all or in part, during normal operation of the equipment shall be at least 1/4-inch thick.

F. Unless otherwise indicated, power supply to the equipment will be 480V ac, 60 Hz, three-phase.

1.02 EQUIPMENT NUMBERS

A. Mechanically Cleaned Wedgewire Fish Screens: EPP-FS-1, EPP-FS-2.

B. Slide Gates: EPP-G-1, EPP-G-2.

C. Screen Control Panel with Air Conditioner: EPP-SCP.

1.03 ABBREVIATIONS

A. CDFG: California Department of Fish and Game.

B. NEMA: National Electrical Manufacturers Association.

C. NMFS: National Marine Fisheries Service.

D. SCP: Screen Control Panel.

1.04 DESIGN REQUIREMENTS

A. The screen system manufacturer shall calculate all static, impact, and fatigue loads to be expected on the screen unit and hoist system and design the system to withstand those stresses. The system manufacturer shall provide detailed supporting calculations for all system components.

B. Welded Stainless Steel: Only Type 304L or 316L stainless steel is acceptable.

1.05 SUBMITTALS

A. Action Submittals:

1. Make, model, and weight of each assembled component.
2. Manufacturer’s catalog information, descriptive literature, specifications, and identification of materials of construction.
3. Detailed structural and mechanical drawings showing the equipment fabrication, plans, sections, details including tubing layout and routing, and interface with other items. Drawings shall include dimensions, size, and locations of connections to other work.
4. Screen Control Panel construction drawings showing interior/exterior layouts and placement of operator interface devices and other control devices. Provide power and control wiring diagrams including terminals and numbers, and detailed Bill of Material listing.
5. Complete motor nameplate data as defined by NEMA, including motor manufacturer, modifications, etc.
6. Finish system information.

7. Complete description of system operation including fish screens, retrieval system, and cleaning cycle.
8. Complete design calculations for the fish screens, retrieval tracks, and lifting mechanisms signed and stamped by a civil or structural engineer licensed in the State of California.
9. Seismic anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

1. Seismic anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
2. Manufacturer's Certificate of Compliance.
3. Special shipping, storage and protection, and handling provisions.
4. Manufacturer's written/printed installation procedures and instructions.
5. Routine maintenance requirements prior to screen system startup.
6. Manufacturer's Certificate of Proper Installation.
7. Operation and maintenance manuals as specified in Section 01 78 23, Operation and Maintenance Data.
8. Manufacturer's Certificate of Proper Installation in accordance with Section 01 43 33, Manufacturers' Field Services.
9. Spare Parts data listing source of supply for replacement parts and supplies.
10. Manufacturer's equipment warranty including duration and exclusion.

1.06 EXTRA MATERIALS

A. Furnish, tag, and box for shipment and storage the following spare parts and special tools.

1. One set of replacement external brushes.
2. One submersible electric motor assembly, complete, ready for installation.
3. Wire rope hosting cable with clevis.

B. Delivery: In accordance with Section 01 61 00, Common Product Requirements.

1.07 QUALITY ASSURANCE

A. Qualifications of Welders, Welding Operators, and Procedures:

1. All welders and welding operators shall be qualified in accordance with AWS D1.1 for carbon steel and AWS D1.6 for stainless steel. All

procedure qualification tests shall be performed on plate samples of steel to be used in the performance of these Specifications.

2. Submit welder performance qualification test records, welding procedure, and welding operator performance qualification test records.
3. Submit certified metal test reports for Type 304L or 316L stainless steel material.

1.08 ENVIRONMENTAL REQUIREMENTS

A. The system shall operate with ambient temperatures ranging from 10 degrees F to 120 degrees F with extended periods of high humidity and full sun exposure. Submerged components will operate in the Sacramento River.

PART 2 PRODUCTS

2.01 GENERAL

A. Coordinate fish screen, Screen Control Panel, and power distribution panel construction and be responsible for system coordination, manufacture, installation, operational startup of a complete functional system meeting the performance requirements of this Specification.

B. Unit shall be designed such that all drive mechanisms, bearings, and shafting will be either compatible with submerged service or located above the high-water level shown on Drawings.

C. The equipment shall be arranged such that all components can be serviced from the platform. All components shall be balanced so that jamming at any point will not result in structural failure, but will cause the drive motor to stall. All components, including the gear reducer, shall be designed to withstand, without damage or permanent distortion, the full stalling torque of the drive motor.

D. Retractable cylindrical wedgewire screen shall be designed to withstand, without damage or permanent distortion, a differential water head of 10 feet. The fish screen shall be designed to be self-cleaning. Operation of the screen and hoist shall be smooth and the screen shall be designed for continuous duty. Screen retrieval shall be manually controlled via the hoist. Screen shall be designed to be removable from the top of the retrieval tracks.

E. General Description:

1. Provide and install one new rotating, retractable, self-cleaning, cylindrical, wedgewire fish screen. The fish screen shall consist of a set of two cylindrical wedgewire screens, a set of screen

installation/retrieval tracks with integrated slide gate, and a screen retrieval mechanism. The tracks shall be attached to the pumping plant structure. The retrieval mechanism shall consist of an electric hoist system installed at the top of the retrieval tracks, and designed to raise and lower the fish screen. A submersible electric drive system shall be provided to power the forward/reverse rotation of each screen unit to facilitate cleaning of the screens.

2. Provide for each screen and track assembly:
    a. Integrated slide gate with stem supports.
    b. Bracing for track system.
    c. Discharge connection to pump wetwell.
    d. Electrically operated slide gate actuator.
    e. Removable integrated fall protection barrier across tracks at upper deck elevation.
3. Provide a Screen Control Panel.
4. All ancillary materials required for a complete installation.

2.02 PERFORMANCE REQUIREMENTS

A. Screen shall comply with NMFS and CDFG criteria for anadromous salmonids.

B. Design Criteria:

1. Screen Cylinder Diameter: 36 inches.
2. Screen Cylinder Length, Each: 66 inches.
3. Design Flow per Screen Assembly: 30 cfs.
4. Maximum Head Loss at Design Flow: 6 inches.
5. Screen Wire Size: No. 69 wire.
6. Slot Width: 0.068-inch.
7. Screen Percent Open Area Minimum: 50 percent.
8. Average Approach Velocity, Feet/Second (Maximum): 0.33 at full screen submergence, measured at 3 inches from screen.
9. Internal baffling required to distribute flow over screen area.
10. Screen Cleaning Frequency: Automatic, adjustable start/stop and continuous.
11. Screen Cleaning Type: Fixed external brush on rotating cylinder and internal brushing system.

2.03 MANUFACTURER

A. Intake Screens, Inc, Sacramento, CA, (916) 665-2727.

2.04 FISH SCREEN SYSTEM

A. Fish Screens: The fish screens shall be mechanically cleaned wedgewire cylinders using wire size, slot width, and open area specified. All welds and metal edges shall be ground smooth to remove burrs and rough edges. Screen cylinders shall be rotated at approximately 2 rpm using an electric drive. Rotation shall be bi-directional, rotating for one-half of each cycle in opposite directions. Exterior of screen shall be cleaned by rotating against a stationary brush bar. Brush material shall be 612 nylon. Interior shall be cleaned using an interior rotating brush. All metal material will be Type 304L stainless steel. Screens shall be made to slide on a track rail system and dock, and lock in place, on a docking inlet. Each screen shall have a position sensing switch, rated 24V dc to indicate proper screen placement when in the docked position. There shall be no gap greater than 1/16 inch on the screen assembly or docking mechanism.

B. Retrieval Track System: Retrieval system track rails shall be fabricated of stainless steel I-beam sections. The track assembly shall be braced with attachments to the platform as shown on Drawings. A closure slide gate shall be integrated into the track system. The slide gate shall be designed to prevent fish and sediment from entering the pump suction can when the screens are raised to the surface and the pump is not operational. The gate shall be a flat plate design with HDPE side and seating seals and designed for a nominal head of a few feet. The gate is not to be designed as a sealing gate over the intake, but should be “fish tight” when in open or closed position. The track assembly shall be fastened to the platform and pump suction can as approved. There shall be a retrieval hoist at the top of the track assembly to move the screen assembly up and down the tracks for screen inspection or maintenance. Hoist shall operate with an electric motor, with power supplied from the screen control panel. Provide a locking system that is independent of the hoist to secure the screen assembly at the working platform elevation when pulled for inspection or maintenance. The retrieval system shall incorporate position sensing switches, with contacts rated for 2A at 24V dc, to sense the top and bottom limits of travel, and slack cable sensing switch to turn the hoist off at the duty (down) position, or if the screen down travel is jammed for any reason.

C. Provide motors in accordance with Section 26 20 00, Low-Voltage AC Induction Motors, and with the features indicated below.

1. Motors shall be 460V ac, three-phase, 60 Hz.

2. Submersible Screen Drive Motors:
    a. Rated for continuous duty at 40-foot submergence, 15 minutes unsubmerged, and provided with moisture and temperature switches.
    b. Horsepower: 1/2 hp maximum.
3. Hoist Motors:
    a. Enclosure: TEFC.
    b. Horsepower: 5 hp maximum.
    c. Ambient Temperature: 50 degrees C.
    d. Provide with integral electrically released spring set brake.
    e. Provide space heater element sized to prevent condensation on the core and windings. The space heater shall be isolated or so located as to prevent heat damage to adjacent painted surfaces and shall be suitable for a 120-volt, 60 Hz, single-phase power supply. The space heater shall be wired to the motor terminal box and fed from the control panel.

D. Motor Power Cable and Supports: The fish screen Manufacturer shall furnish multi-conductor cables extending from the motors and ancillary control equipment to a cable carrier-mounted junction box, where the cables shall terminate on separate power and control terminal junction blocks. All circuits branching from the junction box shall be divided into separate power and control conduits, and factory-wired as much as is practical. The cable entrance to the junction box shall be sealed by cord grips or equivalent. The cables shall be one continuous length running from the junction box to submersible rated Wet-Mate connectors located within the screen assembly. The cables shall be installed and supported in a manner that will not allow tensile stress at the connectors or other termination fittings and shall be protected from chafing against the opening in the operating floor and from interfering with the normal operation of the mechanism. Sufficient length of cables shall be provided.

E. Dissimilar Metals: When stainless steel and carbon steel components come into contact with dissimilar metals, ensure that surfaces are kept from direct contact by a coating or gasket system and the attachment of anodes to the system.

2.05 SCREEN CONTROL PANEL (EPP-SCP)

A. In accordance with requirements in Section 40 99 90, Package Control Systems.

B. General:

1. Power Supply: One, 50 ampere, 480V ac, three-phase, circuit. All other circuits and voltages shall be derived from within.
    a. PLC, PLC I/O Modules and 24V dc Power Supply: 120 volt, single-phase, from UPS.
    b. Panel Interior Light(s) and GFCI Receptacle: 120 volt, single-phase.
2. Enclosure Details:
    a. Enclosure: Dead front door with view access cover, construction with vandal proof design and vandal proof latch guard, pad lockable.
    b. NEMA Rating: NEMA 4 for controls compartment and NEMA 3RX for overall outside cabinetry.
    c. Approximate Size: 84 inches high by 108 inches wide by 20 inches deep.
    d. Material: 12-gauge stainless steel.
    e. Compartments: Provide physically isolated compartments for electrical and control. Electrical power compartment shall house all 480V ac electrical circuits, wiring and components. Electrical control compartment shall house all 120V ac and 24V dc electrical circuits, wiring and components.
    f. Anchorage: Secure enclosure to pump deck with stainless steel anchor bolts. Final size and quantity shall be in accordance with Section 01 88 15, Anchorage and Bracing.
3. Ambient Conditions: Provide equipment suitable for working in 50 degrees C direct sun environment. Provide panel air conditioning unit for temperature control of the electrical control compartment. Provide panel heating units sufficient to prevent condensation on electrical terminations of all compartments.
4. Screen Control System:
    a. Primary Function: Provide control and monitoring of the fish screen, slide gate, and fish screen hoist.
    b. Panel construction and layout to be designed by the SCP supplier.
    c. Programmable Logic Controller (PLC):
        1) Hardware: PLC shall be Siemens S7.
        2) PLC Program: Developed, documented, tested, and started up by the SCP supplier.
    d. Operator Interface Terminal (OIT):
        1) Hardware (Siemens MTP700 7-inch Touchscreen):
            a) EPP- SCP-OIT Function:
                (1) Configuration, documentation, testing and field startup to be provided by SCP supplier.

(2) Configuration, documentation, testing and field startup to be provided by process instrumentation and controls system integrator as specified in Section 40 90 00, Instrumentation and Controls for Process Systems.

e. Operator Controls and Indicators:
   1) Switches:
      a) Hoist control RAISE, Momentary Push button (each screen).
      b) Hoist control LOWER, Momentary Push button (each screen).
      c) Screen control HAND-OFF-AUTO (HOA), three-position, maintained contact, selector switches (each screen).
      d) Screen control FORWARD/OFF/REVERSE (FR), three-position, momentary contact, selector switches (each screen).
   2) Alarm RESET Pushbutton (1): Momentary contact.
   3) E-STOP Pushbutton (1): Mushroom head, maintained contact, twist to release.
   4) Analog Signal Splitter (4): Single input/dual output dc powered analog signal splitter and isolator.
   5) 24V dc Power Supply (2): Size as required for one power supply to power all dc loads.
   6) 24V dc Diode Redundancy Module.
   7) Uninterruptible Power Supply (UPS): American Power Conversion (APC).
      a) UPS Size/Type: As required, 800 VA, minimum; industrial type.
      b) UPS Receptacle: Connected to dedicated circuit breaker; for plugging in UPS power cord.
      c) UPS Output Power: Power PLC, PLC I/O modules, and 24V dc power supply.

f. Portable Hoist Control Pendant Station:
   1) Switches:
      a) RAISE, Normally Open, momentary push button.
      b) LOWER, Normally Open, momentary push button.
   2) Enclosure:
      a) Type: NEMA 4X.
      b) Material: High impact thermoplastic.
      c) External hanger bracket and seal.
      d) External cable strain relief connector with 1/2-inch conduit connection.

3) Electrical Connection:
   a) Cable: Outdoor rated multiple conductor, 300V UL listed cable suitable for non-permanent installation on machine equipment. 18 AWG minimum.
   b) Connectors:
      (1) Style: Industrial rated circular connector with polarized connection. Environmental Protection shall meet or exceed IP65.
      (2) Cable Connector: Integral strain relief with twist lock disconnect. Plug electrical connections.
      (3) Receptacle Connector: Mounted to fish screen terminal box. Socket electrical connections. Preassembled with pigtail wires soldered or crimped to connector sockets. Pigtail wires to match cable wire size. Pigtail wires terminated to screw terminal block located inside fish screen terminal box.

g. External Interfaces:
   1) Discrete Output to EPP-FCP from each Screen:
      a) ESTOP.
      b) SCREEN FAULT.
      c) SCREEN MOTOR FAIL.
      d) SCREEN POWER FAIL.
   2) Analog Output to EPP-FCP:
      a) River Level.
      b) Pump 1 Suction Level.
      c) Pump 2 Suction Level.
   3) Analog Input from Level Instruments:
      a) River Level.
      b) Pump 1 Suction Level.
      c) Pump 2 Suction Level.
   4) Discrete Inputs from Portable Pendant Receptacles:
      a) RAISE Fish Screen 1.
      b) LOWER Fish Screen 1.
      c) RAISE Fish Screen 2.
      d) LOWER Fish Screen 2.
   5) Discrete Inputs from Fish Screen Equipment:
      a) Hoist CABLE SLACK Fish Screen 1.
      b) UP LIMIT Fish Screen 1.
      c) DOWN LIMIT (docked position) Fish Screen 1.
      d) Upstream Screen Rotation Fish Screen 1.
      e) Downstream Screen Rotation Fish Screen 1.
      f) Hoist CABLE SLACK Fish Screen 2.
      g) UP LIMIT Fish Screen 2.

h) DOWN LIMIT (docked position) Fish Screen 2.
i) Upstream Screen Rotation Fish Screen 2.
j) Downstream Screen Rotation Fish Screen 2.

6) Discrete Inputs from Local E-stop Push Button:
a) Screen 1 emergency E-stop.
b) Screen 2 emergency E-stop.

7) Discrete Inputs from EPP-FCP:
a) Screen 1 Cleaning Command.
b) Screen 2 Cleaning Command.

5. Functional Requirements: Complete automatic and manual operation of the fish screen systems. Provide the following functions:

a. Operator Interface Terminal, EPP-OIT-SCP:
1) Display of equipment status and alarms.
2) Display status of emergency stop push position.
3) Display level instrument measurements.
4) Accept operator setpoints for fish screen operation.

b. Manual Screen Operation: When Screen HOA switch is in the hand position, rotate screen cylinders in the forward direction when the screen FR switch is held in the FORWARD position. The screen cylinders shall halt the when FR switch is released. Rotate screen cylinders in the opposite direction when the FR switch is held in the REVERSE position.

c. Automatic Screen Operation: When the Screen HOA switch is in the auto position, operate the screen cylinders at periodic intervals of time based on an operator adjustable setpoint initially set for 3 hours. When the time interval has elapsed, begin rotation of the screen cylinders for a duration based on an operator adjustable setpoint initially set for 2 minutes.

d. Hoist Operation: Hoist control circuits shall operate the hoist without PLC control signals to allow hoist operation while PLC is not operational. Enable hoist control and disable all fish screen rotation when the operator selects the ON position of the Hoist OO switch. Allow operation of each Hoist using the individual RAISE and LOWER push buttons on the SCP or by the RAISE and LOWER push buttons on the portable Hoist Control Pendant Station plugged into the appropriate fish screen receptacle. RAISE and LOWER the hoist while the operator holds down the corresponding push button. Prevent Hoist operation in the rising direction when the UP LIMIT position sensor detects the fish screen. Prevent Hoist operation in the lowering direction when the CABLE SLACK switch detects cable slack.

e. Emergency Stop: Remove power from the motor when the E-STOP push button is pressed. Send the E-STOP signal to the EPP-FCP.

f. Control Panel Power: Monitor control panel power upstream of the UPS. Send the POWER FAULT signal to the EPP-FCP when a power loss is detected.
g. Rotations Sensors: When the screen cylinders are commanded to rotate, monitor the upstream and downstream rotations sensors. If rotation is not detected within a minimum preset time, send the SCREEN FAULT signal to the EPP-FCP. Prevent further operation of the fish screen until an operator has cleared the alarm from the EPP-OIT-SCP.
h. Level Instruments: Provided by Manufacturer to monitor river water level, and pump suction can water levels. Calculate differential level in feet. Monitor differential level for each fish screen. When differential level exceeds an operator adjustable setpoint, rotate the corresponding fish screen cylinders until level returns within a deadband value around zero differential level.

2.06 SLIDE GATE WITH ELECTRIC MOTOR ACTUATOR

A. General:

1. Tag Number: EPP-G-1, EPP-G-2.
2. Screen manufacturer’s standard.
3. Configuration: As shown on Drawings.

B. Electric Motor Actuator:

1. Comply with latest version of AWWA C542.
2. Size to 1 1/2 times required operating torque. Motor stall torque not to exceed torque capacity of gate.
3. Controls integral with actuator and fully equipped as specified in AWWA C542.
4. Suitable for use on multiturn slide gates.
5. Manual override handwheel.
6. Opening and closing speed not less than 12 inches per minute.
7. Size motors for one complete OPEN-CLOSE-OPEN cycle no less than once every 10 minutes.
8. Integral OPEN-STOP-CLOSE momentary pushbuttons with seal-in circuits to control gate.
9. Integral LOCAL-OFF-REMOTE 3-position switch.
10. OPEN and CLOSED indicating lights.
11. Integral reversing motor starter with built-in overload protection.
12. Gate shall remain in last position on loss of actuator power.

13. Actuator Enclosure:
    a. NEMA 250, Type 4.
    b. Contain 120 volt space heaters.
    c. Lockable cover to secure control switches and display.
14. Actuator Power Supply:
    a. 480 volts, three-phase.
    b. Control power transformer, 120 volt secondary.
15. Limit Switch:
    a. Single-pole, double-throw (SPDT) type, field adjustable, with contacts rated for 5 amperes at 120V ac.
    b. Each actuator to have a minimum of two auxiliary transfer contacts at end position, one for gate FULL OPEN and one for gate FULL CLOSED.
    c. Housed in actuator control enclosure.
16. Controls:
    a. Integral OPEN/STOP/CLOSE pushbuttons.
    b. End position limit switches; OPEN and CLOSED position switches shall be normally open contacts that close at the end position; contacts shall be dry and rated for 5 amperes, 120V ac.
    c. OPEN and CLOSED indicating lights.
17. Manufacturers:
    a. AUMA.
    b. Rotork Controls.
    c. Flowserve Limitorque.

2.07 SPARE PARTS

A. One spare portable hoist control pendant station with cable and connector.

B. One spare receptacle connector for portable hoist control pendant station with pigtail wires.

2.08 SHOP/FACTORY FINISHING

A. Coat all surfaces that are not either stainless steel or hot dipped galvanized in accordance with Section 09 90 00, Painting and Coating, System No. 8.

2.09 SOURCE QUALITY CONTROL

A. Factory Demonstration Test (FDT):

1. Notify Engineer of test schedule 4 weeks prior to start of test.
2. Scope:
    a. Test control panel functionality and components including external position sensors.

b. Location: SCP manufacturer's facility.
c. Verify correctness of wiring from panel field terminals to PLC system input/output points and to panel components.
    1) Verify function of discrete field mounted position switches using temporarily installed devices matching make and model of devices to be installed on the fish screen.
    2) Verify function of hoist control pendant station.
    3) Simulate correctness of each analog signal using current source.
d. Verify operation of PLC and EPP-SCP-OIT.
e. Correct deficiencies found and complete prior to shipment to Site.

PART 3 EXECUTION

3.01 INSTALLATION

A. In accordance with the manufacturer's written instructions.

B. Install motor starters in accordance with NEMA ICS 2.3 and manufacturer's instructions and recommendations.

C. Select and install overload relay heaters after the actual nameplate full-load current rating of motor has been determined.

D. Field mount new track systems, fish screens, Screen Control Panel, electric wiring systems, etc.

E. Install interconnecting electrical wiring systems in conduit to the greatest extent possible. Conduit shall be in accordance with Section 26 05 33, Raceway and Boxes.

F. Accurately place anchor bolts using templates furnished by the manufacturer.

G. Install and adjust each fish screen as necessary, for a complete functional unit.

3.02 FIELD QUALITY CONTROL

A. Functional Tests: Conduct tests on each screen and demonstrate proper operation, cleaning cycle operation, retrieval and docking of each fish screen, in both manual and automatic modes of operation. Test each gate over the full range of travel to verify proper operation and compliance with requirements specified herein.

B. Performance Test:

1. Conduct on each screen in conjunction with the control and power unit system.
2. Perform under actual or approved simulated operating conditions.
3. Test screen cleaning equipment and controls for a continuous 4-hour period demonstrating a minimum of seven complete cleaning cycles without malfunction.
4. Test screen docking and retrieval equipment, components, and controls for a continuous 4-hour period demonstrating a minimum of four complete raise/lower cycles on each screen without malfunction.
5. Adjust, realign, or modify units and retest if necessary.

3.03 MANUFACTURER'S SERVICES

A. Manufacturer's Representative present at Site or classroom designated by Owner, for minimum person-days listed below, travel time excluded:

1. 2 person-days for installation assistance and inspection.
2. 2 person-days for functional and performance testing and completion of Manufacturer's Certificate of Proper Installation.
3. 1 person-day for post-startup training of Owner's personnel.

B. See Section 01 43 33, Manufacturer's Field Services, and Section 01 91 14, Equipment Testing and Facility Startup.

END OF SECTION

SECTION 40 05 15
PIPING SUPPORT SYSTEMS

PART 1 GENERAL

1.01 DEFINITIONS

A. Wetted or Submerged: Below 200-year flood elevation.

1.02 SUBMITTALS

A. Action Submittals:

1. Catalog information and drawings of piping support system, locating each support, sway brace, seismic brace, hanger, guide, component, and anchor for piping. Identify support, hanger, guide, and anchor type by catalog number and Shop Drawing detail number.
2. Calculations for each type of pipe support, attachment and anchor.
3. Revisions to support systems resulting from changes in related piping system layout or addition of flexible joints.
4. Seismic anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

1. Seismic anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
2. Component and attachment testing seismic certificate of compliance as required by Section 01 45 33, Special Inspection, Observation, and Testing.
3. Maintenance information on piping support system.

1.03 DESIGN REQUIREMENTS

A. General:

1. Design, size, and locate piping support systems throughout facility, whether shown or not.
2. Piping Smaller than 30 Inches: Supports are shown only where specific types and locations are required; additional pipe supports may be required.

3. Piping 30 Inches and Larger: Support systems have been designed for piping shown.
4. Meet requirements of MSS SP 58 and ASME B31.1 or as modified by this section.

B. Pipe Support Systems:

1. Design pipe support systems for gravity and thrust loads imposed by weight of pipes or internal pressures, including insulation and weight of fluid in pipes.
2. Seismic loads in accordance with governing codes and as shown on Structural General Drawings.
3. Wind loads in accordance with governing codes and as shown on Structural General Drawings.
4. Maximum Support Spacing and Minimum Rod Size: In accordance MSS SP 58 Table 3 and Table 4.
   a. Ductile-iron Pipe 8 Inches and Under: Maximum span limited to that for standard weight steel pipe for water service.
   b. Ductile-iron Pipe 10 Inches and Larger: Maximum span limited to 20 feet.

C. Anchoring Devices: Design, size, and space support anchoring devices, including anchor bolts, inserts, and other devices used to anchor support, to withstand shear and pullout loads imposed by loading and spacing on each particular support.

D. Vertical Sway Bracing: 10-foot maximum centers or as shown.

E. Existing Support Systems: Use existing supports systems to support new piping only if Contractor can show they are adequate for additional load, or if they are strengthened to support additional load.

PART 2 PRODUCTS

2.01 GENERAL

A. When specified items are not available, fabricate pipe supports of correct material and to general configuration indicated.

B. Special support and hanger details may be required for cases where standard catalog supports are not applicable.

C. Materials: Galvanized steel.

2.02 HANGERS

A. Clevis:

1. MSS SP 58, Type 1:
   a. Anvil; Figure 260 for steel pipe and Figure 590 for ductile-iron pipe, sizes 1/2 inch through 30 inches.
   b. Insulated Steel Pipe: Anvil; Figure 260 with insulated saddle system (ISS), sizes 1/2 inch through 16 inches.
   c. B-Line; Figure B3100, sizes 1/2 inch through 30 inches.

B. Adjustable Swivel Split-Ring Pipe Clamp:

1. MSS SP 58, Type 6:
   a. Anvil; Figure 104, sizes 3/4 inch through 8 inches.
   b. B-Line; Figure B3171, sizes 3/4 inch through 8 inches.

C. Steel Yoke Pipe Rolls and Roller Supports:

1. MSS SP 58, Type 41 or Type 43:
   a. Anvil; Figure 181 for sizes 2-1/2 inches through 24 inches, and Figure 171 for sizes 1 inch through 30 inches.
   b. B-Line; Figure B3110 for sizes 2 inches through 24 inches and Figure B3114 for 30 inches.

D. Pipe Rollers and Supports:

1. MSS SP 58, Type 44:
   a. Anvil; Figure 175, sizes 2 inches through 30 inches.
   b. B-Line; Figure B3120, sizes 2 inches through 24 inches.

2.03 WALL BRACKETS, SUPPORTS, AND GUIDES

A. Welded Steel Wall Bracket:

1. MSS SP 58, Type 33 (heavy-duty):
   a. Anvil; Figure 199, 3,000-pound rating.
   b. B-Line; Figure B3067, 3,000-pound rating.

B. Adjustable “J” hanger MSS SP 58, Type 5:

1. Anvil; Figure 67, sizes 1/2 inch through 8 inches.
2. B-Line; Figure B3690, sizes 1/2 inch through 8 inches.

C. Offset Pipe Clamp: Anvil; Figure 103, sizes 3/4 inch through 8 inches.

D. Channel Type:

1. Unistrut.
2. Anvil; Power-Strut.
3. B-Line; Strut System.

2.04 CHANNEL TYPE SUPPORT SYSTEMS

A. Channel Size: 12-gauge, 1-5/8 inch wide minimum steel.

B. Members and Connections: Design for loads using one-half of manufacturer's allowable loads.

C. Manufacturers and Products:

1. B-Line; Strut System.
2. Unistrut.
3. Anvil; Power-Strut.

2.05 PIPE CLAMPS

A. Riser Clamp: MSS SP 58, Type 8.

1. Anvil; Figure 261, sizes 3/4 inch through 24 inches.
2. B-Line; Figure B3373, sizes 1/2 inch through 30 inches.

2.06 ELBOW AND FLANGE SUPPORTS

A. Elbow with Adjustable Stanchion: Sizes 2 inches through 18 inches, Anvil; Figure 62C base.

B. Elbow with Nonadjustable Stanchion: Sizes 2-1/2 inches through 42 inches, Anvil; Figure 63A or Figure 63B base.

C. Flange Support with Adjustable Base: Sizes 2 inches through 24 inches, Standon; Model S89.

2.07 INTERMEDIATE PIPE GUIDES

A. Type: Hold down pipe guide.

1. Manufacturer and Products: B-Line; Figure B3552, 1-1/2 inches through 30 inches.

B. Type: U-bolts with double nuts to provide nominal 1/8-inch to 1/4-inch clearance around pipe; MSS SP 58, Type 24.

1. Anvil; Figure 137 and Figure 137S.
2. B-Line; Figure B3188 and Figure B3188NS.

2.08 PIPE ALIGNMENT GUIDES

A. Type: Spider.

B. Manufacturers and Products:

1. Anvil; Figure 255, sizes 1/2 inch through 24 inches.
2. B-Line; Figure B3281 through Figure B3287, sizes 1/2 inch through 24 inches.

2.09 PIPE ANCHORS

A. Type: Anchor chair with U-bolt strap.

B. Manufacturer and Products: B-Line; Figure B3147A or Figure B3147B.

2.10 SEISMIC RESTRAINTS

A. Solid pipe bracing attachment to pipe clevis with clevis cross brace and angle rod reinforcement.

B. Manufacturers:

1. Mason Industries.
2. B-Line.
3. Anvil.

2.11 ACCESSORIES

A. Anchor Bolts:

1. Size and Material: Sized by Contractor for required loads, 1/2-inch minimum diameter, and as specified in Section 05 50 00, Metal Fabrications.
2. Bolt Length (Extension Above Top of Nut):
   a. Minimum Length: Flush with top of nut preferred. If not flush, shall be no more than one thread recessed below top of nut.
   b. Maximum Length: No more than a full nut depth above top of nut.

B. Dielectric Barriers:

1. Plastic coated hangers, isolation cushion, or tape.
2. Manufacturer and Products:
   a. B-Line; B1999 Vibra Cushion.
   b. B-Line; Iso Pipe, Isolation Tape.

C. Insulation Shields:

1. Type: Galvanized steel or stainless steel, MSS SP 58, Type 40.
2. Manufacturers and Products:
   a. Anvil; Figure 167, sizes 1/2 inch through 24 inches.
   b. B-Line; Figure B3151, sizes 1/2 inch through 24 inches.

D. Welding Insulation Saddles:

1. Type: MSS SP 58, Type 39.
2. Manufacturers and Products:
   a. Anvil; Figure Series 160, sizes 1 inch through 36 inches.
   b. B-Line; Figure Series B3160, sizes 1/2 inch through 24 inches.

E. Plastic Pipe Support Channel:

1. Type: Continuous support for plastic pipe and to increase support spacing.
2. Manufacturer and Products: B-Line; Figure Series B3106V, sizes 1/2 inch through 6 inches with Figure B3106 Vee bottom hanger.

F. Hanger Rods, Clevises, Nuts, Sockets, and Turnbuckles: In accordance with MSS SP 58.

G. Attachments:

1. I-Beam Clamp: Concentric loading type, MSS SP 58, Type 21, Type 28, Type 29, or Type 30, which engage both sides of flange.
2. Concrete Insert: MSS SP 58, Type 18, continuous channel insert with load rating not less than that of hanger rod it supports.
3. Welded Beam Attachment: MSS SP 58, Type 22.
   a. Anvil; Figure 66.
   b. B-Line; Figure B3083.
4. U-Channel Concrete Inserts: As specified in Section 05 50 00, Metal Fabrications.
5. Concrete Attachment Plates:
   a. Anvil; Figure 47, Figure 49, or Figure 52.
   b. B-Line; Figure B3084, Figure B3085, or Figure B3086.

PART 3 EXECUTION

3.01 INSTALLATION

A. General:

1. Install support systems in accordance with MSS SP 58, unless shown otherwise.
2. Install pipe hanger rods plumb, within 4 degrees of vertical during shut down, start up or operations.
3. Support piping connections to equipment by pipe support and not by equipment.
4. Support large or heavy valves, fittings, and appurtenances independently of connected piping.
5. Support no pipe from pipe above it.
6. Support pipe at changes in direction or in elevation, adjacent to flexible joints and couplings, and where shown.
7. Do not use adhesive anchors for attachment of supports to ceiling or walls.
8. Do not install pipe supports and hangers in equipment access areas or bridge crane runs.
9. Brace hanging pipes against horizontal movement by both longitudinal and lateral sway bracing and to reduce movement after startup.
10. Install lateral supports for seismic loads at changes in direction.
11. Install pipe anchors where required to withstand expansion thrust loads and to direct and control thermal expansion.
12. Repair mounting surfaces to original condition after attachments are completed.

B. Standard Pipe Supports:

1. Horizontal Suspended Piping:
   a. Single Pipes: Clevis hangers or adjustable swivel split-ring.
   b. Grouped Pipes: Trapeze hanger system.
2. Horizontal Piping Supported from Walls:
   a. Single Pipes: Wall brackets, or attached to wall, or to wall mounted framing with anchors.
   b. Stacked Piping: Wall mounted framing system and “J” hangers acceptable for pipe smaller than 3-inch.
   c. Pipe clamp that resists axial movement of pipe through support is not acceptable. Use pipe rollers supported from wall bracket.

3. Horizontal Piping Supported from Floors:
    a. Saddle Supports:
        1) Pedestal Type, elbow and flange.
        2) Provide minimum 1-1/2 inch grout beneath baseplate.
    b. Floor Mounted Channel Supports:
        1) Use for pipe smaller than 3-inch running along floors and in trenches at pipe elevations lower than can be accommodated using pedestal pipe supports.
        2) Attach channel framing to floors with baseplate on minimum 1-1/2 inch nonshrink grout and with anchor bolts.
        3) Attach pipe to channel with clips or pipe clamps.
    c. Concrete Cradles: Use for pipe larger than 3 inches along floor and in trenches at pipe elevations lower than can be accommodated using stanchion type.
4. Insulated Pipe:
    a. Pipe hanger and support shall be on outside of insulation. Do not enclose within insulation.
    b. Provide precut 120-degree sections of rigid insulation (minimum length same as shield), shields and oversized hangers or insulated saddle system (ISS).
    c. Wall-mounted pipe clips not acceptable for insulated piping.
5. Vertical Pipe: Support with wall bracket and elbow support, or riser clamp on floor penetration.

C. Standard Attachments:

1. Steel Beams: I-beam clamp or welded attachments.
2. Wooden Beams: Lag screws and angle clips to members not less than 2-1/2 inches thick.
3. Concrete Walls: Concrete inserts or brackets or clip angles with concrete anchors.
4. Concrete Beams: Concrete inserts, or if inserts are not used attach to vertical surface similar to concrete wall. Do not drill into beam bottom.

D. Saddles for Steel or Concrete Pipe: Provide 90-degree to 120-degree pipe saddle for pipe sizes 6 inches and larger when installed on top of steel or concrete beam or structure, pipe rack, trapeze, or where similar concentrated point supports would be encountered.

E. Intermediate and Pipe Alignment Guides:

1. Provide pipe alignment guides, or pipe supports that provide same function, at expansion joints and loops.

2. Guide pipe on each side of expansion joint or loop at 4 pipe and 14 pipe diameters from each joint or loop.
3. Install intermediate guides on metal framing support systems not carrying pipe anchor or alignment guide.

F. Accessories:

1. Insulation Shield: Install on insulated piping with oversize rollers and supports.
2. Welding Insulation Saddle: Install on insulated steel pipe with oversize rollers and supports.
3. Dielectric Barrier:
   a. Provide between painted or galvanized carbon steel members and copper or stainless steel pipe or between stainless steel supports and nonstainless steel ferrous metal piping.
   b. Install rubber wrap between submerged metal pipe and oversized clamps.

3.02 FIELD FINISHING

A. Coat components as specified in Section 09 90 00, Painting and Coating.

END OF SECTION

SECTION 40 27 02
PROCESS VALVES AND OPERATORS

PART 1 GENERAL

1.01 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Product data sheets for each make and model.
   b. Complete catalog information, descriptive literature, specifications, and identification of materials of construction.

PART 2 PRODUCTS

2.01 GENERAL

A. Valves to include operator, actuator, handwheel, extension stem, operating nut, wrench, and accessories to allow a complete operation from the intended operating level.

B. Valve to be suitable for intended service. Renewable parts not to be of a lower quality than specified.

C. Valve same size as adjoining pipe, unless otherwise called out on Drawings.

D. Valve ends to suit adjacent piping.

E. Resilient seated valves shall have no leakage (drip-tight) in either direction at valve rated design pressure. All other valves shall have no leakage (drip-tight) in either direction at valve rated design pressure, unless otherwise allowed for in this section or in stated valve standard.

F. Valve to open by turning counterclockwise, unless otherwise specified.

G. Factory mount operator, actuator, and accessories.

2.02 MATERIALS

A. Bronze and brass valve components and accessories that have surfaces in contact with water to be alloys containing less than 16 percent zinc and 2 percent aluminum.

1. Approved alloys are of the following ASTM designations: B61, B62, B98/B98M (Alloy UNS No. C65100, C65500, or C66100), B139/B139M (Alloy UNS No. C51000), B584 (Alloy UNS No. C90300 or C94700), B164, B194, and B127.
2. Stainless steel Alloy 18-8 may be substituted for bronze.

2.03 VALVES

A. Globe Valves:

1. Type V200 Globe Valve 3 Inches and Smaller:
   a. All-bronze, union bonnet, packed gland, inside screw, rising stem, TFE disc, Class 150 rated 150 psi SWP/300 psi CWP, complies with MSS SP-80 Type 2.
   b. Manufacturers and Products:
      1) Stockham; Figure B-22T, NPT threaded end.
      2) Crane Co.; Figure 7TF, NPT threaded end.
      3) Milwaukee; Model 1590T, soldered ends.
      4) NIBCO; Figure S-235-Y, soldered ends.
2. Type V237 Angle Pattern Hose Valve 1 Inch to 2 Inches:
   a. All-bronze, NPT threaded ends, inside screw-type rising stem, PTFE disc, cast brass male NPT by male NHT adapter with hexagonal center wrench nut, brass cap with chain, complies with MSS SP-80, rated 300 WOG.
   b. Manufacturers and Products:
      1) Stockham; Figure B-222T.
      2) Crane Co.; Cat. No. 17TF.
      3) Nibco; Figure T-335-Y.

B. Ball Valves:

1. Type V300 Ball Valve 3 Inches and Smaller for General Water and Air Service:
   a. Two-piece, standard port, NPT threaded ends, bronze body and end piece, hard chrome-plated solid bronze or brass ball, RTFE seats and packing, blowout-proof stem, adjustable packing gland, zinc-coated steel hand lever operator with vinyl grip, rated 600-pound WOG, 150-pound SWP, complies with MSS SP-110.

b. Manufacturers and Products:
   1) Threaded:
      a) Conbraco Apollo; 70-100.
      b) Nibco; T-580-70.
   2) Soldered:
      a) Conbraco Apollo; 70-200.
      b) Nibco; S-580-70.

C. Butterfly Valves:

1. General:
   a. In full compliance with AWWA C504 and following requirements:
      1) Suitable for throttling operations and infrequent operation after periods of inactivity.
      2) Elastomer seats which are bonded or vulcanized to the body shall have adhesive integrity of bond between seat and body assured by testing, with minimum 75-pound pull in accordance with ASTM D429, Method B.
      3) Bubble-tight with rated pressure applied from either side. Test valves with pressure applied in both directions.
      4) No travel stops for disc on interior of body.
      5) Self-adjusting V-type or O-ring shaft seals.
      6) Isolate metal-to-metal thrust bearing surfaces from flowstream.
      7) Provide traveling nut or worm gear actuator with handwheel. Valve actuators to meet the requirements of AWWA C504.
      8) Buried service operators shall withstand 450 foot-pounds of input torque at fully open and fully closed positions.
2. Type V500 Butterfly Valve Water Works Service 3 Inches to 72 Inches:
   a. AWWA C504, Class 150B.
   b. Short body type, flanged ends.
   c. Cast-iron body, cast or ductile iron disc, Type 304 stainless steel shafts, Buna-N rubber seat, and stainless steel seating surface.
   d. Provide epoxy lining and coating in compliance with AWWA C550.
   e. Manufacturers and Products:
      1) Pratt; Model 2FII or Triton XR-70.
      2) DeZurik; AWWA Valve.

D. Self-Regulated Automatic Valves:

1. Type V730 Pressure-Relief Valve 2 Inches and Smaller:
   a. Direct diaphragm, spring controlled, cast-iron body and spring case, nitrile seat, neoprene diaphragm, Type 416 stainless steel trim, NPT threaded ends, minimum rated working pressure 200 psig.
   b. Opens and modulates inlet pressure when upstream pressure reaches the specified relief setting.
   c. Size and Operating Conditions:
      1) 1-1/2 inch.
      2) Relief Setting: 35 psi.
      3) Maximum Pressure Build-Up Over Relief Setting:
         a) 5 psi at 32 gpm.
         b) 10 psi at 56 gpm.
         c) 20 psi at 90 gpm.
   d. Manufacturer and Product: Fisher; 98 Series.

2.04 OPERATORS AND ACTUATORS

A. Manual Operators:

1. General:
   a. For AWWA valves, operator force not to exceed requirements of applicable valve standard. Provide gear reduction operator when force exceeds requirements.
   b. Operator self-locking type or equipped with self-locking device.
   c. Position indicator on quarter-turn valves.
   d. Worm and gear operators one-piece design, worm-gears of gear bronze material. Worm of hardened alloy steel with thread ground and polished. Traveling nut type operator’s threaded steel reach rod with internally threaded bronze or ductile iron nut.
2. Exposed Operator: Galvanized and painted handwheel.
3. Buried Operator:
   a. Buried service operators on valves larger than 2-1/2 inches shall have a 2-inch AWWA operating nut. Buried operators on valves 2 inches and smaller shall have cross handle for operation by forked key. Enclose moving parts of valve and operator in housing to prevent contact with the soil.
   b. Buried service operators to be grease packed and gasketed to withstand submersion in water to 20 feet minimum.
   c. Buried valves shall have extension stems, bonnets, and valve boxes.

2.05 ACCESSORIES

A. T-Handled Operating Wrench:

1. One galvanized steel or stainless steel operating wrench, 4 feet long.
2. Manufacturers and Products:
   a. Troy Valve; T-Handle Wrench.
   b. Trumbull Manufacturing; T-Handle Main Valve Key.

B. Cast-Iron Valve Box: Designed for traffic loads, sliding type, with minimum of 5-1/4 inch ID shaft.

1. Box: Cast iron with minimum depth of 9 inches.
2. Lid: Cast iron, minimum depth 3 inches, locking type, marked WATER.
3. Extensions: Cast iron.
4. Two-piece box and lid for valves 4 inches through 12 inches, three-piece box and lid for valves larger than 12 inches with base sized for valve.
5. Galvanized steel or stainless steel valve extension stem for valves with operating nuts 3 feet or greater below finish grade.
6. Manufacturers and Products:
   a. East Jordan Iron Works; Cast-Iron Valve Boxes.
   b. Bingham & Taylor; Cast-Iron Valve Boxes.

PART 3 EXECUTION

3.01 INSTALLATION

A. Flange Ends:

1. Flanged valve bolt holes shall straddle vertical centerline of pipe.
2. Clean flanged faces, insert gasket and bolts, and tighten nuts progressively and uniformly.

B. Screwed Ends:

1. Clean threads by wire brushing or swabbing.
2. Apply joint compound.

C. Valve Installation and Orientation:

1. General:
   a. Install valves so handles operate from fully open to fully closed without encountering obstructions.

b. Install valves in location for easy access for routine operation and maintenance.
c. Install valves per manufacturer's recommendations.

3.02 TESTS AND INSPECTION

A. Valve may be either tested while testing pipelines, or as a separate step.

B. Test that valves open and close smoothly under operating pressure conditions. Test that two-way valves open and close smoothly under operating pressure conditions from both directions.

C. Inspect air and vacuum valves as pipe is being filled to verify venting and seating is fully functional.

D. Set, verify, and record set pressures for relief and regulating valves.

END OF SECTION

SECTION 40 90 00
INSTRUMENTATION AND CONTROL FOR PROCESS SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. This section gives general requirements for Process Instrumentation and Control (PIC). The following PIC subsections expand on requirements of this section:

1. Section 40 91 00, Instrumentation and Control Components.

B. Major Work Items: Includes but is not limited to engineering, furnishing, installing, calibrating, adjusting, testing, documenting, starting up, and training for complete a complete PIC system. Tesco will be incharged for all PIC work.

1. Process instrumentation including primary elements, transmitters, control devices, and control panels.
2. Programmable controllers.
3. Operator Interface Terminal (OIT).
4. Provide one Local Control Panels (EPP-FCP) with Programmable Logic Controllers (PLCs).
   a. Size: Refer to Supplement Control Panel Schedule.
   b. Location: Refer to Drawings, Electrical Plan.
5. Provide all field instrumentation and control panels for the Project scope of work as shown on Drawings.
6. Applications Software:
   a. Provided by PLC and OIT vendor (Tesco). Work related to supporting this activity includes:
      1) Assistance with onsite checkout of applications software.
      2) For additional related requirements refer to Article Sequencing and Scheduling.
7. Vendor Package Systems Coordination and Interface:
   a. Coordination, interfaces, applications software, testing in accordance with the requirements of Section 40 99 90, Package Control Systems, for control and integration into plant PLC System: EPP-PLC.
   b. Fish Screens: As defined in Section 35 79 19, Mechanically Cleaned Wedgewire Fish Screens.

C. The PIC integration Work described in this section shall be performed by Tesco Controls, Inc.

1.02 REFERENCES

A. The following is a list of standards which may be referenced in this section and other PIC subsections:

1. American National Standards Institute (ANSI).
2. ASTM International (ASTM):
   a. A182/A182M, Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
   b. A276, Standard Specification for Stainless Steel Bars and Shapes.
   c. A312/A312M, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
   d. B32, Standard Specification for Solder Metal.
   e. B88, Standard Specification for Seamless Copper Water Tube.
3. Deutsche Industrie-Norm (DIN): VDE 0611, Specification for modular terminal blocks for connection of copper conductors up to 1,000V ac and up to 1,200V dc.
4. Institute of Electrical and Electronics Engineers, Inc. (IEEE): C62.41, Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
5. International Society of Automation (ISA):
   a. RP12.06.01, Recommended Practice for Wiring Methods for Hazardous (Classified) Locations Instrumentation Part 1: Intrinsic Safety.
   b. S5.1, Instrumentation Symbols and Identification.
   c. S5.4, Instrument Loop Diagrams.
   d. S50.1, Compatibility of Analog Signals for Electronic Industrial Process Instruments.
   e. TR20.00.01, Specification Forms for Process Measurement and Control Instruments, Part 1: General.
6. International Conference on Energy Conversion and Application (ICECA).
7. National Electrical Code (NEC).
8. National Electrical Manufacturers Association (NEMA):
   a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
   b. ICS 1, Industrial Control and Systems General Requirements.
9. National Fire Protection Association (NFPA): 820, Standard for Fire Protection in Wastewater Treatment and Collection Facilities.

10. NSF International (NSF):
    a. NSF/ANSI 61, Drinking Water System Components - Health Effects.
    b. NSF/ANSI 372, Drinking Water System Components - Lead Content.

1.03 DEFINITIONS

A. Abbreviations:

1. DCU: Distributed Control Unit.
2. EPP: Elkhorn Pumping Plant.
3. FDT: Factory Demonstration Test.
4. I&C: Instrumentation and Control.
5. I/O: Input and Output.
6. OIT: Operator Interface Terminal.
7. O&M: Operation and Maintenance.
8. P&ID: Process and Instrument Diagram.
9. PC: Personal Computer.
10. PIC: Process Instrumentation and Control.
11. PLC: Programmable Logic Controller.
12. SCADA: Supervisory Control, and Data Acquisition.

B. Enclosure: Control panel, console, cabinet, or instrument housing.

C. Instructor Day: 8 hours of actual instruction time.

D. Standard Software: Software packages that are independent of Project on which they are used. Standard software includes system software, Supervisory Control, and Data Acquisition (SCADA) software.

1. System Software: Application independent (non-project specific) software developed by digital equipment manufacturers and software companies. Includes, but is not limited to, operating systems; network support, programming languages (C, C++, Visual C++, BASIC, Visual Basic, etc.); Office Suites (word processor, spreadsheet, database, etc.); e-mail; security (firewall, antivirus; spam, spyware, etc.) debugging aids; and diagnostics.
2. SCADA Software: Software packages independent of specific process control project on which they are used. Includes, but is not limited to, providing configuring and run-time capability for, data acquisition (I/O driver), monitoring, alarming, human-machine interface, supervisory control, data collection, data retrieval, trending, report generation, control, and diagnostics.

3. Controller Programming Software: Software packages for the configuring of PLCs and fieldbus devices.

E. Application Software:

1. Software to provide functions unique to this Project and that are not provided by standard software alone, including but not limited to:
   a. Configuring databases, tables, displays, historians, reports, parameter lists, ladder logic, function block, and control strategies required to implement functions unique to this Project.
   b. Programming in any programming or scripting language.

F. Rising/Falling: Define action of discrete devices about their setpoint.

1. Rising: Contacts close when an increasing process variable rises through setpoint.
2. Falling: Contacts close when a decreasing process variable falls through setpoint.

G. Signal Types:

1. Analog Signal, Current Type:
   a. 4 mA to 20 mA dc signals conforming to ISA S50.1.
   b. Unless otherwise indicated for specific PIC subsection components, use the following ISA S50.1 options.
      1) Transmitter Type: Number 2, two-wire.
      2) Transmitter Load Resistance Capacity: Class L.
      3) Fully isolated transmitters and receivers.
2. Analog Signal, Voltage Type: 1 to 5V dc within panel where common high precision dropping resistor is used.
3. Discrete signals, two-state logic signals using dc or 120V ac sources as indicated.
4. Pulse Frequency Signals:
   a. Direct-current pulses whose repetition rate is linearly proportional to process variable.
   b. Pulses generated by contact closures or solid state switches.
   c. Power source less than 30V dc.
5. Special Signals: Other types of signals used to transmit analog and digital information between field elements, transmitters, receivers, controllers, and digital devices.

1.04 SYSTEM DESCRIPTION

A. Detailed Wiring Design: Process and Instrument diagrams are included on Drawings and designed to show signal wiring, interfaces with other systems, and wiring of components to be provided.

B. Design Requirements:

1. Complete detailed design of PIC components and PIC drawings.
2. Provide consistent hardware and software functions for PIC design as shown and specified and includes:
   a. Functional requirements, performance requirements, and component specifications.
   b. P&IDs, block diagrams, and network diagrams.
3. Typical drawings for installation details, control panel layouts, control panel schedules, PLC I/O module wiring, panel power, and control diagrams.

C. Use TESCO as the qualified PIC System Integrator for at least the following work:

1. For PIC Equipment and Ancillaries:
   a. Completing detail design.
   b. Submittals.
   c. PLC Equipment, PLC enclosure, and ancillaries.
   d. Instrumentation and Control field devices, including terminal junction boxes.
   e. Instructions, details, and recommendations to, and coordination with Contractor for Certificate of Proper Installation.
   f. Verify readiness for operation.
   g. Verify correctness of final power and signal connections (lugging and connecting).
   h. Adjusting and calibrating.
   i. Starting up.
   j. Testing and coordination of testing.
   k. Training.
   l. Assist Engineer with Functional Test Part 2 (FTP2), as defined in Article Field Quality Control.
2. PLC programming, OIT programming, radio programming and communication setup to office of the Natomas Mutal Water Company.

D. Non PIC Equipment Directly Connected to PIC Equipment:

1. Obtain from Contractor, manufacturers’ information on installation, interface, function, and adjustment.

2. Coordinate with Contractor to allow required interface and operation with PIC.
3. For operation and control, verify installations, interfacing signal terminations, and adjustments have been completed in accordance with manufacturer's recommendations.
4. Test to demonstrate required interface and operation with PIC.
5. Examples of items in this category, but not limited to the following:
   a. Valve operators, position switches, and controls.
   b. Motor control centers.
   c. Adjustable speed and adjustable frequency drive systems.
6. Examples of items not in this category:
   a. Internal portions of equipment provided under Division 26, Electrical, that are not directly connected to PIC equipment.
   b. Internal portions of package system instrumentation and controls that are not directly connected to PIC equipment.

1.05 SUBMITTALS

A. General:

1. Submit proposed Submittal breakdown consisting of sequencing and packaging of information in accordance with Project Schedule.
2. Partial Submittals not in accordance with Project Schedule will not be accepted.
3. Submittal Format:
   a. Hard Copy: Required for all Submittals.
   b. Electronic Copies: Required, unless otherwise noted for specific items.
      1) Manufacturers' Standard Documents: Adobe Acrobat PDF.
      2) Documents created specifically for Project:
         a) Text and Graphics: Microsoft Word.
         b) Lists: Microsoft Excel, unless otherwise noted for specific items.
         c) Drawings: AutoCAD.
4. Identify proposed items, options, installed spares, and other provisions for future work (for example, reserved panel space; unused components, wiring, and terminals).
5. Legends and Abbreviation Lists:
   a. Definition of symbols and abbreviations used; for example, engineering units, flowstreams, instruments, structures, and other process items used in nameplates, legends, data sheets, point descriptions, OIT displays, alarm/status logs, and reports.
   b. Use identical abbreviations in PIC subsections.
   c. Submit updated versions as they occur.

6. Activity Completion:
   a. Action Submittals: Completed when reviewed and approved.
   b. Informational Submittals: Completed when reviewed and found to meet conditions of the Contract.

B. Action Submittals:

1. Bill of Materials: List of required equipment.
   a. Group equipment items by enclosure and field, and within an enclosure, as follows:
      1) PIC Components: By component identification code.
      2) Other Equipment: By equipment type.
   b. Data Included:
      1) Equipment tag number.
      2) Description.
      3) Manufacturer, complete model number and all options not defined by model number.
      4) Quantity supplied.
      5) Component identification code where applicable.
      6) For panels, include panel reference number and name plate inscription.
   c. Formats: Hard copy and Microsoft Excel.
2. Catalog Cuts:
   a. I&C components, electrical devices, and mechanical devices:
      1) Catalog information, marked to identify proposed items and options.
      2) Descriptive literature.
      3) External power and signal connections.
      4) Scaled drawings showing exterior dimensions and locations of electrical and mechanical interfaces.
3. Instrument List:
   a. Engineer will provide an initial Instrument List in Microsoft Excel. Data from this may be used as starting point for creating final Instrument List and Component Data Sheets.
   b. Applicable fields to be completed include, but are not limited to:

Instrument List Characteristics	
Item	**Initially Completed By**
Tag Number	Engineer
Loop Number	Engineer
Description	Engineer

Instrument List Characteristics	
Item	**Initially Completed By**
Manufacturer and complete model number	Contractor
Size and scale range	Engineer
Setpoints	Engineer
Reference P&IDs, Electrical, Mechanical, Interconnection Drawings and Installation Details Drawings	Engineer
Instrument detail number	Engineer

c. Submit updated version of Instrument List.
d. Electronic Copies: Microsoft Excel.

4. Component Data Sheets: Data sheets for I&C components.
   a. Format:
      1) Similar to ISA TR20.00.01.
      2) Microsoft Excel, one component per data sheet.
      3) Submit proposed format for Component Data Sheets before completing data sheets for individual components.
   b. Content:
      1) Specific features and configuration data for each component, including but not limited to:
         a) Tag Number.
         b) Component type identification code and description.
         c) Location or service.
         d) Service conditions.
         e) Manufacturer and complete model number.
         f) Size and scale range.
         g) Setpoints.
         h) Materials of construction.
         i) Options included.
         j) Power requirements.
         k) Signal interfaces.
      2) Name, address, and telephone number of manufacturer's local office, representative, distributor, or service facility.
   c. Electronic Copies: Microsoft Excel.

5. Sizing and Selection Calculations:
    a. Primary Elements:
        1) Complete calculations plus process data used. Example for Flow Elements:
            a) Minimum and maximum values, permanent head loss, and assumptions made.
    b. Controller, Computing, and Function Generating Modules: Actual scaling factors with units and how they were computed.
    c. Electronic Copies: Microsoft Excel, one file for each group of components with identical sizing calculations.
6. Preliminary Panel Elevation Drawings:
    a. Provide prior to submitting Panel Construction Drawings:
        1) Scale Drawings: Show dimensions and location of front of panel devices.
        2) Panel Legend (Bill of Material): List front of panel devices by tag number. Include nameplate inscriptions, service legends, and annunciator inscriptions.
        3) Submit electronic copies of Drawings.
7. Panel Construction Drawings:
    a. Scale Drawings: Show dimensions and locations of panel-mounted devices, doors, louvers, subpanels, internal and external.
    b. Panel Legend (Bill of Material): List front of panel devices by tag numbers, nameplate inscriptions, service legends, and annunciator inscriptions.
    c. Bill of Materials: List devices mounted within panel that are not listed in panel legend. Include tag number, description, manufacturer, and model number.
    d. Construction Details: NEMA rating, materials, material thickness, structural stiffeners and brackets, lifting lugs, mounting brackets and tabs, door hinges and latches, and welding and other connection callouts and details.
    e. Construction Notes: Finishes, wire color schemes, wire ratings, wire, terminal block numbering, and labeling scheme.
    f. Submit electronic copies of Drawings.
8. Detailed Wiring Diagrams:
    a. Refer to Drawings for Detailed Wiring Diagrams including:
        1) Panel Wiring Diagrams for discrete control and power circuits.
        2) Loop Wiring Diagrams showing individual wiring diagram for each analog or pulse frequency loop.
        3) Interconnecting Wiring Diagrams showing electrical connections between equipment, consoles, panels, terminal junction boxes, and field-mounted components.

b. Prepare as-built redline markup of detailed wiring diagrams. Show terminal numbers on switch blocks, relays, and internal components.
c. Submit electronic copies of Drawings.

9. Panel Wiring Diagrams:
   a. Cover wiring within a panel including, but not limited to, instrumentation, control, power, and communications, and digital networks.
   b. Objectives: For use in wiring panels, making panel connections, and future panel trouble shooting.
   c. Diagram Type:
      1) Ladder diagrams where applicable. Include devices that are mounted in or on the panel that require electrical connections. Show unique rung numbers on left side of each rung.
      2) Schematic drawings for wiring of circuits that cannot be well represented by ladder diagrams.
   d. Item Identification: Identify each item with attributes listed.
      1) Wires: Wire number and color. Cable number if part of multiconductor cable.
      2) Terminals: Location (enclosure number, terminal junction box number, or MCC number), terminal strip number, and terminal block number.
      3) Components:
         a) Tag number, terminal numbers, and location (“FIELD”, enclosure number, or MCC number).
         b) Switching action (open or close on rising or falling process variable), setpoint value and units, and process variable description (for example, Sump Level High).
      4) I/O Points: PLC unit number, I/O tag number, I/O address, terminal numbers, and terminal strip numbers.
      5) Relay Coils:
         a) Tag number and its function.
         b) On right side of run where coil is located, list contact location by ladder number and sheet number. Underline normally closed contacts.
      6) Relay Contacts: Coil tag number, function, and coil location (ladder rung number and sheet number).
      7) Communications and Networks: Network type, address or node identification, port or channel number, and type of connector.
   e. Show each circuit individually. No “typical” diagrams or “typical” wire lists will be allowed.

f. Ground wires, surge protectors, and connections.
g. Wire and Cable Names: Show names and wire color for circuits entering and leaving a panel. Refer to Division 26, Electrical.

10. Loop Wiring Diagrams: Individual, end-to-end wiring diagram for each analog and discrete or equipment loop.
    a. Conform to the minimum requirements of ISA S5.4.
    b. Under Paragraph 5.3 of ISA S5.4, include the information listed under Subparagraphs 2 and 6.
    c. Show loop components within a panel and identify each component, component terminals, and panel terminals.
    d. If a loop connects to panels or devices not provided under this section and its subsections, such as control valves, motor control centers, package system panels, variable speed drives, include the following information:
        1) Show the first component connected to within the panel or device that is not provided under this section and its subsections.
        2) Identify the component by tag and description.
        3) Identify panel and component terminal numbers.
    e. Drawing Size: Individual 11-inch by 17-inch sheet for each loop.
    f. Divide each loop diagram into areas for panel face, back-of-panel, field and PLC.
    g. One Drawing Per Loop: Show each loop individually. No “typical” loop diagrams will be allowed.
    h. Show:
        1) Terminal numbers, location of dc power supply, and location of common dropping resistors.
        2) Switching contacts in analog loops and output contacts of analog devices. Reference specific control diagrams where functions of these contacts are shown.
        3) Tabular summary on each analog loop diagram:
            a) Transmitting Instruments: Output capability.
            b) Receiving Instruments: Input impedance.
            c) Loop Wiring Impedance: Estimate based on wire sizes and lengths shown.
            d) Total loop impedance.
            e) Reserve output capacity.
        4) Circuit and raceway schedule names.

11. Communications and Digital Networks Diagrams:
    a. Scope: Includes connections to Ethernet network, remote I/O, and fieldbus (for example, Modbus, Profibus, Foundation Fieldbus, Device Net, etc.).
    b. Format: Network schematic diagrams for each different type of network.

c. Show:
    1) Interconnected devices, both passive and active.
    2) Device names and numbers.
    3) Terminal numbers.
    4) Communication Media: Type of cable.
    5) Connection Type: Type of connector.
    6) Node and device address numbers.
    7) Wire and cable numbers and colors.

12. Panel Power Requirements and Heat Dissipation:
    a. For control panels tabulate and summarize:
        1) Required voltages, currents, and phases(s).
        2) Maximum heat dissipations Btu per hour.
        3) Calculations.
        4) Steady State Temperature Calculations: For nonventilated panels, provide heat load calculations showing the panel estimated internal steady state temperature for ambient air temperatures of 100 degrees F.
13. Installation Details: Include modifications or further details required and define installation of I&C components.
14. Spares, expendables, and test equipment.
15. Electronic Copies: Microsoft Excel.
16. PLC I/O List:
    a. Managed by Contractor:
        1) During construction Contractor will maintain PLC I/O List and give electronic Microsoft Excel copies to PIC System Integrator.
        2) Contractor will assign PLC I/O points to specific chassis, slot, and point addresses.
    b. PLC I/O List Changes: Changes to PLC I/O List reflecting actual equipment and instrumentation provided.
        1) Mark up electronic file of latest PLC I/O List from Engineer. Highlight changed cells with yellow, new rows with red, and rows to be deleted with green.
        2) Submit marked up copies changes at 30-day intervals.
17. PLC I/O List: Submit I/O assignment and Rack/Slot/Point.
18. Shop Drawings for Changes Impacting PLC and SLDC Programming:
    a. Submit details of changes required to PLC and SLDC monitoring and control resulting from installation of alternative or upgraded process equipment and instrumentation, and other causes.
    b. Submit changes at 30-day intervals.
19. Color schedule for control panels.

20. Applications Software Documentation:
    a. For equipment for which Contractor does not provide applications software provide:
        1) Complete configuration documentation for microprocessor based programmable devices.
        2) For each device, include program listings and function block diagrams, as appropriate, showing:
            a) Functional blocks or modules used.
            b) Configuration, calibration, and tuning parameters.
            c) Descriptive annotations.
        3) Refer to PIC subsections for additional requirements.

C. Informational Submittals:

1. Operation and Maintenance Data:
    a. In accordance with Section 01 78 23, Operation and Maintenance Data, and in addition the following:
        1) General:
            a) Provide sufficient detail to allow operation, removal, installation, adjustment, calibration, maintenance and purchasing replacements for PIC components.
            b) Submittal Format: Both hard copy and electronic copies for all Submittals. Refer to Article Submittals, heading Submittal Format.
        2) Final versions of Legend and Abbreviation Lists.
        3) Process and Instrumentation Diagrams: Marked up copy of revised P&ID to reflect as-built PIC design.
        4) Provide the following items as defined under heading Action Submittals:
            a) Bill of materials.
            b) Catalog cuts.
            c) Instrument list.
            d) Component data sheets.
            e) Detailed Wiring Diagrams:
                (1) Panel wiring diagrams.
                (2) Loop diagrams.
                (3) Interconnecting wiring diagrams.
            f) Panel plumbing diagrams.
            g) Applications software documentation.
        5) Manufacturer’s O&M manuals for components, electrical devices, and mechanical devices:
            a) Content for Each O&M Manual:
                (1) Table of Contents.
                (2) Operations procedures.

(3) Installation requirements and procedures.
(4) Maintenance requirements and procedures.
(5) Troubleshooting procedures.
(6) Calibration procedures.
(7) Internal schematic and wiring diagrams.
(8) Component and I/O Module Calibration Sheets from field quality control calibrations.

b) Provide PDF file with linked index to all manuals.

6) List of spares, expendables, test equipment and tools provided.
7) List of additional recommended spares, expendables, test equipment, and tools. Include quantities, unit prices, and total costs.

2. Provide Manufacturer's Certificate of Proper Installation where specified.
3. Testing Related Submittals:
   a. Factory Demonstration Test:
      1) Preliminary Test Procedures: Outline of proposed tests, forms, and checklists.
      2) Final Test Procedures:
         a) Proposed test procedures, forms, and checklists.
         b) Capacity, Timing, and Simulation: Describe simulation and monitoring methods used to demonstrate compliance with capacity and timing requirements.
      3) Test Documentation: Copy of signed off test results.
   b. Functional Test:
      1) Preliminary Test Procedures: Outline of proposed tests, forms, and checklists.
      2) Final Test Procedures: Proposed test procedures, forms, and checklists.
      3) Test Documentation:
         a) Copy of signed-off test results.
         b) Completed component calibration sheets.
   c. Performance Test:
      1) Preliminary Test Procedures: Outline of proposed tests, forms, and checklists.
      2) Final Test Procedures: Proposed test procedures, forms, and checklists.
      3) Test Documentation: Copy of signed-off test results.

4. Owner Training Plan: In accordance with Section 01 43 33, Manufacturers' Field Services.
5. Maintenance Service Agreement: Prior to Substantial Completion, submit service agreements signed by Owner and maintenance provider for work required under Article Maintenance.

1.06 QUALITY ASSURANCE

A. Qualifications:

1. TESCO PIC System Integrator: Minimum of 10 years' experience providing, integrating, installing, and starting up similar systems as required for this Project.
2. TESCO PIC System Integrator's Site Representative: Minimum of 5 years' experience installing systems similar to PIC required for this Project.

B. PIC Coordination Meetings:

1. General: Refer to Section 01 31 19, Project Meetings, for PIC coordination meetings.
2. PIC Schedule Coordination Meeting:
   a. Timing: Following Engineer review of PIC Schedule.
   b. Purpose: Discuss Engineer's comments and resolve scheduling issues.
3. Training Coordination Meeting:
   a. Timing: Following Engineer review of preliminary training plan.
   b. Purpose:
      1) Resolve required changes to proposed training plan.
      2) Identify specific Owner personnel to attend training.

1.07 DELIVERY, STORAGE, AND HANDLING

A. In accordance with Section 01 61 00, Common Product Requirements.

B. Prior to shipment, include corrosive inhibitive vapor capsules in shipping containers, and related equipment as recommended by capsule manufacturer.

C. Prior to installation, store items in dry indoor locations. Provide heating in storage areas for items subject to corrosion under damp conditions.

D. Cover panels and other elements that are exposed to dusty construction environments.

1.08 SEQUENCING AND SCHEDULING

A. Refer to Section 01 31 13, Project Coordination, for Contractor's scheduling requirements for applications software testing.

B. Prerequisite Activities and Lead Times:

1. Do not start following key Project activities until prerequisite activities and lead times listed below have been completed and satisfied:
    a. Shop Drawing Reviews by Engineer:
        1) Prerequisite: Engineer acceptance of Schedule of Values and Progress Schedule.
        2) Schedule: In accordance with completed schedule of Shop Drawing and Sample Submittals specified in Section 01 33 00, Submittal Procedures.
    b. Test Prerequisite: Associated test procedures Submittals completed.
    c. Training Prerequisite: Associated training plan Submittal completed.
    d. PLC and OIT Configuration Training Session 1 Prerequisite: PLC and OIT hardware and software Shop Drawings approved.
    e. PLC and OIT Configuring Equipment Demonstration Test.
    f. PLC and OIT Applications Software Configuring by Contractor at Contractor's Office.
        1) Prerequisite: PLC and OIT configuring equipment demonstration test.
    g. PLC and OIT Shipment to Site:
        1) General Prerequisites:
            a) Approval of PIC Shop Drawings and preliminary operation and maintenance data.
            b) FDT completed.
        2) Additional prerequisite for equipment previously shipped to Engineer's office: Completion of PLC and OIT application software configuring and testing by Engineer.
    h. PLC and OIT Installation Prerequisite: Equipment received at Site.
    i. Functional Test Part 1 (FTP1) Prerequisite: PLC and OIT installation complete.
    j. Functional Test Part 2 (FTP2)Prerequisite: Functional Test Part 1 (FTP1) completed.
    k. Performance Test Prerequisite: Functional Test Part 2 (FTP2) completed and facility started up.

1.09 MAINTENANCE

A. Maintenance Service Agreement:

1. Duration of 1 year unless otherwise noted in PIC subsections.
2. Start on date of Substantial Completion.
3. Performed by factory-trained service engineers with experience on PIC systems to be maintained.
4. Spare Parts: If not stocked onsite, delivered to Site within 24 hours from time of request.
5. Repair or replace components or software found to be faulty.
6. Replace and restock within 1 month onsite spare parts and expendables used for maintenance. Provide list of items used and replaced.
7. Submit records of inspection, maintenance, calibration, repair, and replacement within 2 weeks after each Site visit.

B. Telephone Support: Provide telephone support during normal business hours of 8:00 a.m. to 5:00 p.m., Monday through Friday.

C. Software Subscription: As specified in PIC subsections.

1.10 EXTRA MATERIALS

A. As specified in PIC subsections.

B. In computing spare parts quantities based on specified percentages, round up to nearest whole number.

C. Spare Parts:

Description	Percent of Each Type and Size Used	No Less Than
dc power supplies	20	1
Fuses	20	5
Control Relays	20	2
Indicating light bulb	20	5
Hand Switches and Lights	10	3
PLC System Components	-	See Component Specification Y100
Terminal Blocks	10	10

PART 2 PRODUCTS

2.01 GENERAL

A. Provide PIC functions shown on Drawings and required in PIC subsections for each system and loop. Furnish equipment items required in PIC subsections. Furnish materials, equipment, and software (except for Engineer provided applications software), whether indicated or not, necessary to effect required system and loop performance.

B. First Named Manufacturer: PIC design is based on first named manufacturers of equipment, materials, and software.

1. If an item is proposed from other than first named manufacturer, obtain approval from Engineer for such changes in accordance with the General Conditions, Article 6.05 Substitutes and “Or-Equals”.
2. If proposed item requires, but not limited to, different installation, wiring, raceway, enclosures, intrinsically safe barriers, and accessories, provide such equipment and work.

C. Like Equipment Items:

1. Use products of one manufacturer and of the same series or family of models to achieve standardization for appearance, operation, maintenance, spare parts, and manufacturer’s services.
2. Implement same or similar functions in same or similar manner. For example control logic, sequence controls, and display layouts.

2.02 I&C COMPONENTS

A. Specifications: Refer to Section 40 91 00, Instrumentation and Control Components, for I&C components.

B. Components for Each Loop: Major components for each loop are listed in the Instrument List referenced in Article Supplements. Furnish equipment that is necessary to achieve required loop performance.

C. Control Panels: Reference Control Panel Schedule in Article Supplements.

2.03 PROGRAMMABLE LOGIC CONTROLLERS

A. Reference Instrument List in Article Supplements, and PLC components in Section 40 91 00, Instrumentation and Control Components.

2.04 NETWORK COMPONENTS

A. Reference Supplement Instrument List, and Paragraph Y56 Ethernet Switch, in Section 40 91 00, Instrumentation and Control Components.

2.05 SERVICE CONDITIONS

A. Standard Service Conditions:

1. The following defines certain types of environments. PIC subsections refer to these definitions by name to specify the service conditions for individual equipment units. Design equipment for continuous operation in these environments:
   a. Outside:
      1) Temperature: 20 degrees F to 120 degrees F.
      2) Relative Humidity: 0 percent to 100 percent, rain and fog.
      3) NEC Classification: Nonhazardous.

2.06 NAMEPLATES AND TAGS

A. Panel Nameplates: Enclosure identification located on enclosure face.

1. Location and Inscription: Provide descriptive nameplate on the front of new enclosures, use P&ID tag and name.
2. Materials: Laminated plastic attached to panel with stainless steel screws.
3. Letters: 1/2-inch high, white on black background, unless otherwise noted.

B. Component Nameplates, Panel Face: Component identification located on panel face under or near component.

1. Location and Inscription: As shown on panel drawing.
2. Materials: Adhesive-backed, laminated plastic.
3. Letters: 3/16-inch high, white on black background, unless otherwise noted.

C. Component Nameplates, Back of Panel: Component identification located on or near component inside of enclosure.

1. Inscription: Component tag number.
2. Materials: Adhesive-backed, laminated plastic.
3. Letters: 3/16-inch high, white on black background, unless otherwise noted.

D. Legend Plates for Panel Mounted Pushbuttons, Lights, and Switches.

1. Inscription:
   a. Refer to table under Paragraph Standard Pushbutton Colors and Inscriptions.
   b. Refer to table under Paragraph Standard Light Colors and Inscriptions.
   c. Refer to P&IDs on Drawings.
2. Materials: Stainless steel, keyed legend plates. Secured to panel by mounting nut for pushbutton, light, or switch.
3. Letters: Black on gray or white background.

E. Service Legends: Component identification nameplate located on face of component.

1. Inscription: As shown on panel drawing.
2. Materials: Adhesive-backed, laminated plastic.
3. Letters: 3/16-inch high, white on black background, unless otherwise noted.

F. Nametags: Component identification for field devices.

1. Inscription: Component tag number.
2. Materials: 16-gauge, Type 304 stainless steel.
3. Letters: 3/16-inch high, imposed.
4. Mounting: Affix to component with 16-gauge or 18-gauge stainless steel wire or stainless steel screws.

2.07 MECHANICAL SYSTEM COMPONENTS

A. Reference Section 40 91 00, Instrumentation and Control Components.

2.08 FUNCTIONAL REQUIREMENTS FOR CONTROL LOOPS

A. Shown on Process and Instrumentation Diagrams (P&IDs).

B. Supplemented by Loop Specifications that describe requirements not obvious on P&IDs.

C. Supplemented by standard functional requirements in PIC subsections.

2.09 LOOP SPECIFICATIONS

A. See Article Supplements, located at end of this section.

B. Organization: By unit process and loop number.

C. Loop Subheadings: See Article Supplements, located at end of this section.

D. Organization: By unit process and loop number.

E. Loop Subheadings:

1. Overview: Specifies process control summary.
2. Local Functions: Clarifies functional performance of loop for hard wired logic, for example in MCCs and control panels.
3. PLC Functions: Specifies nonstandard PLC functions.
4. OIT Functions: Specifies nonstandard OIT functions.

2.10 ELECTRICAL REQUIREMENTS

A. Electrical Raceways: As specified in Section 26 05 33, Raceway and Boxes.

B. Wiring External to PIC Equipment:

1. Special Control and Communications Cable: Provided by PIC System Integrator as noted in Component Specifications and PIC subsections.
2. Other Wiring and Cable: As specified in Section 26 05 05, Conductors.

C. Wires within Enclosures:

1. AC Circuits:
   a. Type: 600-volt, Type MTW stranded copper.
   b. Size: For current to be carried, but not less than 18 AWG.
2. Analog Signal Circuits:
   a. Type: 600-volt stranded copper, twisted shielded pairs or triad with a 100 percent, aluminum-polyester shield, rated 60 degrees C.
   b. Panels with Circuits Less Than 600 Volts: Rated at 600 volts. Belden 18 AWG Type 9341, Triad Beldon No. 1121A.
   c. Size: 18 AWG, minimum.
3. Other dc Circuits.
   a. Type: 600-volt, Type MTW stranded copper.
   b. Size: For current carried, but not less than 18 AWG.
4. Special Signal Circuits: Use manufacturer’s standard cables.
5. Wire Identification: Numbered and tagged at each termination.
   a. Wire Tags: Machine printed, heat shrink.
   b. Manufacturers:
      1) Brady Perma Sleev.
      2) Tyco Electronics.

D. Terminate and identify wires entering or leaving enclosures as follows:

1. Analog and discrete signal, terminate at numbered terminal blocks.
2. Special signals terminated using manufacturer's standard connectors.
3. Identify wiring in accordance with requirements in Section 26 05 05, Conductors.

E. Terminal Blocks for Enclosures:

1. Quantity:
   a. Accommodate present and spare indicated needs.
   b. Wire spare PLC I/O points to terminal blocks.
   c. One wire per terminal for field wires entering enclosures.
   d. Maximum of two wires per terminal for 18 AWG wire for internal enclosure wiring.
   e. Spare Terminals: 20 percent of connected terminals, but not less than 10 per terminal block, unless otherwise shown on Drawings.
2. Terminal Block Types: Reference Section 40 91 00, Instrumentation and Control Components, Article Electrical Components.

F. Grounding of Enclosures:

1. Furnish isolated copper grounding bus for signal and shield ground connections.
2. Ground this ground bus at a common signal ground point in accordance with National Electrical Code requirements.
3. Single Point Ground for Each Analog Loop:
   a. Locate signal ground at dc power supply for loop.
   b. Use to ground wire shields for loop.
4. Ground terminal block rails to ground bus.

G. Analog Signal Isolators:

1. Furnish signal isolation for analog signals that are sent from one enclosure to another.
2. Do not wire in series instruments on different panels, cabinets, or enclosures.

H. Wiring Interface: Terminate and identify wiring entering or leaving enclosures.

1. Analog and Discrete Signal Wires: Terminate at numbered terminal blocks as shown on the wiring diagrams.

2. Wiring for Special Signals: Terminate communications, digital data, and multiplexed signals using manufacturer's standard connectors for the device to which the signals terminate.

I. Electrical Transient Protection:

1. General:
   a. Function: Protect elements of PIC against damage due to electrical transients induced in interconnecting lines by lightning and nearby electrical systems.
   b. Surge suppressors are not shown for external analog transmitters. Determine quantity and location, and show on Shop Drawings. Refer to example wiring in installation details on Drawings.
   c. Provide, install, coordinate, and inspect grounding of surge suppressors at:
      1) Connection of ac power to PIC equipment including panels, consoles assembles, and field-mounted analog transmitters and receivers.
      2) At the field and panel, console, or assembly connection of signal circuits that have portions of the circuit extending outside of a protective building.
2. Surge Suppressor Types: Reference Section 40 91 00, Instrumentation and Control Components, Article Electrical Components.
3. Installation and Grounding of Suppressors: Grounding equipment, installation of grounding equipment, and terminations for field mounted devices are provided under Division 26, Electrical.

2.11 PANEL FABRICATION

A. General:

1. Nominal Panel Dimensions: As specified in Instrument List.
2. Instrument Arrangements: Proposed by PIC System Integrator on Shop Drawing Submittal; subject to approval by Engineer.
3. Panel Components: As specified in Instrument List and herein.
4. Panel Construction and Interior Wiring: In accordance with the National Electrical Code (NEC), state and local codes, and applicable sections of NEMA, ANSI, UL, and ICECA.
5. Fabricate panels, install instruments and wire, and plumb at PIC System Integrator's facility. No fabrication other than correction of minor defects or minor transit damage permitted onsite.
6. UL Listing Mark for Enclosures: Mark stating "Listed Enclosed Industrial Control Panel" per UL 508A.

7. Electrical Work: In accordance with the applicable requirements of Division 26, Electrical.

B. Temperature Control:

1. Panels Integral to MCC:
   a. Ventilated Panels:
      1) Furnish with louvers and forced ventilation as required to prevent temperature buildup from equipment mounted inside panel and on panel.
      2) For panels with backs against wall, furnish louvers on top and bottom of panel sides.
      3) For panels without backs against wall, furnish louvers on top and bottom of panel back.
      4) Louver Construction: Stamped sheet metal.
      5) Ventilation Fans:
         a) Furnish where required to provide adequate cooling.
         b) Create positive internal pressure within panel.
         c) Fan Motor Power: 120V ac, 60-Hz, thermostatically controlled.
      6) Air Filters: Washable aluminum, Hoffman Series A-FLT.
   b. Refrigerated System: Furnish where heat dissipation cannot be adequately accomplished with natural convection or forced ventilation.
2. Space Heaters: Thermostatically controlled to maintain internal panel temperatures above dewpoint.

C. Nonfreestanding Panel Construction:

1. Based on environmental design requirements, provide the following:
   a. Panels listed as integral to MCC:
      1) Enclosure Type: NEMA 12 in accordance with NEMA 250.
      2) Materials: Steel.
   b. Other Panels:
      1) Enclosure Type: NEMA 4X in accordance with NEMA 250.
      2) Materials: Type 316 stainless steel.
2. Metal Thickness: 14-gauge, minimum.
3. Doors:
   a. Rubber-gasketed with continuous hinge.
   b. Stainless steel lockable quick-release clamps.
4. Manufacturers:
   a. Hoffman Engineering Co.
   b. “Or-equal.”

D. Breather and Drains:

1. Furnish with NEMA 250, Type 4 and 4X panels:
   a. Manufacturer and Products: Cooper Crouse-Hinds; ECD Type 4X Drain and Breather; Drain Model ECD1-N4D, Breather Model ECD1-N4B.

E. Breather and Drains:

1. Furnish with NEMA 250, Type 4 and 4X panels:
   a. Manufacturer and Products: Cooper Crouse-Hinds; ECD Type 4X Drain and Breather; Drain Model ECD1-N4D, Breather Model ECD1-N4B.

F. Control Panel Electrical:

1. Power Distribution within Panels:
   a. Feeder Circuits:
      1) One or more 120V ac, 60-Hz feeder circuits as shown on Drawings.
      2) Make provisions for feeder circuit conduit entry.
      3) Furnish terminal block for termination of wires.
   b. Power Panel: Furnish main circuit breaker and circuit breaker on each individual branch circuit distributed from power panel.
      1) Locate to provide clear view of and access to breakers when door is open.
      2) Breaker Sizes: Coordinate such that fault in branch circuit will blow only branch breaker, but not trip main breaker.
         a) Branch Circuit Breakers: 15 amperes at 250V ac.
      3) Breaker Manufacturer and Products: Square D; Type QOU.
   c. Circuit Wiring:
      1) P&IDs on Drawings show function only. Use following rules for actual circuit wiring:
         a) Devices on Single Circuit: 20, maximum.
         b) Multiple Units Performing Parallel Operations: To prevent failure of any single branch circuit from shutting down entire operation, do not group all units on same branch circuit.
         c) Branch Circuit Loading: 12 amperes continuous, maximum.
         d) Panel Lighting and Service Outlets: Put on separate 15 ampere, 120V ac branch circuit.
         e) Provide 120V ac plugmold for panel components with line cords.

2. Signal Distribution:
   a. Signal Wiring: Separate analog signal cables from power and control within a panel and cross at right angles where necessary.
   b. Within Panels: 4 mA to 20 mA dc signals may be distributed as 1V dc to 5V dc.
   c. Outside Panels: Isolated 4 mA to 20 mA dc only.
   d. Signal Wiring: Twisted shielded pairs.
3. Signal Switching:
   a. Use dry circuit type relays or switches.
   b. No interruption of 4 mA to 20 mA loops during switching.
   c. Switching Transients in Associated Signal Circuit:
      1) 4 mA to 20 mA dc Signals: 0.2 mA, maximum.
      2) 1V dc to 5V dc Signals: 0.05V, maximum.
4. Relay Types: Reference Section 40 91 00, Instrumentation and Control Components, Article Electrical Components.
5. Push-to-Test Circuitry: For each push-to-test indicating light, provide a fused push-to-test circuit.
6. Internal Panel Lights for Freestanding Panels:
   a. Type: Switched 100-watt incandescent back-of-panel lights.
   b. Quantity: One light for every 4 feet of panel width.
   c. Mounting: Inside and in the top of back-of-panel area.
   d. Protective metal shield for lights.
7. Service Outlets for Freestanding Panels:
   a. Type: Three-wire, 120-volt, 15-ampere, GFCI duplex receptacles.
   b. Quantity:
      1) Panels 4 Feet Wide and Smaller: One.
      2) Panels Larger than 4 Feet Wide: One for every 4 feet of panel width, two minimum per panel.
   c. Mounting: Evenly spaced along back-of-panel area.
8. Internal Panel Lights and Service Outlets for Smaller Panels:
   a. Internal Panel Light: Switched 100-watt incandescent light.
   b. Service Outlet: Breaker protected 120-volt, 15-amperes, GFCI duplex receptacle:
   c. Required for Panels: When noted.
9. Standard Pushbutton Colors and Inscriptions:

Tag Function	Inscription(s)	Color
OO	ON OFF	Black Black
OC	OPEN CLOSE	Black Black

Tag Function	Inscription(s)	Color
OCA	OPEN CLOSE AUTO	Black Black Black
OOA	ON OFF AUTO	Black Black Black
MA	MANUAL AUTO	Black Black
SS	START STOP	Black Black
RESET	RESET	Black
EMERGENCY STOP	EMERGENCY STOP	Red

a. Lettering Color:
   1) Black on white and yellow buttons.
   2) White on black, red, and green buttons.

10. Standard Light Colors and Inscriptions:
    a. As shown on P&IDs. Lettering Color:
       1) Black on white and amber lenses.
       2) White on red and green lenses.

G. PIC Enclosure Internal Wiring:

1. Restrain by plastic ties or ducts or metal raceways.
2. Hinge Wiring: Secure at each end so bending or twisting will be around longitudinal axis of wire. Protect bend area with sleeve.
3. Arrange wiring neatly, cut to proper length, and remove surplus wire.
4. Provide abrasion protection for wire bundles that pass through holes or across edges of sheet metal.
5. Connections to Screw Type Terminals:
   a. Locking-fork-tongue or ring-tongue lugs.
   b. Use manufacturer's recommended tool with required sized anvil to make crimp lug terminations.
   c. Wires terminated in a crimp lug, maximum of one.
   d. Lugs installed on a screw terminal, maximum of two.
6. Connections to Compression Clamp Type Terminals:
   a. Strip, prepare, and install wires in accordance with terminal manufacturer's recommendations.

b. Wires installed in a compression screw and clamp, maximum of one for field wires entering enclosure, otherwise maximum of two.

7. Splicing and tapping of wires, allowed only at device terminals or terminal blocks.
8. Terminate 24V dc and analog signal circuits on separate terminal block from ac circuit terminal blocks.
9. Separate analog and dc circuits by at least 6 inches from ac power and control wiring, except at unavoidable crossover points and at device terminations.
10. Arrange wiring to allow access for testing, removal, and maintenance of circuits and components.
11. Plastic Wire Duct Fill: Do not exceed manufacturer's recommendations.
12. Conductors Carrying Foreign Voltages within a Panel:
    a. Route foreign voltage conductors into panel and land on a circuit blade disconnect type terminal block.
    b. Use wire with yellow insulation to identify foreign voltage circuits within panel from terminal block on. Do not use wires with yellow insulation for any other purpose.
13. Harness Wiring:
    a. 120V ac: 14 AWG, MTW.
    b. 24V dc: 16 AWG, MTW where individual conductors are used and Type TC shielded tray cable where shielded wire is used.
14. Panelwork:
    a. No exposed connections.
    b. Allow adjustments to equipment to be made without exposing these terminals.
    c. For power and control wiring operating above 80V ac or dc use covered channels or EMT raceways separate from low voltage signal circuits.
15. Plastic Wire Ducts Color:
    a. 120V ac: White.
    b. 24V dc: Gray.
    c. Communications Cables and Fiber Optic Jumpers: Orange.
16. Provide a communications plastic wire duct for communications cables and fiber optic cables between the communications devices in control panel and communications raceways. Design plastic wire duct design to take into account the minimum bending radius of the communications cable.
17. Make plastic wire ducts the same depth.
18. Provide a minimum of 1-1/2 inches between plastic wire ducts and terminal blocks.

H. Control Relay Arrangement: Install control relays associated with specific loops in same panel section as corresponding terminal blocks or side panels. Provide 20 percent space for future relays. Locate spare space in same sections as spare terminal blocks.

I. Factory Finishing:

1. Furnish materials and equipment with manufacturer's standard finish system in accordance with Section 09 90 00, Painting and Coating.
2. Use specific color if indicated. Otherwise use manufacturer's standard finish color, or light gray if manufacturer has no standard color.
3. Stainless Steel and Aluminum: Not painted.
4. Nonmetallic Panels: Not painted.
5. Steel Panels:
    a. Sand panel and remove mill scale, rust, grease, and oil.
    b. Fill imperfections and sand smooth.
    c. Paint panel interior and exterior with one coat of epoxy coating metal primer, two finish coats of two-component type epoxy enamel.
    d. Sand surfaces lightly between coats.
    e. Dry Film Thickness: 3 mils, minimum.
    f. Color: Manufacturer's standard.

2.12 CORROSION PROTECTION

A. Corrosion-Inhibiting Vapor Capsules:

1. Areas Where Required: Refer to Article Protection.
2. Manufacturers and Products:
    a. Northern Instruments; Model Zerust VC.
    b. Hoffmann Engineering; Model A-HCI.

2.13 SOURCE QUALITY CONTROL

A. General:

1. Engineer may actively participate in many of the tests.
2. Engineer reserves right to test or retest specified functions.
3. Engineer's decision will be final regarding acceptability and completeness of testing.
4. Procedures, Forms, and Checklists:
    a. Except for Unwitnessed Factory Test, conduct tests in accordance with, and documented on, Engineer accepted procedures, forms, and checklists.
    b. Describe each test item to be performed.

c. Have space after each test item description for sign off by appropriate party after satisfactory completion.

5. Required Test Documentation: Test procedures, forms, and checklists signed by Engineer and Contractor.
6. Conducting Tests:
   a. Provide special testing materials and equipment.
   b. Wherever possible, perform tests using actual process variables, equipment, and data.
   c. If not practical to test with real process variables, equipment, and data provide suitable means of simulation.
   d. Define simulation techniques in test procedures.
   e. Test Format: Cause and effect.
      1) Person conducting test initiates an input (cause).
      2) Specific test requirement is satisfied if correct result (effect), occurs.
   f. For PIC systems for which Engineer provides applications software, provide sufficient temporary software configuring to allow FDT and SSDT testing of these subsystems.

B. Unwitnessed Factory Test (UFT):

1. Scope: Inspect and test PIC to ensure it is operational, ready for FDT.
2. Location: PIC System Integrator’s facility.
3. Integrated Test:
   a. Interconnect and test PIC, except for primary elements and smaller panels.
   b. Exercise and test functions.
   c. Provide stand-alone testing of smaller panels.
   d. Simulate inputs and outputs for primary elements, final control elements, and panels excluded from test.

C. Factory Demonstration Tests (FDT):

1. Notify Engineer of test schedule 4 weeks prior to start of test.
2. Scope: Test entire PIC, with exception of primary elements, final control elements, and certain smaller panels, to demonstrate it is operational.
3. Location: PIC System Integrator’s facility.
4. Correctness of wiring from panel field terminals to PLC system input/output points and to panel components.
   a. Simulate each discrete signal at terminal strip.
   b. Simulate correctness of each analog signal using current source.
5. Operation of communications between PLCs and remote I/O and between PLCs and computers.

6. Loop-Specific Functions:
    a. Demonstrate functions shown on P&IDs, control diagrams, and loop specifications:
        1) One of each type function; for example, if there are filter backwash sequence control for several identical filters, demonstrate controls for one filter.
        2) One of each type of function in each panel; for example, but not limited to annunciator operation, controller operation, and recorder operation.
        3) All required and shown functions for 100 percent of loops.
7. Nonloop-Specific Functions:
    a. Capacity: Demonstrate that PIC systems have required spare capacity for expansion. Include tests for both storage capacity and processing capacity.
    b. Timing: Include tests for timing requirements.
    c. Diagnostics: Demonstrate online and offline diagnostic tests and procedures.
8. Correct deficiencies found and complete prior to shipment to Site.
9. Failed Tests:
    a. Repeat and witnessed by Engineer.
    b. With approval of Engineer, certain tests may be conducted by PIC System Integrator and witnessed by Engineer as part of Functional Test.
10. Make following documentation available to Engineer at test site both before and during FDT:
    a. Drawings, Specifications, Addenda, and Change Orders.
    b. Master copy of FDT procedures.
    c. List of equipment to be tested including make, model, and serial number.
    d. Approved hardware shop drawings for equipment being tested.
11. Daily Schedule for FDT:
    a. Begin each day with meeting to review day’s test schedule.
    b. End each day with each meeting to review day’s test results and to review or revise next day’s test schedule.

PART 3 EXECUTION

3.01 EXAMINATION

A. For equipment not provided by PIC System Integrator, but that directly interfaces with PIC, verify the following conditions:

1. Proper installation.
2. Calibration and adjustment of positioners and I/P transducers.

3. Correct control action.
4. Switch settings and dead bands.
5. Opening and closing speeds and travel stops.
6. Input and output signals.

3.02 INSTALLATION

A. Material and Equipment Installation: Follow manufacturers' installation instructions, unless otherwise indicated or directed by Engineer.

B. Wiring connected to PIC components and assemblies, including power wiring in accordance with requirements in Section 26 05 05, Conductors.

C. Electrical Raceways: As specified in Section 26 05 33, Raceway and Boxes.

D. Field Finishing: Refer to Section 09 90 00, Painting and Coating.

3.03 FIELD QUALITY CONTROL

A. General:

1. Coordinate PIC testing with Owner and affected Subcontractors.
2. Notify Engineer of Performance Test schedule 4 weeks prior to start of test.
3. Engineer may actively participate in tests.
4. Engineer reserves right to test or retest specified functions.
5. Engineer's decision will be final regarding acceptability and completeness of testing.

B. Onsite Supervision:

1. Require PIC System Integrator to observe PIC equipment installation to extent required in order to provide Certificates of Proper Installation.
2. Require PIC site representative to supervise and coordinate onsite PIC activities.
3. Require PIC site representative to be onsite while onsite work covered by this section and PIC subsystems is in progress.

C. Testing Sequence:

1. Provide Functional Tests and Performance Tests for facilities as required to support staged construction and startup of plant.
2. Refer to Article Work Sequencing/Contraints, under Section 01 31 13, Project Coordination, for a definition of Project milestones.

3. Refer to Section 01 91 14, Equipment Testing and Facility Startup, for overall testing requirements.
4. Completion: When tests (except Functional Test) have been completed and required test documentation has been accepted.

D. Testing:

1. Prior to Facility Startup and Performance Evaluation period for each facility, inspect, test, and document that associated PIC equipment is ready for operation. Divide Functional Test for each facility into two parts.
2. Functional Test Part 1 (FTP1): Performed by PIC System Integrator to test and document PIC, excluding Contractor provided applications software, is ready for operation. For PIC Subsystems for which Engineer provides applications software, provide sufficient temporary software configuring to allow testing of these subsystems.
    a. Loop/Component Inspections and Tests:
        1) These inspections and tests will be spot checked by Engineer.
        2) Check PIC for proper installation, calibration, and adjustment on loop-by-loop and component-by-component basis.
        3) Provide space on forms for signoff by PIC System Integrator.
        4) Use loop status report to organize and track inspection, adjustment, and calibration of each loop and include the following:
            a) Project name.
            b) Loop number.
            c) Tag number for each component.
            d) Checkoffs/Signoffs for Each Component:
                (1) Tag/identification.
                (2) Installation.
                (3) Termination wiring.
                (4) Termination tubing.
                (5) Calibration/adjustment.
            e) Checkoffs/Signoffs for the Loop:
                (1) Panel interface terminations.
                (2) I/O interface terminations with PLC.
            f) I/O Signals for PLC are Operational: Received/sent, processed, adjusted.
            g) Total loop operational.
            h) Space for comments.

5) Component calibration sheet for each active I&C component (except simple hand switches, lights, gauges, and similar items) and each PLC I/O module and include the following:
   a) Project name.
   b) Loop number.
   c) Component tag number or I/O module number.
   d) Component code number for I&C elements.
   e) Manufacturer for I&C elements.
   f) Model number/serial number for I&C elements.
   g) Summary of Functional Requirements; For Example:
      (1) Indicators and recorders, scale and chart ranges.
      (2) Transmitters/converters, input and output ranges.
      (3) Computing elements' function.
      (4) Controllers, action (direct/reverse) and control modes (P, I, D).
      (5) Switching elements, unit range, differential (fixed/adjustable), reset (auto/manual).
      (6) I/O Modules: Input or output.
   h) Calibrations, for example, but not limited to:
      (1) Analog Devices: Actual inputs and outputs at 0 percent, 10 percent, 50 percent, and 100 percent of span, rising and falling.
      (2) Discrete Devices: Actual trip points and reset points.
      (3) Controllers: Mode settings (P&ID).
      (4) I/O Modules: Actual inputs or outputs of 0 percent, 10 percent, 50 percent, and 100 percent of span, rising and falling.
      (5) Space for comments.

b. Maintain loop status reports, valve adjustment sheets, and component calibration sheets at Site, and make them available to Engineer at all times.

c. Contractor reviews loop status sheets and component calibration sheets and spot-check their entries periodically, and upon completion of Preparation for Testing. Correct deficiencies found.

d. FDT-Repeat:
   1) Repeat FDT onsite with installed PIC equipment and software.
   2) As listed in PIC subsections, certain portions of FDT may not require retesting.
   3) Use FDT test procedures as basis for this test.

4) In general, this test shall not require witnessing. However, portions of this test, as identified by Engineer during original FDT shall be witnessed.

e. Forms: See Loop Status Report, Instrument Calibration Sheet, and I&C Valve Adjustment Sheet referenced in Article Supplements.

3. Functional Test Part 2 (FTP2): Combined effort between Contractor, PIC System Integrator, and Engineer to confirm PIC, including applications software, is ready for operation.
   a. Prerequisite: Completion of Functional Test Part 1 (FTP1).
   b. Joint test with Engineer. Repeat of Contractor's application software tests, except using real field sensors and equipment. Plant interlocking and communications with PLC and OIT tested on loop-by-loop basis.
   c. Test procedures provided by Engineer based on Functional Test Part 1 (FTP1) and on application software tests.
   d. Completed when Functional Test has been conducted and Engineer has spot-checked associated test forms and checklists in field.
4. Functional Test:
   a. Scope: Confirm PIC, including applications software, is ready for operation.
   b. Refer to PIC subsections for additional requirements.
   c. Completed when Functional Test has been conducted and Engineer has spot-checked associated test forms and checklists in field.
5. Required Test Documentation: Test procedures, forms, and checklists. Signed by Engineer and Contractor except for Functional Test items signed only by Contractor.

E. Performance Test During and After Facility Startup:

1. Once a facility's Functional Test has been completed and that facility has been started up, perform a Performance Test on associated PIC equipment to demonstrate that it is operating as required by Contract Documents. Demonstrate each required function on a paragraph-by-paragraph, loop-by-loop, and site-by-site basis.
2. Loop-specific and nonloop-specific tests same as required for FDT except that entire installed PIC tested using actual process variables and functions demonstrated.
3. Perform local and manual tests for each loop before proceeding to remote and automatic modes.

4. Where possible, verify test results using visual confirmation of process equipment and actual process variable. Unless otherwise directed, exercise and observe devices supplied by others, as needed to verify correct signals to and from such devices and to confirm overall system functionality. Test verification by means of disconnecting wires or measuring signal levels is acceptable only where direct operation of plant equipment is not possible.
5. Make updated versions of documentation required for Performance Test available to Engineer at Site, both before and during tests.
6. Make O&M data available to Engineer at Site both before and during testing.
7. Follow daily schedule required for FDT.
8. Determination of Ready for Operation: When Functional Test has been completed.
9. Refer to examples of Supplement Performance Test procedures and forms in Article Supplements.

3.04 MANUFACTURER'S SERVICES

A. Manufacturer's Representative: As required by each PIC subsection.

B. Specialty Equipment: For certain components or systems provided under this section, but not manufactured by PIC System Integrator, provide services of qualified manufacturer's representative during installation, startup, demonstration testing, and training. Provide original equipment manufacturer's services for any components that PIC System Integrator does not have/provide qualified personnel to assist with installation, connection, termination, setup, calibration, testing, and startup. Provide Manufacturer's Representative when requested by Engineer.

C. See Section 01 43 33, Manufacturers' Field Services, and Section 01 91 14, Equipment Testing and Facility Startup.

3.05 TRAINING

A. General:

1. Provide an integrated training program for Owner's personnel.
2. Perform training to meet specific needs of Owner's personnel.
3. Include training sessions, classroom and field, for managers, engineers, operators, and maintenance personnel.
4. Provide instruction on two working shift(s) as needed to accommodate the Owner's personnel schedule.
5. Owner reserves the right to reuse videotapes of training sessions.

B. Operations and Maintenance Training:

1. General:
   a. Refer to specific requirements specified in PIC Subsections.
   b. Include review of O&M data and survey of spares, expendables, and test equipment.
   c. Use equipment similar to that provided.
   d. Unless otherwise specified in PIC subsections, provide training suitable for instrument technicians with at least a 2-year associate engineering or technical degree, or equivalent education and experience in electronics, instrumentation, or digital systems.
2. Operations Training: For Owner's operations personnel on operation of I&C components.
   a. Training Session Duration: 1 instructor day.
   b. Number of Training Sessions: One.
   c. Location: Project Site.
   d. Course Objective: Develop skills needed to use I&C components and functions to monitor and control the plant on a day-to-day basis.
   e. Content: Conduct training on loop-by-loop basis.
      1) Loop Functions: Understanding of loop functions, including interlocks for each loop.
      2) Loop Operation: For example, adjusting process variable setpoints, AUTO/MANUAL control transfer, AUTO and MANUAL control, annunciator acknowledgement and resetting.
      3) Interfaces with PIC subsystems.
3. Maintenance Training:
   a. Training Session Duration: 1 instructor days.
   b. Number of Training Sessions: One.
   c. Location: Project Site.
   d. Course Objective: Develop skills needed for routine maintenance of PIC.
   e. Content: Provide training for each type of component and function provided.
      1) Loop Functions: Understanding details of each loop and how they function.
      2) Component calibration.
      3) Adjustments: For example, controller tuning constants, current switch trip points, and similar items.
      4) Troubleshooting and diagnosis for equipment and software.
      5) Replacing lamps, chart paper, and fuses.
      6) I&C components removal and replacement.
      7) Periodic preventive maintenance.

3.06 CLEANING

A. Upon completion of Work, remove materials, scraps, and debris from interior and exterior of equipment.

3.07 PROTECTION

A. Use corrosion-inhibiting vapor capsules in enclosures to protect electrical, instrumentation, and control devices, including spare parts, from corrosion.

B. Periodically replace capsules based on capsule manufacturer's recommendations.

3.08 SUPPLEMENTS

A. Supplements listed below, follows "End of Section," are part of this Specification.

1. Instrument List.
2. PLC Input/Output List.
3. Control Panel Schedule.
4. Loop Specifications.
5. Preparation for Testing and Functional Test Forms:
    a. Loop Status Report: Each sheet shows status of instruments on a loop. Also, gives functional description for loop.
    b. Instrument Calibration Sheet: Shows details on each instrument (except simple hand switches, lights, and similar items).
    c. I&C Valve Adjustment Sheet: Shows details for installation, adjustment, and calibration of a given valve.
6. Performance Test Sheet: Describe Performance Test for a given loop.
    a. List requirements of the loop.
    b. Briefly describe test.
    c. Cite expected results.
    d. Provide space for checkoff by witness.

END OF SECTION

INSTRUMENT LIST

Tag No.	Comp Code	Component Title	Options	P&ID	Inst. Details
EPP-FE/FIT-P-1	F4	Flow Element and Transmitter, Electromagnetic	Meter Size: 30 inch Flow Range: 0 to 50 CFS Stream Fluid: Raw Water	030-N-0001	4091-211, 4091-383, 4091-384
EPP-FE/FIT-P-2	F4	Flow Element and Transmitter, Electromagnetic	Meter Size: 30 inch Flow Range: 0 to 50 CFS Stream Fluid: Raw Water	030-N-0002	4091-211,4091-383, 4091-384
EPP-LT-P-1 Note 1	L41	Level Element/Transmitter, Submersible, Water	Process Range: 0 to 50 feet Zero Reference: See Drawings Transducer Mounting: See Drawings	030-N-0001	SEE DWG 100-D-5001
EPP-LT-P-2 Note 1	L41	Level Element/Transmitter, Submersible, Water	Process Range: 0 to 50 feet Zero Reference: See Drawings Transducer Mounting: See Drawings	030-N-0002	SEE DWG 100-D-5001
EPP-LT-R-1 Note 1	L41	Level Element/Transmitter, Submersible, Water	Process Range: 0 to 50 feet Zero Reference: See Drawings Transducer Mounting: See Drawings	030-N-0001	4091-410
EPP-LT-SB-1	L42	Level Element/Transmitter, Non-Fouling Submersible, Water	Process Range: 0 to 6 feet Zero Reference: See Drawings Transducer Mounting: See Drawings	030-N-0003	4091-414
EPP-PE-WD-1	P6	Pressure Seal, Diaphragm	Pipe Connection: 1/2 inch Provide factory assembled with pressure gauge (PI-WD-1)	030-N-0001	4091-606
EPP-PI-WD-1	P4	Pressure Gauge	Range: 0 - 100 psig Process connection: 1/2 inch NPT	030-N-0001	4091-606
EPP-PE-WD-2	P6	Pressure Seal, Diaphragm	Pipe Connection: 1/2 inch Provide factory assembled with pressure gauge (PI-WD-2)	030-N-0001	4091-606
EPP-PI-WD-2	P4	Pressure Gauge	Range: 0 - 100 psig Process connection: 1/2 inch NPT	030-N-0001	4091-606
EPP-PT-P-1	L41	Pressure Transducer (level type)	Process Pipe Size: 30" Range: -5 to +5 psig Process Connection: 1/2 inch NPT	030-N-0001	4091-411
EPP-PT-P-2	L41	Pressure Transducer (level type)	Process Pipe Size: 30" Range: -5 to +5 psig Process Connection: 1/2 inch NPT	030-N-0002	4091-411

Tag No.	Comp Code	Component Title	Options	P&ID	Inst. Details
EPP-ZS-VAC-1	M43	Intrusion Switch	Contact Rating: 70 vac/50 watts dc Max Voltage: 150 vac/200 vdc Max switch current: 2.5 amps	030-N-0003	
EPP-TE-PT-P1		Terminal Enclosure		030-N-0001	
EPP-TE-PT-P2		Terminal Enclosure		030-N-0002	
EPP-TE-LT-SB1		Terminal Enclosure		030-N-0003	
EPP-PLC	Y100	Programmable Logic Controller System	Hardware: Tesco L3000 Software: Latest Version of ISaGraf Workbench	030-N-0001	
EPP-OIT	Y182	Operator Interface Terminal	Configurable operator controls, displays, alarm handling, and screen security	030-N-0001	
EPP-RADIO	Y101	Radio, Ethernet	Frequency Band: 902-928MHZ, GE MDS ORBIT ECR Series	030-N-0001	
EPP-ANTENNA	Y104	Yagi Antenna	Frequency Range: 890-960MHZ, GE MDS	030-N-0001	Pole mounted antenna is required. Contractor shall provide a 2-inch (minimum) diameter antenna support pole at location shown on DWG 800-E-2001. Height of Antenna: 8 ft. The support shall be anchored to concrete deck in accordance with Section 01 88 15, Anchorage and Bracing. The antenna shall be horizonal mounted on the top of its support pole and oriented to the East.
EPP-ESW	Y56	Industrial Ethernet Switch	Number of Ports: Eight 10/100Base TX RJ-45 Ports	030-N-0001	
EPP-JS-FCP-1	Y40	Uninterruptible Power Supply	Capacity: 1,400 VA, minimum	030-N-0001	

Tag No.	Comp Code	Component Title	Options	P&ID	Inst. Details
EPP-FCP		Elkhorn Pumping Plant Facility Control Panel	Name Plate: EPP-FCP Location:Beside of MCC panel on the platform, Outdoor Enclosure Size: 90 inch x 30 inch x 20 inch (HxWxD) NEMA Rating: 4X, IP 66 Material: Painted Steel Power: 120VAC, 60 Hz Front of Panel Components: (1) Operator Interface Terminal (OIT) (Y182) Real of Panel Components: (1) Circuit Breakers – Main and Branch (2) UPS (Y40) (3) 24V dc Power Supply, Qty 2 (4) PLC System (Y100) (5) Ethernet Switch (Y56) (6) Radio, Ethernet (Y101) (7) Data Cables: As Required (8) Control Relays: As Required (9) Misc. Panel Hardware: Drawing Pocket, Panel Light, Vent Fan with Filter Kit, Duplex Receptacle, Relays, Terminal Blocks, Wire, etc.	030-N-0001	
	Y103	Antenna Cable			Length: As Required

Note 1: Level element/Transmitter to be provided by Fish Screen manufacturer.

PLC INPUT AND OUTPUT LIST						
Instrument\Equip Tag No.	**PLC I/O Tag No.**	**Description**	**Range**	**Units or Active State**	**P&ID**	**Notes**
		Analog Inputs				
EPP-FE/FIT-P-1	EPP-FI-P1	Pump 1 Discharge Flow	0 to 50	cft	030-N-0001	
EPP-FE/FIT-P-2	EPP-FI-P2	Pump 2 Discharge Flow	0 to 50	cft	030-N-0002	
EPP-LT-P-1	EPP-LI-P1	Pump Can 1 Level	0 to 50	ft	030-N-0001	
EPP-LT-P-2	EPP-LI-P2	Pump Can 2 Level	0 to 50	ft	030-N-0002	
EPP-LT-R-1	EPP-LI-R1	River Level	0 to 50	ft	030-N-0001	
EPP-LT-SB-1	EPP-LI-SB1	Sedimentation Basin Level	0 to 6	ft	030-N-0003	
EPP-PT-P-1	EPP-PI-P1	Pump 1 Discharge Pressure	-5 to +5	psig	030-N-0001	
EPP-PT-P-2	EPP-PI-P2	Pump 2 Discharge Pressure	-5 to +5	psig	030-N-0002	
EPP-P-1	EPP-SI-P1	Irrigation Pump 1 Speed	0 to 100	%	030-N-0001	
EPP-P-2	EPP-SI-P2	Irrigation Pump 2 Speed	0 to 100	%	030-N-0002	
		Analog Outputs				
EPP-P-1	EPP-SC-P1	Irrigation Pump 1 Speed Command	0 to 100	%	030-N-0001	
EPP-P-1	EPP-SC-P1	Irrigation Pump 2 Speed Command	0 to 100	%	030-N-0001	
		Discrete Inputs				
EPP-FS-1	EPP-YS-FS1-A	Fish Screen 1 in Auto		Auto	030-N-0001	
EPP-FS-1	EPP-YA-FS1-A	Fish Screen 1 Emergency Stop		Stop	030-N-0001	
EPP-FS-1	EPP-YA-FS1-B	Fish Screen 1 Motor Fail		Fail	030-N-0001	
EPP-FS-1	EPP-JA-FS1	Fish Screen 1 Power Loss		Fail	030-N-0001	
EPP-FS-1	EPP-ZSO-G1	Fish Screen 1 Gate Opened		Opened	030-N-0001	
EPP-FS-1	EPP-ZSC-G1	Fish Screen 1 Gate Closed		Closed	030-N-0001	
EPP-FS-1	EPP-YS-FS-B	Fish Screen 1 Ready		Ready	030-N-0001	
EPP-FS-1	EPP-YS-FS-C	Fish Screen 1 Running		On	030-N-0001	
EPP-FS-1	EPP-YS-FS-D	Fish Screen 1 Forward		FWD	030-N-0001	
EPP-FS-1	EPP-YS-FS-E	Fish Screen 1 Reverse		REV	030-N-0001	
EPP-FS-1	EPP-YA-FS1-C	Fish Screen 1 Fault		Fail	030-N-0001	
EPP-FS-1	EPP-YA-FS1-D	Fish Screen 1 Up		Up Limit	030-N-0001	
EPP-P-WD	EPP-YL-WD	Washdown Pump Running		On	030-N-0001	
EPP-P-WD	EPP-YA-WD	Washdown Pump Fail		Fail	030-N-0001	

Instrument\Equip Tag No.	PLC I/O Tag No.	Description	Range	Units or Active State	P&ID	Notes
EPP-P-1	EPP-YS-P1	Irrigation Pump 1 in Remote		Remote	030-N-0001	
EPP-P-1	EPP-YL-P1	Irrigation Pump 1 Running		On	030-N-0001	
EPP-P-1	EPP-TAH-P1	Irrigation Pump 1 High Temperature		High Temp	030-N-0001	
EPP-P-1	EPP-YA-P1-B	Irrigation Pump 1 AFD Fail		Fail	030-N-0001	
EPP-P-1	EPP-YA-P1-A	Irrigation Pump 1 Emergency Stop		Stop	030-N-0001	
EPP-JS-FCP-1	EPP-JA-FCP	Control Panel UPS Power Failure		Fail	030-N-0001	
EPP-SCP	EPP-YS-SCP	Screen PLC "Heart Beat"		Heart Beat	030-N-0001	
EPP-FS-2	EPP-YS-FS2	Fish Screen 2 in Auto		Auto	030-N-0002	
EPP-FS-2	EPP-YA-FS2-A	Fish Screen 2 Emergency Stop		Stop	030-N-0002	
EPP-FS-2	EPP-YA-FS2-B	Fish Screen 2 Motor Fail		Fail	030-N-0002	
EPP-FS-2	EPP-JA-FS2	Fish Screen 2 Power Failure		Fail	030-N-0002	
EPP-FS-2	EPP-ZSO-G2	Fish Screen 2 Gate Opened		Opened	030-N-0002	
EPP-FS-2	EPP-ZSC-G2	Fish Screen 2 Gate Closed		Closed	030-N-0002	
EPP-FS-2	EPP-YS-FS-B	Fish Screen 2 Ready		Ready	030-N-0001	
EPP-FS-2	EPP-YS-FS-C	Fish Screen 2 Running		On	030-N-0001	
EPP-FS-2	EPP-YS-FS-D	Fish Screen 2 Forward		FWD	030-N-0001	
EPP-FS-2	EPP-YS-FS-E	Fish Screen 2 Reverse		REV	030-N-0001	
EPP-FS-2	EPP-YA-FS1-C	Fish Screen 2 Fault		Fail	030-N-0001	
EPP-FS-2	EPP-YA-FS1-D	Fish Screen 2 Up		Up Limit	030-N-0001	
EPP-P-2	EPP-YS-P2	Irrigation Pump 2 in Remote		Remote	030-N-0002	
EPP-P-2	EPP-YL-P2	Irrigation Pump 2 Running		On	030-N-0002	
EPP-P-2	EPP-TAH-P2	Irrigation Pump 2 High Temperature		High Temp	030-N-0002	
EPP-P-2	EPP-YA-P2-B	Irrigation Pump 2 AFD Fail		Fail	030-N-0002	
EPP-P-2	EPP-YA-P2-A	Irrigation Pump 2 Emergency Stop		Stop	030-N-0002	
EPP-VPCP	EPP-LAH-TNK	Vacuum Receiver High Level Alarm		High Level	030-N-0003	Future
EPP-VPCP	EPP-PAH-TNK	Vacuum Receiver High Pressure Alarm		High Press	030-N-0003	Future
EPP-VPCP	EPP-YL-VP1	Vacuum Pump 1 Running		Running	030-N-0003	Future
EPP-VPCP	EPP-YA-VP1	Vacuum Pump 1 Fail		Fail	030-N-0003	Future
EPP-VPCP	EPP-YL-VP2	Vacuum Pump 2 Running		Running	030-N-0003	Future
EPP-VPCP	EPP-YA-VP2	Vacuum Pump 2 Fail		Fail	030-N-0003	Future
EPP-VPCP	EPP-YA-VPS	Vacuum Priming System Common Alarm		Alarm	030-N-0003	Future
EPP-VPCP	EPP-YL-VPS	Vacuum Priming System Enable		Enable	030-N-0003	Future
EPP-FV-VP1-1	EPP-ZSO-VP1-1	Vacuum Flow Valve 1-1 Opened		Opened	030-N-0003	Future

Instrument\Equip Tag No.	PLC I/O Tag No.	Description	Range	Units or Active State	P&ID	Notes
EPP-FV-VP1-1	EPP-ZSC-VP1-1	Vacuum Flow Valve 1-1 Closed		Closed	030-N-0003	Future
EPP-FV-VP1-1	EPP-YS-VP1-1	Vacuum Flow Valve 1-1 Remote		Remote	030-N-0003	Future
EPP-FV-VP1-2	EPP-ZSO-VP1-2	Vacuum Flow Valve 1-2 Opened		Opened	030-N-0003	Future
EPP-FV-VP1-2	EPP-ZSC-VP1-2	Vacuum Flow Valve 1-2 Closed		Closed	030-N-0003	Future
EPP-FV-VP1-2	EPP-YS-VP1-2	Vacuum Flow Valve 1-2 Remote		Remote	030-N-0003	Future
EPP-FV-VP2-1	EPP-ZSO-VP2-1	Vacuum Flow Valve 2-1 Opened		Opened	030-N-0003	Future
EPP-FV-VP2-1	EPP-ZSC-VP2-1	Vacuum Flow Valve 2-1 Closed		Closed	030-N-0003	Future
EPP-FV-VP2-1	EPP-YS-VP2-1	Vacuum Flow Valve 2-1 Remote		Remote	030-N-0003	Future
EPP-FV-VP2-2	EPP-ZSO-VP2-2	Vacuum Flow Valve 2-2 Opened		Opened	030-N-0003	Future
EPP-FV-VP2-2	EPP-ZSC-VP2-2	Vacuum Flow Valve 2-2 Closed		Closed	030-N-0003	Future
EPP-FV-VP2-2	EPP-YS-VP2-2	Vacuum Flow Valve 2-2 Remote		Remote	030-N-0003	Future
EPP-ZS-VAC-1	EPP-YA-VAC-1	Vacuum Priming Enclosure Intrusion Alarm		Intrusion	030-N-0003	
EPP-LSH-1-1	EPP-LAH-1-1	Priming Valve 1-1 High Level		High Level	030-N-0003	Future
EPP-LSH-1-2	EPP-LAH-1-2	Priming Valve 1-2 High Level		High Level	030-N-0003	Future
EPP-LSH-2-1	EPP-LAH-2-1	Priming Valve 2-1 High Level		High Level	030-N-0003	Future
EPP-LSH-2-2	EPP-LAH-2-2	Priming Valve 2-1 High Level		High Level	030-N-0003	Future
		Discrete Outputs				
EPP-P-1	EPP-YC-P1	Irrigation Pump 1 Run Command		Run	030-N-0001	
EPP-P-2	EPP-YC-P2	Irrigation Pump 2 Run Command		Run	030-N-0002	
EPP-FS-1	EPP-YC-FS1-CLN	Fish Screen 1 Cleaning Command		Cleaning	030-N-0001	
EPP-FS-2	EPP-YC-FS2-CLN	Fish Screen 2 Cleaning Command		Cleaning	030-N-0002	
EPP-FV-VP1-1	EPP-ZCO-VP1-1	Vacuum Flow Valve 1-1 Open Command		Open	030-N-0003	Future
EPP-FV-VP1-1	EPP-ZCC-VP1-1	Vacuum Flow Valve 1-1 Close Command		Close	030-N-0003	Future
EPP-FV-VP1-2	EPP-ZCO-VP1-2	Vacuum Flow Valve 1-2 Open Command		Open	030-N-0003	Future
EPP-FV-VP1-2	EPP-ZCC-VP1-2	Vacuum Flow Valve 1-2 Close Command		Close	030-N-0003	Future
EPP-FV-VP2-1	EPP-ZCO-VP2-1	Vacuum Flow Valve 2-1 Open Command		Open	030-N-0003	Future
EPP-FV-VP2-1	EPP-ZCC-VP2-1	Vacuum Flow Valve 2-1 Close Command		Close	030-N-0003	Future
EPP-FV-VP2-2	EPP-ZCO-VP2-2	Vacuum Flow Valve 2-2 Open Command		Open	030-N-0003	Future
EPP-FV-VP2-2	EPP-ZCC-VP2-2	Vacuum Flow Valve 2-2 Close Command		Close	030-N-0003	Future

NOTE: PROVIDE EXTRA SPACE FOR THE FUTURE I/O MODULES AND TERMINAL BLOCKS TO BE INSTALLED IN THE PLC CONTROL PANEL BASED ON THE FUTURE I/O LISTED ABOVE.

CONTROL PANEL SCHEDULE

Panel No.	Service	Mounting	NEMA	Dimensions (in) H W D	FDT	Serv. Lights, Outlets	Environment	Comment
ERP-FCP	Plant Pumping Station	beside MCC	4X	90 x 30 x 20	Y	Two lights with door activated switches, one GFCI receptacle	Outside	Gasketed Single Door Provide Closed Loop Air Conditioner

Column Descriptions:
FDT: Factory demonstration test required. Witnessed by Engineer, Owner. Witnessed by Contractor optional.
Dimensions: Maximum space available for panel

LOOP SPECIFICATIONS

GENERAL

Provide Standard Functions in PLC and OIT for all loops plus loop specific functions as indicated below.

Provide control pop-ups for equipment control and operator setpoint entry displays.

Provide Guest, Operator, Supervisor, and Engineer/Administrator login levels.

- Guest level login can only navigate between screens for general viewing and cannot open any pop-up screens.
- Operator level login has access to pop-up screens, can manually control the plant and adjust designated setpoints.
- Supervisor level login has all privileges of an operator and can reset totalized values.
- Engineer/Administrator level login has full HMI development and PID parameter adjustment privileges.

Provide an alarm database that can be accessed by alarm dialer software for operator notification of activated alarms.

Coordinate with Fish Screen package vendor for passing I/O between their PLCs and the Plant PLCs. The Supplement 2 I/O list provides a minimum I/O count to be passed between Fish Screen PLCs and the Plant PLC using Produced and Consumed tags. Provide other signals as required and requested to ensure that all process equipment operates as designed.

Provide a communications heart-beat between Plant PLCs and package system PLCs. Alarm on loss of communications.

LOOP SPECIFICATIONS

A. Standard Analog Instrument Functions:

1. Functions:
   a. Monitor analog instrument value.
   b. Alarm on High and Low values.
   c. Alarm on Transducer failure, less than 3.8mA greater than 20.2mA.

2. PLC Functions:
    a. Receive and scale analog instrument value.
    b. Provide operator entered adjustable High and Low alarm and clear (reset) dead band setpoints.
    c. Provide operator entered adjustable Transducer alarm setpoints.
    d. Provide operator entered adjustable time delay to prevent nuisance alarm notification. 5 seconds minimum.
    e. Provide flow totalization with daily, weekly, monthly, yearly, and instantaneous flow totals for each plant flowmeter. Make each flow totalizer resettable from the HMI with Supervisor login.
    f. Provide a timer that will reset a disabled alarm after an operator adjustable time.
    g. Provide operator alarm disable.
3. OIT Displays:
    a. Display and log scaled analog instrument values.
    b. Display alarm status and alarm setpoint values.
    c. Provide operator entry to adjust alarm setpoint values.
    d. Provide trend display of analog instrument values.
    e. Provide operator control for alarm disable.
    f. Provide operator entry for adjustable alarm disable reset time.

B. Standard Discrete Alarm Functions:

1. Functions: Provide individual alarms and a common alarm for abnormal process conditions.
2. PLC Functions:
    a. Receive alarm inputs.
    b. Provide operator entered adjustable time delay to prevent nuisance alarm notification. 5 seconds minimum.
    c. Provide operator alarm disable.
    d. Provide a timer that will reset a disabled alarm after an operator adjustable time.
3. OIT Displays:
    a. Display, log, and annunciate alarms.
    b. Provide operator adjustable alarm and time delay setpoints.
    c. Provide operator control for alarm disable.
    d. Provide operator entry for adjustable alarm disable reset time.

C. Standard Discrete I/O Functions:

1. Functions: Provide I/O functions shown on P&IDs.
2. PLC Functions:
    a. Accumulate the runtime of each piece of equipment that has an ON or Running status at the PLC.

b. Accumulate the number of starts for each piece of equipment that has an ON or Running status at the PLC.
c. Provide monitoring and control of I/O functions shown on P&IDs.

3. OIT Displays:
   a. Display and log the accumulated runtime values.
   b. Provide reset of the accumulated runtime values to operators with a Supervisor level login.
   c. Display and log the accumulated start values.
   d. Provide reset of the accumulated start values to operators with a Supervisor level login.
   e. Display I/O functions shown on P&IDs.

D. Elkhorn Fish Screens (EPP-FS-1 and EPP-FS-2), P&ID: 030-N-0001 and 030-N-0002:

1. Function: Monitoring of fish screen operation and fault conditions.
2. EPP-PLC Function:
   a. Provide a clean cycle command to fish screen when the river and pump can differential level reaches to an operator adjustable differential level setpoint High.
   b. Monitor the following discrete signals, and alarms:
      1) Fish Screen 1 in Auto.
      2) Fish Screen 1 Emergency Stop.
      3) Fish Screen 1 Motor Fail.
      4) Fish Screen 1 Power Failure.
      5) Fish Screen 1 Forward.
      6) Fish Screen 1 Reverse.
      7) Fish Screen 1 fault.
      8) Fish Screen 1 Ready.
      9) Fish Screen 1 Running.
      10) Fish Screen 1 Up Limit.
      11) SCP-PLC “Heart Beat”.
      12) Fish Screen 1 Cleaning Command.
      13) Fish Screen 2 in Auto.
      14) Fish Screen 2 Emergency Stop.
      15) Fish Screen 2 Motor Fail.
      16) Fish Screen 2 Power Failure.
      17) Fish Screen 2 Forward.
      18) Fish Screen 2 Reverse.
      19) Fish Screen 2 fault.
      20) Fish Screen 2 Ready.
      21) Fish Screen 2 Running.
      22) Fish Screen 2 Up Limit.
      23) Fish Screen 2 Cleaning Command.

3. EPP-OIT Display:
    a. Fish Screen 1 in Auto.
    b. Fish Screen 1 Emergency Stop.
    c. Fish Screen 1 Motor Fail.
    d. Fish Screen 1 Power Failure.
    e. Fish Screen 1 Cleaning Duration Setpoint.
    f. Fish Screen 1 Forward.
    g. Fish Screen 1 Reverse.
    h. Fish Screen 1 fault.
    i. Fish Screen 1 Ready.
    j. Fish Screen 1 Running.
    k. Fish Screen 1 Up Limit.
    l. Fish Screen 2 in Auto.
    m. Fish Screen 2 Emergency Stop.
    n. Fish Screen 2 Motor Fail.
    o. Fish Screen 2 Power Failure.
    p. Fish Screen 2 Forward.
    q. Fish Screen 2 Reverse.
    r. Fish Screen 2 fault.
    s. Fish Screen 2 Ready.
    t. Fish Screen 2 Running.
    u. Fish Screen 2 Up Limit.
4. Fish Screen Cleaning Duration Setpoints:
    a. Operator adjustable Screen Cleaning Duration for Fish Screen 1.
    b. Operator adjustable Screen Cleaning Duration for Fish Screen 2.

E. Fish Screen Slide Gate (EPP-G-1 and EPP-G-2), P&ID: 030-N-0001 and 030-N-0002:

1. Function: Provide monitoring of fish screen gate position limit switches. Disable pump operation when the gate is not in the fully open position.
2. EPP-PLC Function: Monitoring gates opened/closed statuses for screens and pumps operation.
    a. Slide Gate 1 Opened.
    b. Slide Gate 1 Closed.
    c. Slide Gate 2 Opened.
    d. Slide Gate 2 Closed.
3. EPP-OIT Display:
    a. Slide Gate 1 Opened.
    b. Slide Gate 1 Closed.
    c. Slide Gate 2 Opened.
    d. Slide Gate 2 Closed.

F. Sacramento River Level (EPP-LT-R-1), P&ID:030-N-0003:

1. Function: Provide continuous river level measurement and log level for using in screen operation process.
2. EPP-PLC Function: Provide Standard Analog Instrument and Alarm Functions.
   a. River Level (LT-R-1).
3. EPP-OIT Display: River Level (LT-R-1).

G. Irrigation Pump Can Level (EPP-LT-P-1 and EPP-LT-P-2), P&ID: 030-N-0001 and 030-N-0002:

1. Function: Provide continuous pump can level measurement and log level for using in irrigation pump operation process. Provide pump can low level alarm and pump shutdown interlock. Reset shutdown interlock when operator presses the pump reset button on the OIT. Provide operator adjustable setpoints for low level alarm.
2. EPP-PLC Function: Provide Standard Analog Instrument and Alarm Functions.
   a. Pump Can 1 Level (LT-P1).
   b. Pump Can 2 Level (LT-P2).
3. EPP-OIT Display: Pump Can 1 Level (LT-P1) and Pump Can 2 Level (LT-P2).

H. The Elkhorn Pumping Plant Power Quality Monitoring, (EPP_JQI-PM-1), P&ID: 030-N-0001:

1. Functions:
   a. Provide monitoring of pumping plant power quality meter from EPP-PLC using MODBUS/TCP communications. Retrieve real time voltage, current, power, and power factor data from the power quality meter. Provide Voltage alarms and Power meter communications alarms from PLP-PLC. Trigger a High Voltage alarm when phase voltages A-B, B-C, or C-A exceed an operator adjustable setpoint for more than a present time. Trigger a Low Voltage alarm when phase voltages A-B, B-C, or C-A drop below an operator adjustable setpoint for more than a preset time. Trigger a Voltage Imbalance alarm when the absolute value of the difference between phase voltages A-B and B-C OR A-B and C-A OR B-C and C-A are greater than an operator adjustable setpoint for more than a preset time. Trigger a Power Meter Communications Fail alarm if communication with the power meter is interrupted for more than a preset time. Automatically clear alarms when alarm condition returns to normal.

b. Install and configure power quality meter software provided by the manufacturer to allow Owner to access power quality meter real time data, historical logs, and waveform captures. Coordinate with owner to select a computer in the operations room for installation of the power meter manufacturer's monitoring software. Configure power quality meter to perform the following functions:
   1) Log high voltage, low voltage, and voltage imbalance events.
   2) Provide transient waveform capture of high voltage, low voltage and voltage imbalance events.

2. EPP-PLC Function:
   a. Monitor the following signals via Modbus/TCP:
      1) Phase Voltage A-B (Vab).
      2) Phase Voltage B-C (Vbc).
      3) Phase Voltage C-A (Vca).
      4) Phase Current A (Ia).
      5) Phase Current B (Ib).
      6) Phase Current C (Ic).
      7) KVA Power (PKVA).
      8) Power Factor (PF).
   b. Generate the following alarms:
      1) High Voltage Alarm.
      2) Low Voltage Alarm.
      3) Voltage Imbalance Alarm.
      4) Power Meter Communications Alarm.
3. EPP-OIT Display:
   a. Phase Voltage A-B (Vab).
   b. Phase Voltage B-C (Vbc).
   c. Phase Voltage C-A (Vca).
   d. Phase Current A (Ia).
   e. Phase Current B (Ib).
   f. Phase Current C (Ic).
   g. KVA Power (PKVA).
   h. Power Factor (PF).
   i. High Voltage Alarm.
   j. Low Voltage Alarm.
   k. Voltage Imbalance Alarm.
   l. Power Meter Communications Alarm.

I. Washdown Pump (EPP-P-WD), P&ID: 030-N-0001:

1. Functions: Monitoring pump running status.
2. EPP-PLC Function: Monitoring the following discrete signals.
    a. Pump ON.
    b. Pump FAIL.
3. EPP-OIT Function and Display:
    a. Pump ON.
    b. Pump FAIL.

J. Elkhorn Pumping Plant Irrigation Pumps (EPP-P-1 and EPP-P-2), P&ID: 030-N-0001 and 030-N-0002:

1. Function: Control pump operation around a range of designated level in the Irrigation Canal.
2. EPP-PLC Function:
    a. In Remote Manual mode, the 2 irrigation pumps are controlled from its OIT. The pumps are manually started and stopped, each pump speed is manually controlled.
    b. In Remote Auto mode, the irrigation pumps are automatically started and stopped based on the designated sedimentation basin level setpoints. Each pump speed will be operated from its common PID controller that will modulate pump speed(s) to maintain a level band in the Sedimentation Basin.
    c. The pump will be stopped when river and pump can differential level is more than an operator adjustable differential level setpoint High High for each pump.
    d. Both pumps will be stopped in the event of both Screen Motors failure when the screens are not in the down limit position.
    e. Both pumps will be started if one screen or both have reached to the down limit position and the Sedimentation Basin level is below the operator adjustable setpoint.
3. EPP-OIT Function and Display:
    a. Provide Remote Auto/Manual control for Pump 1 and Pump 2.
    b. Provide operator pump Start/Stop control in Remote Manual mode for Pump 1 and Pump 2.
    c. Provide operator entry of pump Start and Stop level setpoints for Pump 1 and Pump 2.
    d. Provide operator entry of pump stop High High differential level between river level and pump can level for Pump 1 and Pump 2.
    e. Display pump statuses and alarms.
        1) Irrigation Pump 1 in Remote.
        2) Irrigation Pump 1 Running.
        3) Irrigation Pump 1 High Temperature.

4) Irrigation Pump 1 AFD Fail.
5) Irrigation Pump 1 Emergency Stop.
6) Irrigation Pump 1 Speed Command.
7) Irrigation Pump 1 Speed Indication.
8) Irrigation Pump 1 Run Command.
9) Irrigation Pump 2 in Remote.
10) Irrigation Pump 2 Running.
11) Irrigation Pump 2 High Temperature.
12) Irrigation Pump 2 AFD Fail.
13) Irrigation Pump 2 Emergency Stop.
14) Irrigation Pump 2 Speed Command.
15) Irrigation Pump 2 Speed Indication.
16) Irrigation Pump 2 Run Command.

K. Irrigation Pump Discharge Pressure (EPP-PT-P-1 and EPP-PT-P-2), P&ID: 030-N-0001 and 030-N-0002:

1. Functions: Provide pressure measurement of pump discharge.
2. EPP-PLC Function: Provide Standard Analog Instrument and Alarm Functions.
3. EPP-OIT Display: Display: Pump 1 Discharge Pressure (PT-P-1) and Pump 2 Discharge Pressure (PT-P-2).

L. Irrigation Pump Discharge Flow (EPP-FIT-P-1 and EPP-FIT-P-2), P&ID: 030-N-0001 and 030-N-0002:

1. Functions: Provide flow measurement of pump discharge.
2. EPP-PLC Function:
   a. Provide Standard Analog Instrument and Alarm Functions.
   b. Provide zero reading on flowmeter scaling block value when the pump is not running.
   c. EPP-OIT Display: Pump 1 Discharge Flow (FIT-P-1) and Pump 2 Discharge Flow (FIT-P-2).

M. Sedimentation Basin Level (EPP-LT-SB-1), P&ID: 030-N-0003:

1. Function: Monitor level in the sedimentation basin. Provide level control in the basin by providing sequence and flow setpoint values to the appropriate Elkhorn Pumping Plant.
2. EPP-PLC Function: Monitor the level in the Sedimentation Basin. Provide high and low basin level alarms with operator adjustable setpoints. Provide an operator adjustable pump start level setpoint to start the irrigation pumps. Provide an operator adjustable pump stop level setpoint to turn off the pumps. Provide a Proportional level

controller with an operator input level band. The level control band is used to generate a pump speed setpoint. The pump speed is modulated until the pumped flow in the range of 60 percent to 100 percent, the minimum flow rate at pump discharge is 10.4 CFS (4,664 gpm).

3. EPP-OIT Display:
   a. Basin Level (LI-SB-1).
   b. Basin High Level Alarm.
   c. Basin Low Level Alarm.
   d. EPP-Pumps Start Level Setpoint.
   e. EPP Pumps Stop Level Setpoint.
   f. All Alarms and Level Setpoints will be generated in EPP-PLC.

N. Future Vacuum Priming System, P&ID: 030-N-0003:

1. Function: Establish and maintain a primed condition in raw water discharge pipes by evacuating air from the pipe high points and automatically removing air that may tend to accumulate over time. The priming system shall be controlled by a vacuum priming PLC located in its control panel as provided by their respective process system integrator. In normal operation, the system shall automatically operate as programmed by the equipment manufacturer. The control panel with PLC and operator interface should be designed based on P&ID. Vacuum Priming Pumps are operated, when set to AUTO, vacuum pumps shall start and cycle automatically in a LEAD/LAG manner in response to rising pressure in the vacuum receiver.
2. EPP-PLC Function: Monitoring of vacuum priming system operation and fault conditions.
   a. Monitor the following discrete signals, and alarm:
      1) Vacuum Pump 1 Running.
      2) Vacuum Pump 1 Fail.
      3) Vacuum Pump 2 Running.
      4) Vacuum Pump 2 Fail.
      5) Vacuum receiver Level High Alarm.
      6) Vacuum receiver Pressure High Alarm.
      7) Vacuum priming enclosure door Intrusion Alarm.
      8) Flow Valve 1 to receiver in Remote.
      9) Flow Valve 1 to receiver Opened.
      10) Flow Valve 1 to receiver Closed.
      11) Flow Valve 2 to receiver in Remote.
      12) Flow Valve 2 to receiver Opened.
      13) Flow Valve 2 to receiver Closed.
      14) Flow Valve 1 to sedimentation basin in Remote.
      15) Flow Valve 1 to sedimentation basin Opened.
      16) Flow Valve 1 to sedimentation basin Closed.

17) Flow Valve 2 to sedimentation basin in Remote.
18) Flow Valve 2 to sedimentation basin Opened.
19) Flow Valve 2 to sedimentation basin Closed.
20) Flow Valve 1 to receiver Open command.
21) Flow Valve 1 to receiver Close command.
22) Flow Priming Valve 2 to receiver Open command.
23) Flow Valve 2 to receiver Close command.
24) Flow Valve 1 to sedimentation basin Open command.
25) Flow Valve 1 to sedimentation basin Close command.
26) Flow Valve 2 to sedimentation basin Open command.
27) Flow Valve 2 to sedimentation basin Close command.

3. EPP-OIT Display:
   a. Vacuum Pump 1 Running.
   b. Vacuum Pump 1 Fail.
   c. Vacuum Pump 2 Running.
   d. Vacuum Pump 2 Fail.
   e. Vacuum receiver Level High Alarm.
   f. Vacuum receiver Pressure High Alarm.
   g. Flow Valve 1 to receiver Opened.
   h. Flow Valve 1 to receiver Closed.
   i. Flow Valve 2 to receiver Opened.
   j. Flow Valve 2 to receiver Closed.
   k. Flow Valve 1 to sedimentation basin Opened.
   l. Flow Valve 1 to sedimentation basin Closed.
   m. Flow Valve 2 to sedimentation basin Opened.
   n. Flow Valve 2 to sedimentation basin Closed.

END OF SECTION

JACOBS **LOOP STATUS REPORT—EXAMPLE FORMAT** **Rev.06.05.92**

Project Name: *Newport News WTP*						Project No. *WDC23456.C1*	
FUNCTIONAL REQUIREMENTS:							
1. Measure, locally indicate, and transmit RAS flow to LP-10.							
2. At LP-10 indicate flow and provide flow control by modulation of FCV-10-2.							
3. Provide high RAS flow alarm on LP-10.							
COMPONENT STATUS (Check and initial each item when complete)							
Tag Number	**Delivered**	**Tag ID Checked**	**Installation**	**Termination Wiring**	**Termination Tubing**	**Calibration**	
FE/FIT-10-2	*Jan-12-90 DWM*	*Jan-12-90 DWM*	*Feb-7-90 DWM*	*Mar-5-90 DWM*	*N.A.*	*May-6-90 VDA*	
FIC-10-2	*Jan-12-90 DWM*	*Jan-12-90 DWM*	*Mar-5-90 DWM*	*Apr-4-90 DWM*		*May-4-90 VDA*	
FSH-10-2	*Jan-12-90 DWM*	*Jan-12-90 DWM*	*Mar-5-90 DWM*	*Apr-4-90 DWM*		*May-7-90 VDA*	
FAH-10-2	*Jan-12-90 DWM*	*Jan-12-90 DWM*	*Mar-5-90 DWM*	*Apr-4-90 DWM*		*May-7-90 VDA*	
FCV-10-2	*Mar-2-90 DWM*	*Mar-2-90 DWM*	*Apr-20-90 DWM*	*Apr-30-90 DWM*		*May-16-90 VDA*	
REMARKS: None.							
Loop Ready for Operation		By: *D.W. Munzer*		Date: *May-18-90*		Loop No.: *10-2*	

JACOBS **INSTRUMENT CALIBRATION SHEET—EXAMPLE—ANALYZER/TRANSMITTER** **Rev.06.05.92**

COMPONENT	MANUFACTURER		PROJECT
Code: *A7*	Name: *Leeds & Northrup*		Number: *WDC30715.B2*
Name: *pH Element & Analyzer/Transmitter*	Model: *12429-3-2-1-7*	Serial #: *11553322*	Name: *UOSA AWT PHASE 3*

FUNCTIONS

	RANGE	VALUE	UNITS	COMPUTING FUNCTIONS? N	CONTROL? N
Indicate? Y Record? N	Chart:			Describe:	Action? direct / reverse Modes? P / I / D
	Scale:	*1-14*	*pH units*		SWITCH? N Unit Range:
Transmit/ Convert? Y	Input:	*1-14*	*pH units*		Differential: fixed/adjustable
	Output:	*4-20*	*mA dc*		Reset? automatic / manual

ANALOG CALIBRATIONS							DISCRETE CALIBRATIONS					Note No.
REQUIRED			AS CALIBRATED				REQUIRED			AS CALIBRATED		
Input	Indicated	Output	Increasing Input		Decreasing Input		Number	Trip Point	Reset Pt.	Trip Point	Reset Pt.	
			Indicated	Output	Indicated	Output		(note rising or falling)		(note rising or falling)		
1.0	*1.0*	*4.0*	*1.0*	*4.0*	*1.0*	*3.9*	*1.*	*N.A.*		*N.A.*		
2.3	*2.3*	*5.6*	*2.2*	*5.5*	*2.3*	*5.6*	2.					*1.*
7.5	*7.5*	*12.0*	*7.5*	*11.9*	*7.5*	*12.0*	3.					
12.7	*12.7*	*18.4*	*12.7*	*18.3*	*12.6*	*18.3*	4.					
14.0	*14.0*	*20.0*	*14.0*	*20.0*	*14.0*	*20.0*	5.					
CONTROL MODE SETTINGS:			P: *N.A.*	I:	D:		6.					

#	NOTES:	Component Calibrated and Ready for Start-up
	1. Need to recheck low pH calibration solutions.	
		By: *J.D. Sewell*
		Date: *Jun-6-92*
		Tag No.: *AIT-12-6*[pH]

JACOBS **I&C VALVE ADJUSTMENT SHEET—EXAMPLE** Rev.06.05.92

PARTS	Project Name: *SFO SEWPCP*	Project Number: *SFO10145.G2*
Body	Type: *Vee-Ball*	Mfr: *Fisher Controls*
	Size: *4-inch*	Model: *1049763-2*
	Line Connection: *159 # ANSI Flanges*	Serial #: *1003220*
Operator	Type: *Pneumatic Diaphragm*	Mfr: *Fisher Controls*
	Action: *Linear – Modulated*	Model: *4060D*
	Travel: *3-inch*	Serial #: *2007330*
Positioner	Input Signal: *3-15 psi*	Mfr: *Fisher Controls*
	Action: *Direct - air to open*	Model: *20472T*
	Cam: *Equal percentage*	Serial #: *102010*
Pilot	Action:	Mfr:
Solenoid	Rating: *None*	Model: Serial #:
I/P	Input: *4-20 mA dc*	Mfr: *Taylor*
Converter	Output: *3-15 psi*	Model: *10-T-576-3*
	Action: *Direct*	Serial #: *1057-330*
Position	Settings: *Closed / Open 5 deg, rising*	Mfr: *National Switch*
Switch	Contacts: *Close / Close*	Model: *1049-67-3*
		Serial #: *156 &157*
Power	Type: *Pneumatic*	Air Set Mfr: *Air Products*
Supply	Potential: *40 psi*	Model: *3210D*
		Serial #: *1107063*

ADJUSTMENTS	Initial	Date	**VERIFICATION**	Initial	Date
Air Set	*JDS*	*Jun-06-92*	Valve Action	*JDS*	*Jun-03-92*
Positioner	*JDS*	*Jun-06-92*	Installation	*JDS*	*Jun-03-92*
Position Switches	*JDS*	*Jun-06-92*	Wire Connection	*JDS*	*Jun-04-92*
I/P Converter	*JDS*	*Jun-07-92*	Tube Connection	*JDS*	*Jun-04-92*
Actual Speed	*JDS*	*Jun-07-92*			

REMARKS: *Valve was initially installed backwards.*	**Valve Ready for Start-up**
Observed to be correctly installed May-25-92	By: *J.D. Sewell*
	Date: *Jun-07-92*
	Tag No.: *FCV-10-2-1*

JACOBS PERFORMANCE TEST SHEET - EXAMPLE Rev.06.05.92

Project Name: *SFO SEWPCP Plant Expansion*	Project No.: *SFO12345.C1*

Demonstration test(s): For each functional Requirement of the loop:
(a) List and number the requirement. (b) Briefly describe the demonstration test.
(c) Cite the results that will verify the required performance. (d) Provide space for signoff.

1. MEASURE EFFLUENT FLOW

1.a With no flow, water level over weir should be zero and

FIT indicator should read zero. *Jun-20-92 BDG*

2. FLOW INDICATION AND TRANSMISSION TO LP & CCS

With flow, water level and FIT indicator should be related by expression

*Q(MGD) = 429*H**(2/3) (H = height in inches of water over weir).*

Vary H and observe that following.

2.a Reading of FIT indicator. *Jun-6-92 BDG*

2.b Reading is transmitted to FI on LP-521-1 *Jun-6-92 BDG*

2.c Reading is transmitted and displayed to CCS. *Jun-6-92 BDG*

H(measured)	*0*	*5*	*10*	*15*
Q(computed)	*0*	*47.96*	*135.7*	*251.7*
Q(FIT indicator)	*0*	*48.1*	*137*	*253*
Q(LI on LP-521-1)	*0*	*48.2*	*138*	*254*
Q(display by CCS)	*0*	*48.1*	*136.2*	*252.4*

Forms/Sheets Verified	By	Date	**Loop Accepted By Owner**
Loop Status Report	*J.D. Sewell*	*May-18-92*	By: *J.D. Smith*
Instrument Calibration Sheet	*J.D. Sewell*	*May-18-92*	Date: *Jun-6-92*
I&C Valve Calibration Sheet	*N.A.*		
Performance Test	By	Date	
Performed	*J. Blow MPSDC Co.*	*Jun-6-92*	
Witnessed	*B. DeGlanville*	*Jun-6-92*	Loop No.: *30-12*

SECTION 40 91 00
INSTRUMENTATION AND CONTROL COMPONENTS

PART 1 GENERAL

1.01 SUMMARY

A. This section gives general requirements for instrumentation and control components.

PART 2 PRODUCTS

2.01 GENERAL

A. Article Mechanical Systems Components, covers requirements of mechanical PIC components that are not specifically referenced by Section 40 90 00, Instrumentation and Control for Process Systems, Supplement Instrument Lists.

B. Article Electrical Components, covers requirements for electrical PIC components that are not specifically referenced by Section 40 90 00, Instrumentation and Control for Process Systems, Supplement Instrument Lists.

C. All other Part 2 articles cover components that are referenced by Instrument Lists or Data Sheets in Section 40 90 00, Instrumentation and Control for Process Systems, or by specific component numbers in other PIC subsections.

2.02 MECHANICAL SYSTEMS COMPONENTS

A. Pressure Gauge: For other than process variable measurement.

1. Dial Size: Nominal 2-inch dial size.
2. Accuracy: 2 percent of span.
3. Scale Range: Such that normal operating pressure lies between 50 percent and 80 percent of scale range.
4. Connection: 1/4-inch NPT through bottom, unless otherwise noted.
5. Manufacturers and Products:
    a. Ashcroft Utility; Gauge Series 1000.
    b. Marsh; Standard Gauge Series.
    c. Ametek U.S.; Gauge Series P500.
    d. Acculite; Series 2000.

B. ON/OFF Valves:

1. Type: Ball valve.
2. Materials: Brass, stainless steel, PVC, or CPCV, as recommended by manufacturer for designated service, unless otherwise shown on Drawings.
3. Manufacturers and Products:
    a. Whitey; Series 41 through Series 43.
    b. Hoke; Flomite 7100 Series.

C. Valve, Three-Way:

1. Type: Ball valve.
2. Materials: Brass or stainless steel with nylon handle as recommended by manufacturer for designated service, unless otherwise shown on Drawings.
3. Manufacturers and Products:
    a. Whitey; Series 41 through Series 43.
    b. Hoke; Selecto-Mite Series.

D. Solenoid Valve, Two-Way:

1. Type: Globe valve directly actuated by solenoid and not requiring minimum pressure differential for operation.
2. Materials:
    a. Body: Brassed or stainless steel globe valves as recommended by manufacturer for designated service, unless otherwise shown on Drawings.
    b. Valve Seat: Buna-N.
3. Size: Normally closed or opened, as noted.
4. Coil: 115V ac, unless noted otherwise.
5. Solenoid Enclosure: NEMA 4.
6. Manufacturer and Product: ASCO; Red Hat Series 8260.

E. Pressure Regulator, Water:

1. Materials:
    a. Body: Bronze.
    b. Spring Case: Cast iron.
    c. Seat Rings: Brass.
    d. Valve Disk and Holder: Buna-N and bronze.
    e. Diaphragm: Buna-N diaphragm.
2. Sizing: For maximum of 7 psi offset pressure.

3. Manufacturers and Products:
    a. Fisher; Controls Type 95H or 95L.
    b. Masoneilan; Series 17.

F. Test Tap:

1. Manufacturers and Products:
    a. Imperial-Eastman; Quick-disconnect couplings No. 292-P and caps No. 259-P.
    b. Crawford Fitting Co.; Swagelok quick-connects Series QC4 and caps QC4-DC.
    c. Parker; CPI Series precision quick couplings.

G. Copper Tubing and Fittings:

1. Type K hard copper, ASTM B88, with commercially pure wrought copper solder joint fittings. Make joints with 95-5 wire solder, ASTM B32, Grade 95 TA. Do not use cored solder.
2. Alternatively, Type K, soft temper copper tubing, ASTM B88, with brass compression type fittings may be used where shown on Drawings.
3. Manufacturers:
    a. Parker-Hannifin.
    b. Swagelok tube fittings.

H. Plastic Tubing and Fittings:

1. Tubing:
    a. Polyethylene capable of withstanding 190 psig at 175 degrees F.
    b. Manufacturers and Products:
        1) Dekoron; Type P.
        2) Imperial Eastman; Poly-Flo black instrument tubing.
2. Fittings:
    a. Type: Brass compression.
    b. Manufacturers and Products:
        1) Imperial Eastman; Poly-Flo tube fittings.
        2) Dekoron; E-Z fittings.

I. Stainless Steel Tubing: ASTM A312/A312M, Type 316, 0.065-inch wall, seamless, soft annealed, as shown on Drawings.

J. Stainless Steel Fittings:

1. Compression Type:
    a. Materials: Type 316 stainless steel, ASTM A182/A182M forged bodies or ASTM A276 barstock bodies, flareless.

b. Manufacturers and Products:
   1) Parker Flodar; BA Series.
   2) Swagelok tube fittings.
   3) Parker CPI tube fittings; Parker A-LOK dual ferrule tube fittings.

2. Socket Weld Type:
   a. Materials: Type 316 stainless steel, ASTM A182/A182M forged bodies or ASTM A276 barstock bodies, 3,000 psi maximum working pressure, safety factor 4:1.
   b. Manufacturers:
      1) Cajon.
      2) Swagelok.
      3) Parker WELDLOK.

2.03 ELECTRICAL COMPONENTS

A. Terminal Blocks for Enclosures:

1. General:
   a. Connection Type: Screw compression clamp.
   b. Compression Clamp:
      1) Complies with DIN-VDE 0611.
      2) Hardened steel clamp with transversal grooves that penetrate wire strands providing a vibration-proof connection.
      3) Guides strands of wire into terminal.
   c. Screws: Hardened steel, captive, and self-locking.
   d. Current Bar: Copper or treated brass.
   e. Insulation:
      1) Thermoplastic rated for minus 55 degrees C to plus 110 degrees C.
      2) Two funneled shaped inputs to facilitate wire entry.
   f. Mounting:
      1) Standard DIN rail.
      2) Terminal block can be extracted from an assembly without displacing adjacent blocks.
      3) End Stops: Minimum of one at each end of rail.
   g. Wire Preparation: Stripping only permitted.
   h. Jumpers: Allow jumper installation without loss of space on terminal or rail.
   i. Marking System:
      1) Terminal number shown on both sides of terminal block.
      2) Allow use of preprinted and field marked tags.
      3) Terminal strip numbers shown on end stops.

4) Mark terminal block and terminal strip numbers as shown on panel control diagrams and loop diagrams.
5) Fuse Marking for Fused Terminal Blocks: Fuse voltage and amperage rating shown on top of terminal block.

2. Terminal Block, General Purpose:
   a. Rated Voltage: 600V ac.
   b. Rated Current: 30 amperes.
   c. Wire Size: 24 AWG to 10 AWG.
   d. Rated Wire Size: 10 AWG.
   e. Color: Gray body.
   f. Spacing: 0.25-inch, maximum.
   g. Test Sockets: One screw test socket 0.079-inch diameter.
3. Terminal Block, Ground:
   a. Wire Size: 24 AWG to 10 AWG.
   b. Rated Wire Size: 10 AWG.
   c. Color: Green and yellow body.
   d. Spacing: 0.25-inch, maximum.
   e. Grounding: Electrically grounded to mounting rail.
4. Terminal Block, Blade Disconnect Switch:
   a. Rated Voltage: 600V ac.
   b. Rated Current: 10 amperes.
   c. Wire Size: 22 AWG to 10 AWG.
   d. Rated Wire Size: 10 AWG.
   e. Color: Gray body, orange switch.
   f. Spacing: 0.25-inch, maximum.
5. Terminal Block Diode:
   a. Rated Voltage: 24V dc.
   b. Rated Current: 30 ma.
   c. Wire Size: 16 AWG.
6. Terminal Block, Fused, 24V dc:
   a. Rated Voltage: 600V dc.
   b. Rated Current: 25 amperes.
   c. Wire Size: 22 AWG to 10 AWG.
   d. Rated Wire Size: 10 AWG.
   e. Color: Gray body.
   f. Fuse: 0.25 inch by 1.25 inches.
   g. Indication: LED diode 24V dc.
   h. Spacing: 0.512-inch, maximum.
7. Terminal Block, Fused, 120V ac:
   a. Rated Voltage: 600V ac.
   b. Rated Current: 25 amperes.
   c. Wire Size: 22 AWG to 10 AWG.
   d. Rated Wire Size: 10 AWG.
   e. Color: Gray body.

f. Fuse: 0.25 inch by 1.25 inches.
g. Indication: Neon lamp, 110V ac.
h. Leakage Current: 1.8 mA, maximum.
i. Spacing: 0.512-inch, maximum.

8. Terminal Block, Fused, 120V ac, High Current:
   a. Rated Voltage: 600V ac.
   b. Rated Current: 35 amperes.
   c. Wire Size: 18 AWG to 8 AWG.
   d. Rated Wire Size: 8 AWG.
   e. Color: Gray.
   f. Fuse: 13/32 inch by 1-1/2 inches.
   g. Spacing: 0.95-inch, maximum.
9. Manufacturers and Products:
   a. Entrelec; Type MB10/24.SF.
   b. TE Connectivity.
   c. Phoenix Contact.
   d. Weidmuller.
   e. Eaton.
   f. “Or-equal.”

B. Grounding: Internal copper grounding bus for ground connections on panels, consoles, racks, and cabinets.

C. Relays:

1. General:
   a. Relay Mounting: Plug-in type socket.
   b. Relay Enclosure: Furnish dust cover.
   c. Socket Type: Screw terminal interface with wiring.
   d. Socket Mounting: Rail.
   e. Provide holddown clips.
2. Signal Switching Relay:
   a. Type: Dry circuit.
   b. Contact Arrangement: 2 Form C contacts.
   c. Contact Rating: 5 amperes at 28V dc or 120V ac.
   d. Contact Material: Gold or silver.
   e. Coil Voltage: As noted or shown.
   f. Coil Power: 0.9 watt (dc), 1.2VA (ac).
   g. Expected Mechanical Life: 10,000,000 operations.
   h. Expected Electrical Life at Rated Load: 100,000 operations.
   i. Indication Type: Neon or LED indicator lamp.
   j. Seal Type: Hermetically sealed case.

3. Control Circuit Switching Relay, Nonlatching:
    a. Type: Compact general purpose plug-in.
    b. Contact Arrangement: 3 Form C contacts.
    c. Contact Rating: 10A at 28V dc or 120V ac, and 6.6A at 240V ac.
    d. Contact Material: Silver cadmium oxide alloy.
    e. Coil Voltage: As noted or shown.
    f. Coil Power: 1.8 watts (dc), 2.7VA (ac).
    g. Expected Mechanical Life: 10,000,000 operations.
    h. Expected Electrical Life at Rated Load: 100,000 operations.
    i. Indication Type: Neon or LED indicator lamp.
    j. Push-to-test button.
4. Control Circuit Switching Relay, Latching:
    a. Type: Dual coil mechanical latching relay.
    b. Contact Arrangement: 2 Form C contacts.
    c. Contact Rating: 10A at 28V dc or 120V ac.
    d. Contact Material: Silver cadmium oxide alloy.
    e. Coil Power: 2.7 watts (dc), 5.3VA (ac).
    f. Expected Mechanical Life: 500,000 operations.
    g. Expected Electrical Life at Rated Load: 50,000 operations.
5. Control Circuit Switching Relay, Time Delay:
    a. Type: Adjustable time delay relay.
    b. Contact Arrangement: 2 Form C contacts.
    c. Contact Rating: 10A at 30V dc or 277V ac.
    d. Contact Material: Silver cadmium oxide alloy.
    e. Operating Temperature: Minus 10 degrees C to 55 degrees C.
    f. Repeatability: Plus or minus 2 percent.
    g. Delay Time Range: Select range such that time delay setpoint fall between 20 percent to 80 percent of range.
    h. Adjustment Type: Integral potentiometer with knob external to dust cover.
6. Manufacturers:
    a. Idec.
    b. TE Connectivity.
    c. “Or-equal.”

D. Surge Suppressors:

1. General:
    a. Construction: First-stage, high-energy metal oxide varistor and second-stage, bipolar silicon avalanche device separated by series impedance; includes grounding wire, stud, or terminal.
    b. Response: 5 nanoseconds maximum.

c. Recovery: Automatic.
d. Temperature Range: Minus 20 degrees C to plus 85 degrees C.
e. Enclosure Mounted: Encapsulated inflame retardant epoxy.

2. Suppressors on 120V ac Power Supply Connections:
   a. Occurrences: Tested and rated for a minimum of 50 occurrences of IEEE C62.41 Category B test waveform.
   b. First-Stage Clamping Voltage: 350 volts or less.
   c. Second-Stage Clamping Voltage: 210 volts or less.
   d. Power Supplies for Continuous Operation:
      1) Four-Wire Transmitter or Receiver: Minimum 5 amperes at 130V ac.
      2) All Other Applications: Minimum 30 amperes at 130V ac.
3. Suppressors on Analog Signal Lines:
   a. Test Waveform: Linear 8-microsecond rise in current from 0 amperes to a peak current value followed by an exponential decay of current reaching one-half the peak value in 20 microseconds.
   b. Surge Rating: Tested and rated for 50 occurrences of 2,000-ampere peak test waveform.
      1) DC Clamping Voltage: 20 percent to 40 percent above operating voltage for circuit.
      2) DC Clamping Voltage Tolerance: Plus or minus 10 percent.
      3) Maximum Loop Resistance: 18 ohms per conductor.
4. Manufacturers and Products:
   a. Analog Signals Lines:
      1) Emerson Edco; PC-642 or SRA-64 series.
      2) “Or-equal.”
   b. 120V ac Lines:
      1) Emerson Edco; HSP-121.
      2) “Or-equal.”
   c. Field Mounted at Two-Wire Instruments:
      1) Encapsulated in stainless steel pipe nipples.
         a) Emerson Edco; SS64 series.
         b) “Or-equal”.
   d. Field Mounted at Four-Wire Instruments: With 120V ac outlet, ac circuit breaker, and 10-ohm resistors on signal lines, all in enclosure.
      1) Enclosure:
         a) NEMA 4X with door.
         b) Maximum Size: 12 inches by 12 inches by 8 inches deep.
      2) Emerson Edco; SLAC series.
      3) “Or-equal”.

E. Power Supplies:

1. Furnish as required to power instruments requiring external dc power, including two-wire transmitters and dc relays. Provide dual power supplies with diode auctioneered outputs.
2. Convert 120V ac, 60-Hz power to dc power of appropriate voltage(s) with sufficient voltage regulation and ripple control to assure that instruments being supplied can operate within their required tolerances.
3. Provide output over voltage and over current protective devices to:
   a. Protect instruments from damage due to power supply failure.
   b. Protect power supply from damage due to external failure.
4. Enclosures: NEMA 1.
5. Mount such that dissipated heat does not adversely affect other components.
6. Fuses: For each dc supply line to each individual two-wire transmitter.
   a. Type: Indicating.
   b. Mount so fuses can be easily seen and replaced.

2.04 I&C COMPONENTS

A. F4 Flow Element and Transmitter, Electromagnetic:

1. General:
   a. Function: Measure, indicate, and transmit the flow of a conductive process liquid in a full pipe.
   b. Type:
      1) Electromagnetic flowmeter, with operation based on Faraday’s Law, utilizing the pulsed dc type coil excitation principle with high impedance electrodes.
      2) Full bore meter with magnetic field traversing entire flow-tube cross section.
      3) Unacceptable are insert megameters or multiple single point probes inserted into a spool piece.
   c. Straight Pipe Requirement: 0 x DN upstream and 0 x DN downstream.
   d. Parts: Flow element, transmitter, interconnecting cables, and mounting hardware. Other parts as noted.
2. Service:
   a. Stream Fluid:
      1) As noted.
      2) Suitable for liquids with a minimum conductivity of 5 microS/cm and for demineralized water with a minimum conductivity of 20 microS/cm.
   b. Flow Stream Description: Raw municipal sewage.

3. Operating Temperature:
   a. Element:
      1) Ambient: Minus 5 degrees F to 140 degrees F, typical, unless otherwise noted.
      2) Process: Minus 5 degrees F to 140 degrees F, typical, unless otherwise noted.
   b. Transmitter:
      1) Ambient: Minus 5 degrees F to 140 degrees F, typical, unless otherwise noted.
      2) Storage: 15 degrees F to 120 degrees F, typical, unless otherwise noted.
4. Performance:
   a. Flow Range: As noted.
   b. High Accuracy: Plus or minus 0.25 percent (or better) of rate for all flows resulting from pipe velocities of 3 to 30 feet per second. Plus or minus 0.50 percent (or better) of rate for all flows resulting from pipe velocities of 1 to 3 feet per second.
   c. Turndown Ratio: Minimum of 10 to 1 when flow velocity at minimum flow is at least 1 foot per second.
5. Features:
   a. Zero stability feature to eliminate the need to stop flow to check zero alignment.
   b. No obstructions to flow.
   c. Very low pressure loss.
   d. Measures bi-directional flow.
6. Process Connection:
   a. Meter Size (diameter inches): As noted.
   b. Connection Type: 150-pound ANSI raised-face flanges; AWWA C207, Table 2 Class D; or wafer style depending on meter size, unless otherwise noted.
   c. Flange Material: Carbon steel, unless otherwise noted.
7. Power (Transmitter): 120V ac, 60 Hz, unless otherwise noted.
8. Element:
   a. Meter Tube Material: Type 304 or 316 stainless steel, unless otherwise noted.
   b. Liner Material:
      1) Hard rubber, unless otherwise noted.
      2) For potable water service, must have appropriate approvals.
   c. Liner Protectors: Covers (or grounding rings) on each end to protect liner during shipment.
   d. Electrode Type: Flush or bullet nose as recommended by the manufacturer for the noted stream fluid.
   e. Electrode Material: Type 316 stainless steel or Hastelloy C, unless otherwise noted.

f. Grounding Ring:
   1) Required, unless otherwise noted.
   2) Quantity: Two, unless otherwise noted.
   3) Material: Type 316 stainless steel, unless otherwise noted.
g. Enclosure: 6P, unless otherwise noted.
h. Submergence:
   1) Temporary: If noted.
   2) Continuous (up to 10 feet depth), NEMA 6P/IP68.
i. Direct Buried (3 feet to 10 feet): If noted.

9. Transmitter:
   a. Mounting: Remote mounted.
   b. Display: Required, unless otherwise noted.
      1) Digital LCD display, indicating flow rate and total.
      2) Bi-directional Flow Display: Required, unless otherwise noted.
         a) Forward and reverse flow rate.
         b) Forward, reverse and net totalization.
   c. Parameter Adjustments: By keypad or non-intrusive means.
   d. Enclosure: NEMA 4X, minimum, unless otherwise noted.
   e. Empty Pipe Detection:
      1) Drives display and outputs to zero when empty pipe detected.

10. Signal Interface (at Transmitter):
   a. Analog Outputs:
      1) If available, two separately configurable analog outputs corresponding to forward and reverse flow.
      2) Isolated 4 mA to 20 mA dc for load impedance from 0 ohm to at least 500 ohms minimum, for 24V dc supply.
      3) Supports Superimposed Digital HART protocol: If noted.
   b. Discrete Outputs: If noted.
      1) Two discrete outputs, typical, rated for up to 30 volts, typical.
      2) Programmable as noted for the following typical parameters:
         a) Totalizer pulse, high/low flow rates, percent of range, empty pipe zero, fault conditions, forward/reverse flow, etc.
   c. Discrete Input: If noted.
      1) Contact closure, configured as noted for the following typical parameters: reset totalizer, change range, hold output constant, drive output to zero, and low flow cutoff, etc.
   d. Other: As noted.

11. Cables:
    a. Types: As recommended by manufacturer.
    b. Lengths: As required to accommodate device locations.
12. Built-in Diagnostic System:
    a. Features:
        1) Field programmable electronics.
        2) Self-diagnostics with troubleshooting codes.
        3) Ability to program electronics with full scale flow, engineering units, meter size, zero flow cutoff, desired signal damping, totalizer unit digit value, etc.
        4) Initial flow tube calibration and subsequent calibration checks.
13. Factory Calibration:
    a. Calibrated in an ISO 9001 and NIST certified factory.
    b. Factory flow calibration system must be certified by volume or weight certified calibration devices.
    c. Factory flow calibration system shall be able to maintain calibration flow rate for at least 5 minutes for repeatability point checks.
    d. Flow Test Points: Five, submit results to Engineer for approval.
14. Factory Ready for Future In situ Verifications: If noted.
    a. Original meter parameter values available from vendor by request.
15. Accessories:
    a. In situ Verification System: If noted.
        1) Quantity: One complete system provided for the Project.
        2) Verifies quantitatively that the meter and signal converter's present condition is the same as originally manufactured.
        3) Physical access to the flow-tube required.
        4) Meet standards established by the National Testing Laboratory.
        5) Tests and stores over 50-meter parameters related to primary coils, electrodes, interconnecting cable and signal converter.
        6) Verification standard shall be plus or minus 1 percent of wet calibration for meters produced using the calibration verification service, or plus or minus 2 percent for standard meters.
        7) Windows-based software.
    b. Primary Simulation System: If noted.
        1) Quantity: One complete system provided for the Project.
        2) Verifies proper operation of the signal converter by simulating the flow meter's output signal.
            a) Generates pulsed dc excitation signal with a reference voltage of 70 mV.

b) Generated signal ranges from 0 percent to 99 percent (0 feet to 32.8 feet per second) with a resolution of 0.1 percent.
c) Switch selectable for forward, reverse and zero flow rate.

3) Verifies various input and output signals.

16. Manufacturers and Products:
    a. Endress+Hauser; Proline Promag W400.
    b. "Or-equal."

B. L41 Level Element/Transmitter, Submersible, Water:

1. General:
    a. Function: Measure and transmit a signal proportional to pressure or level.
    b. Type: Totally submersible, two-wire transmitter.
    c. Parts: Transmitter, sensor termination enclosure, interconnecting cable and vent filter.
2. Service:
    a. Fluid: River water.
3. Performance:
    a. Range: As noted.
    b. Accuracy: 0.1 percent of full scale.
    c. Sensitivity: Plus or minus 0.5 percent of reading.
    d. Temperature, Operating: Minus 5 degrees F to plus 140 degrees F.
4. Features:
    a. Dimensions: 1-inch diameter by 5 inches long.
    b. Materials: Titanium body.
    c. Process Connection: 1/2-inch NPT conduit connection required for instruments shown with blind flange installation.
    d. Vent Filter: Prevents moisture from entering the vent tube, manufacturer standard product.
5. Signal Interface: 4 mA to 20 mA dc output for load impedance of 0 ohms to 750 ohms minimum for 24V dc supply without load adjustment.
6. Cable: Length as required to measure river, intake, or canal level, as applicable.
7. Sensor Termination Enclosure:
    a. Dimensions: 8 inches wide, 6 inches tall, 4 inches deep.
    b. Materials: Type 304 stainless steel.
    c. Construction: NEMA 4X with back panel and pressure compensation device mounted at the bottom of enclosure.
    d. Terminal Type: DIN rail mounted terminals for cable shield instrument cable connections, minimum three terminal blocks.

e. Enclosure Manufacturer: Hoffman A8064NFSS with APCDSS6 pressure compensator.

8. Manufacturers and Products:
   a. Pressure System Inc. KPSI; Series 720.
   b. "Or-equal."

C. L42 Level Element/Transmitter; Non-Fouling Submersible:

1. General:
   a. Function: Measure and transmit signal proportional to level.
   b. Type:
      1) Totally submersible pressure sensor (loop powered).
      2) Suitable for sedimentation basin water.
   c. Parts: Transmitter, sensor termination enclosure, interconnecting cable, and vent filter.
2. Service:
   a. Fluid: Sedimentation basin water.
3. Performance:
   a. Process Range:
      1) As noted.
      2) Provide fixed factory range such that noted process range is between 40 percent and 80 percent of fixed factory range.
   b. Accuracy: 0.25 percent of full scale.
   c. Temperature, Operating: Minus 4 degrees F to plus 140 degrees F.
   d. Overpressure:
      1) Proof: At least 1.5 times full scale.
      2) Burst: At least 2.0 times full scale.
4. Features:
   a. Sensor:
      1) Silicon pressure-sensing element.
      2) External Diaphragm: Flush type, coated with fluoro-polymer.
      3) Titanium or Type 316 stainless steel pressure module assembly, unless otherwise noted.
         a) For Titanium Sensors Only: 5-year corrosion warranty, replace sensor if it fails due to corrosion: If noted.
      4) NEMA 6/IP 68 rating (submersible).
      5) Temperature compensation.
      6) Dimensions, Nominal:
         a) Diameter: 1.2 inches.
         b) Length: 5 inches.
      7) Loop powered, 9 to 30V dc.

b. Interconnecting Cable:
   1) Length: As required.
   2) Polyurethane sheathed, unless otherwise noted.
   3) Kevlar strain relief cord.
   4) Integral vent tube.
c. Sensor Termination Enclosure, TJB: Required, unless otherwise noted.
   1) Enclosure:
      a) Dimensions: 8 inches wide, 6 inches tall, 4 inches deep.
      b) Materials: Type 304 stainless steel.
      c) Construction: NEMA 4X with back panel and pressure compensation device mounted at the bottom of enclosure.
      d) Terminal Type: DIN rail mounted terminals for cable shield instrument cable connections, minimum three terminal blocks.
      e) Enclosure Manufacturer: Hoffman A8064NFSS with APCDSS6 pressure compensator.
d. Vent Filter: Prevents moisture from entering the vent tube, manufacturer standard product.
   1) Houses aneroid bellows.
e. Accessories:
   1) Aneroid Bellows: Required.
      a) Bellows shall be suitable for application.
   2) Cable Hanger, Kellems Type Grip: Required.
   3) Lightning Protection:
      a) Internal (protects against water lightning strike): If noted.
      b) External (protects 4 mA to 20 mA dc output): Required, unless otherwise noted.
   4) Anchor Assembly: If noted.
      a) Marine anchor, clamps, Type 316 stainless steel cable or chain, length as required, nominally 3 feet longer than interconnecting cable.

5. Signal Interface: 4 mA to 20 mA dc output, for load impedance of 0 ohm to 750 ohms, minimum for 24V dc supply without load adjustment.
6. Manufacturers and Products (provided that they can furnish the noted options):
   a. Measurement Specialties; KPSI Series 750 with model 815 Aneroid Bellows.
   b. “Or-equal.”

D. P4 Pressure Gauge:

1. General:
   a. Function: Local pressure indication.
   b. Type: Bourdon tube element.
2. Performance:
   a. Scale Range: As noted.
   b. Accuracy: Plus or minus 0.50 percent of full scale.
3. Features:
   a. Dial: 4-1/2 inch diameter.
   b. Pointer Vibration Reduction: Required. Use the following method.
      1) Liquid filled gauge front.
         a) Glycerin fill.
   c. Case Material: Black thermoplastic.
   d. Materials of Wetted Parts (including element, socket/process connection, throttling device (if specified) and secondary components): Stainless steel.
   e. Pointer: Adjustable by removing ring and window.
   f. Window: Glass or acrylic.
   g. Threaded reinforced polypropylene front ring.
   h. Case Type: Solid front with blow-out back.
4. Process Connection:
   a. Mounting: Lower stem.
   b. Size: 1/2-inch MNPT.
5. Accessories:
   a. Throttling Device: Required.
      1) Type suitable for the intended service.
      2) Install in gauge socket bore.
6. Manufacturers and Products:
   a. Ashcroft; Duragauge Model 1259/Model, 1279/Model, 1279 PLUS!.
   b. Ametek U.S. Gauge; Solfrunt Model 19XX/1981Advantage.
   c. WIKA; Type 2XX.3.

E. P6 Pressure Seal, Diaphragm:

1. General:
   a. Function: Isolate sensing element from process fluid.
   b. Type:
      1) Diaphragm.
      2) Fluid filled between diaphragm and sensing element.
2. Service:
   a. Pressure: Same as associated sensor.
   b. Temperature Range: If noted.

3. Performance:
    a. Pressure:
        1) For threaded process connections, at least 2,500 psig at 100 degrees F.
        2) Fill Fluid:
            a) Glycerin: Suitable only for pressure (not for vacuum applications), unless otherwise noted.
            b) Silicone: Suitable for pressure and vacuum applications.
            c) Halocarbon: Suitable for pressure and vacuum applications in presence of strong oxidizing agent.
    b. Temperature:
        1) Dependent upon fill fluid.
            a) Glycerin (food grade): 0 degrees F to 400 degrees F.
            b) Silicone: Minus 40 degrees F to plus 600 degrees F.
            c) Silicone (food grade): 0 degrees F to 375 degrees F.
            d) Halocarbon: Minus 70 degrees F to 300 degrees F.
4. Features:
    a. Materials:
        1) Lower Housing: Type 316 stainless steel, unless otherwise noted.
        2) Diaphragm Material: Type 316 stainless steel, unless otherwise noted.
        3) Top Housing: Steel.
    b. Diaphragm: Welded to upper housing.
    c. Filling screw in upper housing.
    d. Fill Fluid:
        1) Glycerin.
        2) “Or-equal.”
        3) Factory assembled and filled.
    e. Flushing Connection: 1/4-inch NPT in lower housing.
    f. Diaphragm Seal Displacement: 0.1-cubic inch, nominal.
5. Connections:
    a. Instrument: 1/2-inch female NPT, unless otherwise noted.
    b. Process: 1/2-inch female NPT, unless otherwise noted.
6. Manufacturers and Products:
    a. Ashcroft; Type 201.
    b. Ametek; Mansfield and Green Division; Type SG.
    c. WIKA; Type L990.10.

F. M43 Intrusion Switch:

1. General
   a. Function: Monitor intrusion of entry points such as doors, overhead doors, pullboxes and headholes.
   b. Parts: Magnet, switch and cabling.
2. Features:
   a. Type: Large magnet, surface-mount suitable for door, unless otherwise noted.
   b. Cable: Armored, 36 inches long.
      Magnet and Switch Dimensions: Each, 2.6 inches long by 0.875 inches wide by 0.600 inches thick, nominal inches.
   c. Housing: Weather-resistant aluminum.
   d. Two holes on switch and magnet for fasteners.
3. Signal Interface:
   a. Contact Rating: 70VA ac/50 watts dc.
   b. Maximum Voltage: 150V ac/200V dc.
   c. Maximum Switching Current: 0.7-ampere ac/1.0-ampere dc.
   d. Maximum Carry Current: 2.5 amperes.
4. Manufacturers and Products:
   a. George Risk Industries; Model 4402A.
   b. “Or-equal.”

G. Y40 Uninterruptible Power Supply System (UPS):

1. UPS provided shall meet the following requirements:
   a. Input Voltage: 96 to 138V ac, 60 Hz.
   b. Output Voltage: 120V ac, 60 Hz.
   c. Output Connections: Model dependent; minimum of six total.
   d. Alarms: Visual (LCD display) and audible alarms.
   e. Regulation: Plus or minus 3 percent.
   f. Safety: UL listed.
   g. Efficiency: 85 percent, minimum.
   h. Temperature, Operating: 0 degrees C to 40 degrees C.
   i. Relative Humidity, Operating: 5 percent to 95 percent, noncondensing.
   j. Outlet Receptacles: Four, minimum.
   k. Receptacle Type: NEMA 5-15R.
   l. Runtime: 21 minutes at full load, minimum, with extended runtime option.
   m. Capacity: 1,400VA, minimum.
   n. Manufacturers and Products:
      1) Eaton Powerware, Ferrups FE Series 60 Hz.
      2) American Power Conversion.

H. Y56 Industrial Ethernet Switch:

1. General:
   a. Function: Connect Ethernet compatible components in the facility control panel.
   b. Type: Fully managed.
   c. Parts: Switch with built-in copper Ethernet ports.
2. Service:
   a. Temperature: Minus 40 degrees C to 85 degrees C.
   b. Humidity: 10 percent to 95 percent, noncondensing.
3. Performance:
   a. IEEE Compliance: Full 802.3.
   b. EMI Emissions and Safety: FCC Part 15A, UL 1604, Class 1, Division 2, Groups A, B, C, D, T4A.
4. Features:
   a. Number of Ports: Eight 10/100Base TX copper.
   b. Full-Duplex Operation: Automatically switches from half-duplex to full-duplex when full-duplex capable devices are sensed on ports.
   c. SNMP and Web Brower management.
   d. Mounting: DIN rail.
5. Power: 10V to 30V dc.
6. Manufacturers and Products:
   a. NTRON; 700 Series.
   b. “Or-equal.”

I. Y100 Programmable Logic Controller System:

1. General: Design PLC system including hardware and software configuration as necessary to meet requirements in Section 40 90 00, Instrumentation and Control for Process Systems, Supplement Loop Specifications, and Supplement PLC Input/Output List.
2. Hardware: PLC shall be TESCO L3000, no substitutions permitted. Hardware components shall include:
   a. Power Supply, L3000-PSU.
   b. L2000/L3000 terminal board HDIO - TB, 579.1.
   c. L2000 HDIO terminal boards, L300-HDIOCB-48”.
   d. L3000 Card Rack, L3000-L5E.
   e. L3000 Processor, L3000-CPU.
   f. L2000/L3000 HDIO Card, analog input/output, digital input/output cards, L300-HDIO.
3. Hardware Spares: Provide 20 percent of Input/Output counts shown in Section 40 90 00, Instrumentation and Control for Process Systems, Supplement 2, PLC Input and Output List.

4. Software: PLC Programming shall be performed using the latest version of ISaGraf workbench compatible with TESCO L3000 PLC.
5. Identification:
    a. Nameplates installed above/below each PLC component (CPU, I/O rack, power supply, etc.).
    b. Identify on I/O modules and terminal blocks the specific I/O points as they have been configured (addressed) in the system, as approved by the Engineer.

J. Y101 Radio, Ethernet:

1. General:
    a. Function: Transmit and receive Ethernet network data communication between distant sites using wireless radio channels. High Performance Unlicensed 900 MHz.
    b. Type: Spread-spectrum, unlicensed, frequency-hopping radio (FHSS + DTS).
2. Service:
    a. Temperature: Minus 30 degrees C to plus 60 degrees C.
    b. Humidity: 95 percent at 40 degrees C, noncondensing.
3. Performance:
    a. Frequency Band: 902 to 928Mhz.
    b. Data Port Rates (Speed): 125 Kbps, 250 Kbps, 1 Mbps, 1.25 Mbps.
    c. Transmitter Power Output: 0.01 watt to 1.0 watt (10 to 30 dBm).
    d. Transmitter Duty Cycle: Continuous.
    e. Range: Up to 30 miles.
    f. Transmitter Output Impedance: 50 ohms.
    g. Occupied Bandwidth: 600KHz.
4. Features:
    a. Frequency Hopping Range: Software selectable.
    b. Operation: Configurable as a stand-alone repeater.
    c. Operating Power: 10.5V to 30V dc, with power connector.
    d. Diagnostics: Each radio enabled for diagnostics, including received signal strength; input voltage; internal temperature; signal-to-noise ratio; radio status; and data quality level in each frequency zone.
    e. Alarm and Status Indicators: External LED indicators for Power, Carrier Detect, Link Status, Receive, and Transmit.
    f. Configuration and Diagnostic Software (two copies, minimum, for use by Owner and Engineer): Manufacturer’s standard software packages for radio network diagnostics and individual radio configuration.
    g. Agency Approvals: FCC Part 15, UL IC.

5. Signal Interface:
    a. Data Port 1: Ethernet, 10BaseT, RJ-45.
    b. Programming Port 2: Serial COM 1, RS-232/V.24, DB-9F, DCE.
    c. Data Port 3: Serial COM 2, RS-232/V.24, DB-9M, DTE.
    d. Antenna Ports: One.
    e. Antenna Surge Protector: PolyPhaser IS-50NX-C2.
6. Manufacturers and Products:
    a. GE/MDS; Orbit ECR.
    b. "Or-equal."

K. Y103 Antenna Cable:

1. General:
    a. Function: Connect radio to antenna.
    b. Type: Coaxial cable.
    c. Size:
        1) 1/2-Inch Cable: Use on runs of 50 feet or less.
        2) 7/8-Inch Cable: Use on runs over 50 feet.
2. Service:
    a. Operating Temperature: Minus 40 degrees C to plus 85 degrees C.
    b. Wind Survival Rating: 120 mph, minimum.
    c. Environment: Indoors and outdoors, suitable for wet locations and direct sunlight exposure.
3. Performance:
    a. Impedance: 50 ohms.
    b. Attenuation:
        1) At 900 MHz and 25 degrees C:
            a) 1/2-Inch: 2.50 dB per 100 feet, maximum.
            b) 7/8-Inch: 1.27 dB per 100 feet, maximum.
    c. Minimum Bending Radius:
        1) 1/2-Inch: 5 inches.
        2) 7/8-Inch: 10 inches.
    d. Average Power Rating:
        1) At 900 MHz and 40 degrees C:
            a) 1/2-Inch: 0.93 kW, minimum.
            b) 7/8-Inch: 2.1 kW, minimum.
    e. Relative Propagation Velocity: 87 percent, minimum.
    f. Capacitance: 23.4 pF per foot, maximum.
4. Features:
    a. Dielectric: Closed cell polyethylene foam.
    b. Jacket: Black UV-protected polyethylene.
    c. Shielding: Greater than 90 dB.

5. Accessories:
    a. Hangers: Manufacturer's standard, spaced in accordance with manufacturer's guidelines.
    b. Connectors: Type as required for mating to antenna and radio.
6. Manufacturers and Products:
    a. Andrew Heliax, LDF4-50A (1/2-inch) and LDF5-50A (7/8-inch).
    b. Times Microwave Systems, LMR-600 (1/2-inch) and LMR-900 (7/8-inch).

L. Y104 Yagi Antenna:

1. General:
    a. Function: Transmit and receive radio signals to/from master radio.
    b. Type: Bluewave Yagi antenna.
2. Service:
    a. Wind Rating: 125 mph.
3. Performance:
    a. Frequency Range: 900 MHz (890 to 960 MHz).
    b. Gain: 12 dB.
    c. Cable Length: 2 feet.
    d. Polarization: Horizontal/Vertical.
    e. Connector End: N Female, one connection.
    f. Mounting: Pole mount.
4. Features:
    a. Dimensions: 24 inches high, 6.8 inches wide.
    b. Weight: 2 pounds.
    c. Materials 10dbd powder coated solid aluminum elements and fully welded dipole on the stainless steel boom.
5. Signal Interface: Type N-Female connector.
6. Manufacturers and Products:
    a. PCTel; BGYD890K.
    b. "Or-equal."

M. Y182 Operator Interface Terminal (OIT):

1. Type: Operator interface terminal suitable for panel mounting.
2. Display: Color, active matrix thin film transistor, flat-panel, touch screen, with antiglare overlay.
3. Graphics: Pixel color graphic displays.
4. Features: Configurable operator controls, displays, alarm handling, and screen security.
5. Backlight: Provide one spare field-replaceable backlight.
6. Clock: Real-time, battery-backed.
7. Memory Card: 10 MB PC Flash, minimum.

8. Power: 24V dc.
9. Data Communications Port: Ethernet, compatible with Component Y100.
10. Data Cable for Connection to PLC: 6 feet.
11. Programming Cable: 10 feet.
12. Manufacturer and Product: C-MORE; EA7 T10C.

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 40 99 90
PACKAGE CONTROL SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. This Specification provides general panel design and construction requirements for the Screen Control Panel (EPP-SCP) specified in Section 35 79 19, Mechanically Cleaned Wedgewire Fish Screens.

1.02 SYSTEM DESCRIPTION

A. Assemble panels and install instruments, plumbing, and wiring in equipment manufacturer's factories.

B. Test panels and panel assemblies for proper operation prior to shipment from equipment manufacturer's factory.

1.03 SUBMITTALS

A. Action Submittals:

1. Bill of material, catalog information, descriptive literature, wiring diagrams, and Shop Drawings for components of control system.
2. Catalog information on electrical devices furnished with system.
3. Shop Drawings, catalog material, and dimensional layout drawings for control panels and enclosures.
4. Panel elementary diagrams of prewired panels. Include in diagrams control devices and auxiliary devices, for example, relays, alarms, fuses, lights, fans, and heaters.
5. Plumbing diagrams of preplumbed panels and interconnecting plumbing diagrams.
6. Interconnection wiring diagrams that include numbered terminal designations showing external interfaces.
7. Seismic anchorage and bracing data sheets and drawings as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

1. Seismic anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.

2. Programmable Controller Submittals:
   a. Complete set of user manuals.
   b. Fully documented ladder logic listings.
   c. Function listing for function blocks not fully documented by ladder logic listings.
   d. Cross-reference listing.
3. Manufacturer's list of proposed spares, expendables, and test equipment.
4. Manufacturer's Certificate of Proper Installation, in accordance with Section 01 43 33, Manufacturers' Field Services.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Prior to shipment, include corrosive-inhibitive vapor capsules in shipping containers and related equipment as recommended by capsule manufacturer.

1.05 EXTRA MATERIALS

A. Spares, Expendables, and Test Equipment:

1. Selector Switch, Pushbutton, and Indicating Light: 20 percent, one minimum, of each type used.
2. Light Bulb: 100 percent, 2 minimum, of each type used.
3. Fuse: 100 percent, 5 minimum, of each type used.
4. Surge Suppressors: 20 percent, one minimum, of each type used.

PART 2 PRODUCTS

2.01 GENERAL

A. Package controls provided under this section are required to interface with the plantwide control system defined on Drawings, and in Section 40 90 00, Instrumentation and Control for Process Systems.

2.02 SIGNAL CHARACTERISTICS

A. Analog Signals:

1. 4 mA to 20 mA dc, in accordance with compatibility requirements of ISA S50.1.
2. Unless otherwise specified or shown, use Type 2, two-wire circuits.
3. Transmitters: Load resistance capability conforming to Class L.
4. Fully isolate input and output signals of transmitters and receivers.

B. Discrete Signals:

1. Two-state logic signals.
2. Utilize 120V ac sources for control and alarm signals.
3. Alarm signals shall be normally open, close to alarm isolated contacts rated for 5-ampere at 120V ac and 2-ampere at 30V dc.

2.03 CORROSION PROTECTION

A. Corrosion-Inhibiting Vapor Capsule Manufacturers and Products:

1. Northern Instruments; Model Zerust VC.
2. Hoffmann Engineering; Model A-HCI.

2.04 CONTROL PANEL

A. Panel Construction and Interior Wiring: In accordance with the National Electrical Code (NEC), UL 508, state and local codes, and applicable sections of NEMA, ANSI, and ICECA.

B. Conform to NEMA ratings as specified in individual equipment sections.

C. Minimum Metal Thickness: 14 gauge.

D. NEMA 250, Type 4X Panels: Type 316 stainless steel construction unless otherwise specified.

E. Doors:

1. Three-point latching mechanisms with clamps in accordance with NEMA 250 Type 1 and 12 and 4X with doors higher than 18 inches.
2. Provide padlockable handle or hasps.

F. Cutouts shall be cut, punched, or drilled and finished smoothly with rounded edges.

G. Access: Front, suitable for installation with back and sides adjacent to or in contact with other surfaces, unless otherwise specified.

H. Temperature Control:

1. For non-air-conditioned compartments, size panels to adequately dissipate heat generated by equipment mounted on or in the panel.
2. Furnish cooling fans with air filters if required to dissipate heat.
3. Furnish thermostatically controlled heaters to maintain temperature above 40 degrees F.

4. Provide air conditioning unit for compartment with microprocessor based equipment and uninterruptable power supplies.

I. Push-to-Test Circuitry: For each push-to-test indicating light, provide a fused push-to-test circuit.

J. Lighting: Minimum of one hand switch controlled internal 100-watt incandescent light for panels 12 cubic feet and larger.

K. Minimum of one 120-volt GFCI duplex receptacle for panels 12 cubic feet and larger.

L. Finish:

1. Metallic External Surfaces (Excluding Aluminum and Stainless Steel): Manufacturer's standard gray unless otherwise specified.
2. Internal Surfaces: White enamel.

M. Panel Manufacturers:

1. Hoffman.
2. H.F. Cox.
3. "Or-equal."

N. Breather and Drains: Furnish with NEMA 250, Type 4 and 4X panels.

1. Manufacturer and Products: Cooper Crouse-Hinds; ECD Type 4X Drain and Breather; Drain Model ECD1-N4D, Breather Model ECD1-N4B.

2.05 CONTROL PANEL ELECTRICAL

A. UL Listing Mark for Enclosures: Mark stating "Listed Enclosed Industrial Control Panel" per UL 508A.

B. I&C and electrical components, terminals, wires, and enclosures UL recognized or UL listed.

C. Control Panels with Three-Phase Power Supplies and Motor Starters:

1. Interlock man circuit breaker with panel door.
   a. Mount logic controls, branch circuit breaker, overload reset switches, and other control circuit devices.
   b. Mount operator controls and indications on dead front panel.

2. Circuit Breaker:
    a. In accordance with NEMA AB 1.
    b. Breaker, except Motor Branch Breaker: Molded case thermal magnetic.
    c. Minimum 22,000-ampere RMS symmetrical interrupting rating at 480 volts, unless otherwise specified in equipment specification sections.
    d. Tripping: Indicate with operator handle position.
3. Magnetic Motor Starter:
    a. Full voltage, NEMA ICS 2, Class A, Size O minimum.
    b. Include three-pole bimetallic or eutectic alloy thermal overload relays sized for each motor.
    c. Manual reset type with reset button mounted on dead front panel.
4. Motor Control: 120V ac (except intrinsically safe circuits where applicable).
    a. Power Control Transformer:
        1) Sufficient capacity to serve connected load, including 200VA for duplex outlet plus 100va (minimum)
        2) Limit voltage variation to 15 percent during contact pickup.
        3) Fuse one side of secondary winding and ground the other.
        4) Furnish primary winding fuses in ungrounded conductors.
5. Power Monitoring Relay:
    a. Protect three-phase equipment from single phasing, phase imbalance, or phase reversal.
    b. Separate, isolated contact outputs to stop motors and activate alarm light during abnormal conditions.
    c. Transient Voltage Protection: 10,000 volts.
    d. Manufacturer and Product: Furnas; Class 47.
6. Power Distribution Blocks: Furnish to parallel feed tap on branch circuit protective devices. Do not “leap frog” power conductors.
7. Terminations for Power Conductors: Suitable for use with 75 degrees C wire full NEPA 70, 75 degree C ampacity.

D. Wiring:

1. AC Circuits:
    a. Type: 600-volt, Type MTW stranded copper.
    b. Size: For current to be carried, but not less than 14 AWG.
2. Analog Signal Circuits:
    a. Type: 300-volt, Type 2 stranded copper, twisted shielded pairs.
    b. Size: 18 AWG, minimum.
3. Other dc Circuits.
    a. Type: 600-volt, Type MTW stranded copper.
    b. Size: 18 AWG, minimum.

4. Separate analog and other dc circuits by at least 6 inches from ac power and control wiring, except at unavoidable crossover points and at device terminations.
5. Enclose wiring in sheet metal raceways or plastic wiring ducts.
6. Wire Identification: Numbered and tagged at each termination.
    a. Wire Tags: Machine printed, heat shrink.
    b. Manufacturers:
        1) Brady PermaSleeve.
        2) Tyco Electronics.

E. Wiring Interface:

1. For analog and discrete signal, terminate at numbered terminal blocks.
2. For special signals, terminate power (240 volts or greater) at manufacturer's standard connectors.
3. For panel, terminate at equipment on/with which it is mounted.

F. Terminal Blocks:

1. Quantity:
    a. For external connections.
    b. Wire spare or unused panel mounted elements to their panels' terminal blocks.
    c. Spare Terminals: 20 percent of connected terminals, but not less than 10.
2. General: Group to keep 120V ac circuits separate from 24V dc circuits.
    a. Connection Type: Screw connection clamp.
    b. Compression Clamp:
        1) Hardened steel clamp with transversal grooves penetrating wire strands providing a vibration-proof connection.
        2) Guides strands of wire into terminal.
    c. Screws: Hardened steel, captive, and self-locking.
    d. Current Bar: Copper or treated brass.
    e. Insulation:
        1) Thermoplastic rated for minus 55 degrees C to plus 110 degrees C.
        2) Two funnel shaped inputs to facilitate wire entry.
    f. Mounting:
        1) Rail.
        2) Terminal block can be extracted from an assembly without displacing adjacent blocks.
        3) End Stops: One at each end of rail, minimum.
    g. Wire Preparation: Stripping only.

h. Jumpers: Allow jumper installation without loss of space on terminal or rail.
i. Marking System:
1) Terminal number shown on both sides of terminal block.
2) Allow use of preprinted and field marked tags.
3) Terminal strip numbers shown on end stops.
4) Mark terminal block and terminal strip numbers as shown.

3. Terminal Block, 120-Volt Power:
a. Rated Voltage: 600V ac.
b. Rated Current: 30 ampere.
c. Wire Size: 22 through 10 AWG.
d. Rated Wire Size: 10 AWG.
e. Color: Gray body.
f. Spacing: 0.25-inch, maximum.
g. Manufacturer and Product: Entrelec; Type M4/6.

4. Terminal Block, Ground:
a. Wire Size: 22 through 12 AWG.
b. Rated Wire Size: 12 AWG.
c. Color: Green and yellow body.
d. Spacing: 0.25-inch, maximum.
e. Grounding: Ground terminal blocks electrically grounded to the mounting rail.
f. Manufacturer and Product: Entrelec; Type M4/6.P.

5. Terminal Block, Blade Disconnect Switch:
a. Use: Provide one for each discrete input and output field interface wire.
b. Rated Voltage: 600V ac.
c. Rated Current: 10 ampere.
d. Wire Size: 22 through 12 AWG.
e. Rated Wire Size: 12 AWG.
f. Color: Gray body, orange switch.
g. Spacing: 0.25-inch, maximum.
h. Manufacturer and Product: Entrelec; Type M4/6.SN.

6. Terminal Block, Fused, 24V dc:
a. Rated Voltage: 600V dc.
b. Rated Current: 6.3 ampere.
c. Wire Size: 22 through 12 AWG.
d. Rated Wire Size: 12 AWG.
e. Color: Gray body.
f. Fuse: 5 by 20 GMA fuses.
g. Fuse Marking: Fuse amperage rating shown on top of terminal block.
h. Indication: LED diode 24V dc.
i. Leakage Current: 5.2 mA, maximum.

j. Spacing: 0.32-inch, maximum.
k. Manufacturer and Product: Entrelec; Type M4/6.SFD.

7. Terminal Block, Fused, 120V ac:
   a. Rated Voltage: 600V ac.
   b. Rated Current: 6.3 ampere.
   c. Wire Size: 22 through 12 AWG.
   d. Rated Wire Size: 12 AWG.
   e. Color: Gray body.
   f. Fuse: 5 by 20 GMA fuses.
   g. Fuse Marking: Fuse amperage rating shown on top of terminal block.
   h. Indication: Neon lamp 110V ac.
   i. Leakage Current: 1.8 mA, maximum.
   j. Spacing: 0.32-inch, maximum.
   k. Manufacturer and Product: Entrelec; Type M4/6.SFL.

G. Grounding: Internal copper grounding bus for ground connections on panels, consoles, racks, and cabinets.

H. Relays:

1. General:
   a. Relay Mounting: Plug-in type socket.
   b. Relay Enclosure: Provide dust cover.
   c. Socket Type: Screw terminal interface with wiring.
   d. Socket Mounting: Rail.
   e. Furnish holddown clips.
2. Control Circuit Switching Relay, Nonlatching:
   a. Type: Compact general purpose plug-in.
   b. Contact Arrangement: 3 Form C contacts.
   c. Contact Rating: 10A at 28V dc or 240V ac.
   d. Contact Material: Silver cadmium oxide alloy.
   e. Coil Voltage: As noted or shown.
   f. Coil Power: 1.8 watts (dc), 2.7VA (ac).
   g. Expected Mechanical Life: 10,000,000 operations.
   h. Expected Electrical Life at Rated Load: 100,000 operations.
   i. Indication Type: Neon or LED indicator lamp.
   j. Push-to-test button.
   k. Manufacturer and Product: Potter and Brumfield; Series KUP.
3. Control Circuit Switching Relay, Latching:
   a. Type: Dual coil mechanical latching relay.
   b. Contact Arrangement: 2 Form C contacts.
   c. Contact Rating: 10A at 28V dc or 120V ac.
   d. Contact Material: Silver cadmium oxide alloy.

e. Coil Voltage: As noted or shown.
f. Coil Power: 2.7 watts (dc), 5.3VA (ac).
g. Expected Mechanical Life: 500,000 operations.
h. Expected Electrical Life at Rated Load: 50,000 operations.
i. Manufacturer and Product: Potter and Brumfield; Series KB/KBP.

4. Control Circuit Switching Relay, Time Delay:
   a. Type: Adjustable time delay relay.
   b. Contact Arrangement: 2 Form C contacts.
   c. Contact Rating: 10A at 240V ac.
   d. Contact Material: Silver cadmium oxide alloy.
   e. Coil Voltage: As specified or shown.
   f. Operating Temperature: Minus 10 degrees C to 55 degrees C.
   g. Repeatability: Plus or minus 2 percent.
   h. Delay Time Range: Select range such that time delay setpoint fall between 20 percent to 80 percent or range.
   i. Time Delay Setpoint: As specified or shown.
   j. Mode of Operation: As specified or shown.
   k. Adjustment Type: Integral potentiometer with knob external to dust cover.
   l. Manufacturer and Products: Potter and Brumfield.
      1) Series CB for 0.1-second to 100-minute delay time ranges.
      2) Series CK for 0.1-second to 120-second delay time ranges.

I. Programmable Controllers:

1. Solid state units capable of performing same function as conventional relays, timers, counters, drum sequencers, arithmetic, and other special functions necessary to perform required control functions.
2. Minimum of 64 internal control relays, 16 timer/counters, and four, 16 stop drum sequencers. Furnish minimum of 256 words of nonvolatile memory.
3. Minimum of 12 discrete inputs and 8 discrete outputs, optical isolations rated at 2,500-volt rms. Discrete inputs shall be 120V ac. Discrete outputs shall be rated for 2 amperes at 120V ac. Each input and output shall have an LED ON/OFF status indicator.
4. Minimum of 25 percent excess capacity for inputs, outputs, internal coils, registers, and other necessary functions.
5. Capable of operating in a hostile industrial environment (for example, heat, electrical transients, RFI, and vibration) without fans, air conditioning, or electrical filtering. Units operate from 0 degrees C to 60 degrees C and up to 95 percent humidity, noncondensing.

6. Furnish with a handheld, CRT, or personal computer programmer that plugs into controller. Program using conventional relay ladder diagram notation and drum sequencer chart notation. Programmer shall provide a force function to set inputs or outputs to a given state regardless of program or input conditions. Programmer shall indicate power flow through internal elements.
7. Manufacturer: Siemens.

J. Software Requirements:

1. Application Software: Application software program code and software configuration information for PLCs, OITs and network components shall be non-proprietary and fully documented to allow the Owner to interface with and to operate, program, configure and maintain the software. A final copy of the PLC and OIT programs in native format will be presented to the Owner at the end of equipment commissioning.
2. Coordination and Testing:
    a. General:
        1) The Package System Supplier shall coordinate package system PLC and OIT software with the Programmer who will provide configuration of the Owner's plant SCADA system and plant PLCs.
        2) Package System Supplier shall test PLC and software at time of unwitnessed FAT and SAT and as part of startup testing.

K. PLC Interface:

1. Package supplied PLCs will communicate with Owner's Plant PLCs via hard wired I/O.
2. Coordination and Testing:
    a. Provide dedicated time for coordinating final data point definitions with the Owner, Programmer and PIC.
    b. Provide onsite testing and startup time devoted to data interface testing with the Owner's Plant SCADA PLCs.

L. Operator Interface Terminal (OIT):

1. OIT shall be PanelView Plus 7 Color:
    a. Provide touch screen for operator interface, 7-inch touch.
    b. Display: Color TFT LCD, display resolution: 640 x 480 VGA, 18-bit color graphics.
2. Input Voltage: 24V dc, nominal.

3. Full user's documentation for all standard software packages at time of initial delivery; plus a full new set of this documentation for the version (revision level) currently in release when the Functional Testing of the facility begins.
4. Full user's documentation for all application software, plus a full new set of this documentation for any/all revisions or updates to the application made during commissioning.

M. PLC I/O List:

1. Provide an input/output (IO) list for each PLC with the following columns:
   a. I/O Tag Number.
   b. Description: A description of each IO point.
   c. IO Type: Choice of Analog Input (AI), Analog Output (AO), Digital Input (DI), Digital Output (DO).
   d. Engineering Range: 0.1 for Discrete; 0 to Maximum for Analogs.
   e. Engineering Units: Feet, GPM, Gallons, PSIG, PPM, and MG/L.
   f. PLC Number.
   g. IO Name: the point address in the PLC database.
   h. Chassis Slot: Slot the IO Point is terminated.
   i. Point Number: IO Point number.
   j. Comments.

N. Dead Front-of-Panel Devices Used in Conjunction with NEMA 250, Type 4X Panels:

1. Potentiometer, Watertight:
   a. Three-terminal, heavy-duty NEMA 250, Type 4X watertight construction, resolution of 1 percent and linearity of plus or minus 5 percent.
   b. Single-hole, panel mounting accommodating panel thicknesses between 1/8 inch and 1/4 inch.
   c. Include engraved legend plates with service markings.
   d. Manufacturer and Product: Allen-Bradley; Bulletin 800H.
2. Indicating Lights, Watertight:
   a. Heavy-duty, push-to-test type, NEMA 250, Type 4X watertight, industrial type with integral transformer for 120V ac applications and corrosion-resistant service.
   b. Screwed on prismatic lenses and factory engraved legend plates for service legend.
   c. Manufacturers and Products:
      1) Square D; Type SK.
      2) Allen-Bradley; Type 800H.

3. Pushbutton, Momentary, Watertight:
   a. Heavy-duty, NEMA 250, Type 4X watertight, industrial type with momentary contacts rated for 120V ac service at 10 amperes continuous and corrosion-resistant service.
   b. Standard size, black field, legend plates with white markings for service legend.
   c. Manufacturers and Products:
      1) Square D; Type SK.
      2) Allen-Bradley; Type 800H.
4. Selector Switch, Watertight:
   a. Heavy-duty, NEMA 250, Type 4X watertight, industrial type with contacts rated for 120V ac service at 10 amperes continuous and corrosion-resistant service.
   b. Standard size, black field, legend plates with white markings, for service legend.
   c. Operators: Black knob type.
   d. Single-hole mounting, accommodating panel thicknesses from 1/16 inch to 1/4 inch.
   e. Manufacturers and Products:
      1) Square D; Class 9001, Type SK.
      2) Allen-Bradley; Type 800H.

2.06 INSTRUMENT TAG NUMBERS

A. A shorthand tag number notation is used in P&ID, I/O List and Loop Specifications. For example:

EPP-FIT-P-1 -

Notation	Explanation
EPP	Facility Name, EPP = Elkhorn Pumping Plant.
FIT	ISA designator for Flow Indicating Transmitter.
P	Loop number.
1	Unit number; number of same component types in a given loop; -1 and -2 in this example.

2.07 NAMEPLATES, NAMETAGS, AND SERVICE LEGENDS

A. Nametags: Permanently mounted bearing entire ISA tag number.

1. Panel Mounted: Plastic, mounted to instrument behind panel face.

2. Field Mounted: Engraved Type 316 stainless steel, 22-gauge minimum thickness, attached with stainless steel.

B. Service Legends (Integrally Mounted with Instrument) and Nameplates:

1. Engraved, rigid, laminated plastic type with adhesive back. Furnish service legends and nameplates to adequately describe functions of panel face mounted instruments.
2. Color: White with black letters.
3. Letter Height: 3/16 inch.
4. For each panel, face mounted laminated nameplate inscribed with the panel name and tag number. Color shall be white with black letters 1/2 inch high.

C. Standard Light Colors and Inscriptions:

1. Unless otherwise specified in individual equipment specifications, use the following color code and inscriptions:

Tag	Inscription(s)	Color
ON	ON	Red
OFF	OFF	Green
OPEN	OPEN	Red
CLOSED	CLOSED	Green
POWER ON	POWER	White
LOW	LOW	Amber
FAIL	FAIL	Amber
HIGH	HIGH	Amber
AUTO	AUTO	White
MANUAL	MANUAL	Yellow
LOCAL	LOCAL	White
REMOTE	REMOTE	Yellow
FORWARD	FORWARD	Red
REVERSE	REVERSE	Blue

2. Lettering: Black on white and amber lenses; white on red and green lenses.

D. Standard Pushbutton Colors and Inscriptions:

1. Use following unless otherwise noted:

Tag Function	Inscription(s)	Color
OO	ON OFF	Black Black
OC	OPEN CLOSE	Black Black
OSC	OPEN STOP CLOSE	Black Black Black
HOA	HAND OFF AUTO	Black Black Black
FR	FORWARD OFF REVERSE	Black Black Black
SS	START STOP	Black Black
RESET	RESET	Black
EMERGENCY STOP	EMERGENCY STOP	Red

a. Lettering Color:
   1) Black on white and yellow buttons.
   2) White on black, red, and green buttons.

2.08 ELECTRICAL SURGE AND TRANSIENT PROTECTION

A. Equip control panels with surge-arresting devices to protect equipment from damage as a result of electrical transients induced in interconnecting lines from lightning discharges and nearby electrical devices.

B. Suppressor Locations:

1. At point of connection between an equipment item, including ac powered transmitters, and power supply conductor (direct-wired equipment).
2. On analog pairs at each end when the pair travels outside of building.

3. In other locations where equipment sensitivity to surges and transients requires additional protection beyond that inherent to design of equipment.

C. Suppressor Design:

1. Construction: First-stage, high-energy metal oxide varistor and second-stage, bipolar silicon avalanche device separated by series impedance; includes grounding wire, stud, or terminal.
2. Response: 5 nanoseconds maximum.
3. Recovery: Automatic.
4. Temperature Range: Minus 20 degrees C to plus 85 degrees C.
5. Enclosure Mounted: Encapsulated inflame retardant epoxy.

D. Suppressors on 120V ac Power Supply Connections:

1. Occurrences: Tested and rated for a minimum of 50 occurrences of IEEE C62.41 Category B test waveform.
2. First-Stage Clamping Voltage: 350 volts or less.
3. Second-Stage Clamping Voltage: 210 volts or less.
4. Power Supplies for Continuous Operation:
   a. Four-Wire Transmitter or Receiver: Minimum 5 amperes at 130V ac.
   b. All Other Applications: Minimum 30 amperes at 130V ac.

E. Suppressors on Analog Signal Lines:

1. Test Waveform: Linear 8-microsecond rise in current from 0 ampere to a peak current value followed by an exponential decay of current reaching one-half the peak value in 20 microseconds.
2. Surge Rating: Tested and rated for 50 occurrences of 2,000-ampere peak test waveform.
   a. DC Clamping Voltage: 20 percent to 40 percent above operating voltage for circuit.
   b. DC Clamping Voltage Tolerance: Plus or minus 10 percent.
   c. Maximum Loop Resistance: 18 ohms per conductor.

F. Manufacturers and Products:

1. Analog Signals Lines: Emerson Edco; PC-642 or SRA-64 series.
2. 120V ac Lines: Emerson Edco; HSP-121.
3. 480-Volt, Three-Phase Power Supplies: Square D; Model SDSA3650.
4. Field Mounted at Two-Wire Instruments:
   a. Encapsulated in stainless steel pipe nipples.
   b. Emerson Edco; SS64 series.

5. Field Mounted at Four-Wire Instruments: With 120V ac outlet, ac circuit breaker, and 10-ohm resistor on signal line, all in enclosure.
   a. Enclosure:
      1) NEMA 4X with door.
      2) Maximum Size: 12 inches by 12 inches by 8 inches deep.
   b. Emerson Edco; SLAC series.

G. Grounding:

1. Coordinate surge suppressor grounding in field panels and field instrumentation as specified in Division 26, Electrical, and suppressor manufacturer's requirements.
2. Provide control panels with an integral copper grounding bus for connection of suppressors and other required instrumentation.

PART 3 EXECUTION

3.01 ELECTRICAL POWER AND SIGNAL WIRING

A. Restrain control and signal wiring in control panels by plastic ties or ducts. Secure hinge wiring at each end so bending or twisting will occur around the longitudinal axis of wire. Protect bend area with a sleeve.

B. Arrange wiring neatly, cut to proper length, and remove surplus wire. Install abrasion protection for wire bundles passing through holes or across edges of sheet metal.

C. Use manufacturer's recommended tool with sized anvil for crimp terminations. No more than one wire may be terminated in a single crimp lug. No more than two lugs may be installed on a single screw terminal.

D. Do not splice or tap wiring except at device terminals or terminal blocks.

3.02 STARTUP AND TESTING

A. Provide Functional Tests and Performance Tests of the complete control system including software functions to support startup of plant.

B. Prior to facility startup, inspect, test, and document that the control system is ready for operation.

C. Verify instruments, panels, and components for proper installation, calibration, and adjustment, on a loop-by-loop and component-by-component basis. Document results on loop test status reports, instrument calibration sheets, test forms, and check lists.

D. Perform functional tests including software functions and data communications for all control, monitoring and alarm loops and document test results on test procedure forms.

E. Provide onsite testing and startup time devoted to data exchange testing, message validation and network timing validation with plant SCADA.

3.03 PROGRAMMING

A. PLCs:

1. Programs shall be organized into logical routines. Programs containing all logic in a single routine are not allowed.
2. Programs must be fully documented with address descriptions and descriptive logic explanations (rung comments and function block comments).
3. Tagging: Tag instruments and I/O as indicated on P&IDs.

B. OITs: OIT graphics shall use the Owner's color standards for status indication. Owner color standards will be provided during construction.

C. Alarm Management: All alarming functionality (acknowledgement, reset, disable/enable, suppress, and shelving) will take place at both the package system OIT and the Owner's Plant HMI. Coordinate with Programmer for alarm handshaking. With alarm handshaking, any alarm control operated at the local OIT would be automatically updated at the Owner's Plant HMI and vice versa. Critical alarms that are to only be controlled at the local OIT are to be determined on a case by case basis during coordination workshops.

3.04 PROTECTION

A. Protect enclosures and other equipment containing electrical, instrumentation and control devices, including spare parts, from corrosion through the use of corrosion-inhibiting vapor capsules.

B. During Work, periodically replace capsules in accordance with capsule manufacturer's recommendations. Replace capsules at Substantial Completion.

END OF SECTION

SECTION 44 42 56.04
SUBMERSIBLE PUMPS

EQUIPMENT NUMBERS

Sediment Jetting/Washdown Pump: EPP-P-WD.

PART 1 GENERAL

1.01 DEFINITIONS

A. Terminology pertaining to pumping unit performance and construction shall conform to ratings and nomenclature of Hydraulic Institute Standards (HIS).

1.02 SUBMITTALS

A. Action Submittals:

1. Make, model, weight, and horsepower of each equipment assembly.
2. Complete catalog information, descriptive literature, specifications, and identification of materials of construction, including cable seal details.
3. Performance data curves showing head, capacity, $NPSH_R$, horsepower demand, and pump efficiency over entire operating range of pump, from shutoff to maximum capacity. Indicate values separately at the guarantee point.
4. Power and control wiring diagrams, including terminals and numbers.
5. Motor data, in accordance with the requirements of Section 26 20 00, Low-Voltage AC Induction Motors.
6. Factory-finish system.
7. L-10 bearing life calculations per ABMA.

B. Informational Submittals:

1. Special shipping, storage and protection, and handling instructions.
2. Manufacturer’s printed installation instructions.
3. Factory Functional Test Reports.
4. Suggested spare parts list to maintain equipment in service for period of 1 year and 5 years. Include list of special tools required for checking, testing, parts replacement, and maintenance with current price information.
5. List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.
6. Operation and Maintenance Data as specified in Section 01 78 23, Operation and Maintenance Data.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers and Products:

1. Grundfos Pumps Corporation; Series 85S50.
2. “Or-equal”.

2.02 SERVICE CONDITIONS

A. Installation: Top-feed suction can configuration as shown on Drawings. Furnish pump and motor assembly with a stainless steel flow shroud designed to direct water flow past the motor for motor cooling. Flow shroud dimensions shall be as required to provide adequate cooling flow as recommended by the motor manufacturer.

B. Liquid Pumped: Raw river water.

C. Liquid Temperature: 40 degrees F to 80 degrees F.

2.03 PERFORMANCE REQUIREMENTS

A. HIS Acceptance Grade: 1U.

B. Rated Condition: 105 gpm at 110 feet TDH.

C. Secondary Condition: 45 gpm at not less than 190 feet TDH.

D. Minimum Shutoff Head: 200 feet TDH.

E. Maximum Brake Horsepower: 5.0 at any pumping condition.

2.04 CONSTRUCTION DETAILS

A. General: Submersible multi-stage well-type pump, with integral check valve, lifting eyes, motor cooling flow shroud, and suitable for installation in 8-inch and larger casings.

B. Discharge Connection: 3-inch NPT.

C. Materials:

1. Housings, Shafts, Impeller, Check Valve, Cable Guard: Type 304 stainless steel.
2. Motor Stator and Rotor: Type 304 stainless steel.

3. Motor Cooling Flow Shroud: Type 304 stainless steel.
4. Motor Bearings: Carbon thrust bearing and ceramic tungsten carbide radial bearing.
5. O-Rings and Seals: NBR rubber.
6. Fasteners: Stainless steel.

D. Motor:

1. 5-hp, 460-volt, three-phase, 60 Hz, 1.15 service factor.
2. Housing sealed and filled with FDA/NSF approved lubricant.
3. Factory-installed submersible cable, length as required.
4. Rated for minimum 15 starts per hour.

2.05 SOURCE QUALITY CONTROL

A. Functional Test: Perform manufacturer’s standard tests on equipment.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer’s printed instructions.

3.02 FIELD QUALITY CONTROL

A. Functional Test: Test for specified flow and head.

END OF SECTION

SECTION 44 42 56.23
MIXED FLOW IRRIGATION PUMPS

EQUIPMENT NUMBERS

Irrigation Supply Pumps: EPP-P-1, EPP-P-2.

PART 1 GENERAL

1.01 DEFINITIONS

A. Terminology pertaining to pumping unit performance and construction shall conform to the ratings and nomenclature of the Hydraulic Institute Standards (HIS) and of ANSI/AWWA E101, American National Standard for Vertical Turbine Pumps.

1.02 QUALITY ASSURANCE

A. Pump manufacturer shall have a minimum of 15 years' experience in the design and manufacture of vertical mixed flow pumps substantially similar to pumps specified herein.

1.03 SUBMITTALS

A. Action Submittals:

1. Make, model, weight, and horsepower of each equipment assembly.
2. Complete catalog information, descriptive literature, specifications, keyed bill of materials, and identification of materials of construction.
3. Performance data curves showing total pump head, capacity, brake horsepower, submergence required, $NPSH_R$, AOR, POR, and pump efficiency from shutoff to runout. Indicate all values separately at each design flow condition.
4. Certified dimensional outline and installation drawings including equipment dimensions, sizes and locations of connections, and weights of equipment. Soleplate drawings shall include leveling screw and leveling plate details, anchor bolt and sleeve details, and foundation installation and leveling requirements.
5. Calculations:
   a. Torsional analysis for complete rotating assembly. Analysis report shall include the specific items of API 610, Part 2.8, Dynamics.
   b. Lateral vibration analysis for discharge head motor assembly and for column pipe bowl assembly.
6. Pump maximum downthrust and upthrust in pounds.

7. Power and control wiring diagrams, including terminals and numbers.
8. Complete motor description, information, and nameplate data, as defined by NEMA, motor manufacturer, and including any motor modifications.
9. Electrical drawings including circuit schematics, interconnection diagrams, and all information necessary for connection of motors and electrical and instrumentation components.
10. Complete description of all factory finish systems including surface preparation and product data sheets.
11. Seismic anchorage and bracing calculations in accordance with Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

1. Seismic anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
2. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements, that factory finish system is identical to requirements specified herein.
3. Special shipping, storage and protection, and handling instructions.
4. Manufacturer's printed installation instructions, including details of soleplate installation as specified.
5. Factory Functional and Performance Test Reports and Log. Factory test data for each pump shall be submitted, reviewed, and approved by Engineer prior to shipment of equipment.
6. Suggested spare parts list to maintain equipment in service for a period of 1 year and 5 years. Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information.
7. List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.
8. Operation and Maintenance Data: As specified in Section 01 78 23, Operation and Maintenance Data.
9. Manufacturer's Certificate of Proper Installation, in accordance with Section 01 43 33, Manufacturers' Field Services.

1.04 EXTRA MATERIALS

A. Spare Parts and Special Tools:

1. Furnish, suitably tag and mark, securely pack and crate in a hinged-cover box or boxes suitable for shipment and long-term storage, the following items:
   a. One spare impeller.

b. One complete set of pump shaft bearings.
c. One complete set of any special tools required to dismantle or service pump.

PART 2 PRODUCTS

2.01 GENERAL

A. Adjustable Speed Drives:

1. Coordinate pump and motor requirements with adjustable speed drive manufacturer and be responsible for the following:
   a. Torsional vibration of rotating assembly and related stresses.
   b. Motor thermal rating.
   c. Structural design of pump and motor assembly.
   d. Drive capacity for actual motor's nameplate current rating being supplied.
   e. Minimum motor speed rating for required corresponding torque.

B. Lateral and Torsional Vibrations:

1. Pump and motor assembly shall have no natural frequencies within 20 percent of operating speed range.
2. Fundamental critical speed of rotating assembly shall be no less than 30 percent above the rated speed.
3. Pump manufacturer shall conduct an analysis of the lateral and torsional vibration of pump and motor assembly.
   a. Excitation frequency range of the analysis shall include, but not be limited to, number of motor poles and number of impeller vanes.
   b. Perform detailed stress analysis for pump, coupling, motor system at each critical speed, and steady-state operating condition.
   c. Stress analysis shall demonstrate that in no case shall maximum stress on pump, coupling and motor component exceed endurance limits of pump, coupling and motor assembly components materials of construction.

2.02 MANUFACTURERS

A. Manufacturers and Products:

1. Cascade Pump Co.; Model 24MF.
2. "Or-equal."

2.03 SERVICE CONDITIONS

A. Liquid Pumped: Raw river water.

B. Water Temperature: 40 degrees F to 75 degrees F.

C. Design Ambient Temperature: 122 degrees F.

D. Site Altitude: Approximately 40 feet.

E. Minimum Rated Submergence: 6 feet.

2.04 PERFORMANCE REQUIREMENTS

A. Pump operating at rated speed shall not overload the motor throughout the AOR.

B. Pump performance curve shall exhibit a continuously rising head from runout to not less than 75 percent of the minimum AOR.

C. Operating Head Range at Rated Speed: 44 feet to 5 feet TDH.

D. Rated Condition:

1. Capacity: 30 cfs.
2. Total Head: 32.0 feet.
3. Efficiency: 82 percent.
4. NPSH Required: Not greater than 16 feet.

E. Secondary Conditions:

1. Minimum POR:
   a. Capacity: Not greater than 30 cfs.
   b. Total Head: Not less than 32 feet.
2. Maximum POR:
   a. Capacity: Not less than 39 cfs.
   b. Total Head: Not greater than 15 feet.
3. Runout:
   a. Capacity: Not less than 44 cfs.
   b. Total Head: Not greater than 4 feet.
   c. NPSH Required: Not greater than 42 feet.

F. Pump Nominal Rated Speed: 700 rpm.

G. Pump Minimum Speed: Not greater than 60 percent of Nominal Rated Speed.

2.05 PUMP CONSTRUCTION DETAILS

A. General: ASTM, AISI, etc., numbers, types, and grades specified are typical of material composition and quality. Equivalent materials will require review and approval by Engineer.

B. Pump Configuration:

1. Vertical, mixed flow type with shaft enclosing tube and below-deck discharge nozzle, driven by a solid shaft, squirrel-cage, adjustable-speed motor.
2. Pump dimensions and arrangement shall be in accordance with Drawings.

C. Shaft Lubrication:

1. Manually grease lubricated, with one grease fittings serving shaft bearings in the enclosing tube and discharge bowl, and a second grease fitting serving the suction bowl shaft bearing.
2. Locate grease fittings such that they are easily accessible at the motor stand without removal of the shaft coupling guard.
3. Provide Type 316 stainless steel tubing between grease fittings and grease injection points.

D. Shaft Enclosing Tube:

1. Steel pipe, ASTM A120, Grade B, Schedule 80.
2. The ends of the enclosing tube shall be threaded internally for connection to the line shaft bearings.
3. The enclosing tubes shall support the line shaft bearings from the tension nut body assembly to the discharge bowl.
4. Enclosing tube section lengths not to exceed 10 feet.

E. Tension Nut Body Assembly:

1. Cast iron with bronze lock ring and bearing or all bronze construction.
2. Threaded to the enclosing tube to allow tensioning.
3. Provide NPT connection for grease lubrication line.
4. Bearing grooved for grease lubrication.
5. Bronze to be ASTM B144, Grade 3B (CDA932).

F. Lineshaft Bearings:

1. Bronze, ASTM B145, Grade 5A (CDA844), grooved for grease lubrication.
2. Bearing spacing shall be as required to prevent resonant vibrations of the lineshaft, but not greater than 5 feet.
3. Bearings shall be threaded externally to act as couplings for the shaft enclosing tubes.

G. Lineshaft and Bowl Shaft: ASTM A582, Type 416 stainless steel.

H. Shaft Couplings: Keyed construction, ASTM A582, Type 416 stainless steel.

I. Impeller:

1. Semi-open type, aluminum bronze, ASTM B148, C95400.
2. Provide shaft keys, thrust rings, and fasteners of stainless steel, ASTM A582, Type 416.
3. Statically and dynamically balanced.

J. Bowl and Suction Bell:

1. Cast iron, ASTM A48, Class 30.
2. Suction bell outside diameter as shown on Drawings.
3. Suction bell bearing cap shall not extend below bell lip greater than 4 inches.
4. Provide bypass ports to relieve pressure in enclosing tube.
5. Provide guide vanes to minimize losses and prevent vortexing.
6. Hydrostatic test at 1.5 times pump shutoff head.

K. Bowl and Suction Bell Bearings:

1. Bronze, ASTM B144, Grade 3B (CDA932).
2. Provide grease-lubricated bearing in suction bell with Type 316 stainless steel grease line extended from baseplate.
3. Bearing lengths shall be not less than two times the shaft diameter.
4. Provide bronze protecting collar at suction bell bearing.
5. Provide bearing on both sides of impeller. Pumps lacking a bearing to support the shaft below the impeller will not be considered.

L. Discharge Column:

1. Fabricated steel, diameter and wall thickness shall match discharge elbow.
2. Flanged and registered joints.
3. Column section lengths not to exceed 10 feet.

M. Discharge Elbow:

1. Below-base type, fabricated steel, four-section mitered elbow, 3/8-inch wall thickness.
2. Discharge Nozzle Size: 30-inch outside diameter.
3. Plain-end discharge nozzle with thrust tie lugs. Coordinate thrust tie lug design with that of mating pipe.
4. Flanged and registered joints at column connections.
5. Section length not to exceed 10 feet.
6. Diameter and wall thickness of support column between discharge elbow and baseplate shall match discharge nozzle.
7. Furnish with provision for attachment of resilient column seal, as shown on Drawings.

N. Pump Soleplate:

1. Constructed of steel plate with thickness as required for weight of pump, but not less than 2 inches.
2. Machine top surface at interface with motor stand.
3. Furnish with tapped holes for leveling jack screws.

O. Motor Stand:

1. Provide motor stand between baseplate and motor with windows for access to motor coupling and tension nut body assembly.
2. Reinforce motor stand with gusset plates or by other means as required for operation with specified adjustable-speed motor over the required operating rpm range.
3. Provide OSHA-compliant hinged and lockable stainless steel expanded metal guards on access windows. Provide guard perimeter with stainless steel U-edging such that they are free of sharp edges.

P. Motor Shaft Coupling:

1. Flanged, adjustable type, steel AISI 1020.
2. Registered fits to assure positive alignment.
3. Dynamically balanced and match marked.

Q. Pump-Mounted Vortex Suppressor: Furnished by pump manufacturer and designed as shown on Drawings.

2.06 DRIVE MOTOR

A. See Supplements following “End of Section” as part of this Specification.

2.07 SUCTION CAN

A. Pump manufacturer shall be responsible for supply of the suction can, sediment jetting/washdown pump suction well, and associated accessories.

B. Drawings show the general arrangement and construction requirements but are not all inclusive and do not constitute a complete design. Specific design and fabrication details shall be the responsibility of the pump manufacturer.

C. Pump manufacturer shall coordinate all details of the equipment with other related parts of the Work, including verification that all structures, piping, and equipment components are compatible.

D. Suction can shall be constructed of fabricated steel, inside diameter as shown by Drawings, with minimum 3/8-inch wall thickness. All weldments shall be complete joint penetration welds.

E. Provide suction can with internal turning vane as shown on Drawings.

F. Anchorage: Provide suction can with double-gusset lug plate anchors for attachment to structural steel members as shown on Drawings. Design such that either the upper or lower set of supports may carry the full weight of the suction can assembly without subtracting buoyancy forces.

G. Provide suction can assembly complete with all accessories shown on Drawings, including:

1. Top flange, top flange cover, resilient column seal.
2. Level Element Stilling Well and Sediment Jetting Pipes: 2-inch Schedule 40S ASTM A312/A312M Type 304 stainless steel.
3. Sediment Jetting/Washdown Pump Suction Well:
    a. Schedule 40 steel pipe per ASTM A106/A106M Grade B, or ASTM A53/A53M Grade B.
    b. Provide with pipe coupling, top flange, and companion flange as shown on Drawings.
    c. Design anchorage to RW Pump suction can as shown on Drawings.

H. Apply factory finishing as specified.

2.08 FACTORY FINISHING

A. General: Coating System No. in accordance with Section 09 90 00, Painting and Coating.

B. Motor: Coat with manufacturer's standard corrosion-resistant outdoor-service coating.

C. Soleplate:

1. Top Surfaces: System No. 1, except bare at interface with motor stand flange.
2. Bottom Surface: As required for epoxy grout installation.

D. Motor Stand:

1. Exterior Surfaces: System No. 1, except bare at interface with soleplate.
2. Interior Surfaces: System No. 1.

E. Column Pipe and Discharge Elbow:

1. Exterior Surfaces: System No. 1.
2. Interior Surfaces: System No. 1.

F. Enclosing Tube:

1. Exterior Surfaces: System No. 1.
2. Interior Surfaces: System No. 1.

G. Discharge Bowl and Suction Bowl:

1. Exterior Surfaces: System No. 1 or System No. 29.
2. Interior Surfaces: System No. 29.

H. Suction Can:

1. Exterior Surfaces: System No. 1.
2. Interior Surfaces: System No. 1.

I. Sediment Jetting/Washdown Pump Suction Well:

1. Exterior Surfaces: System No. 1.
2. Interior Surfaces: System No. 1.

2.09 ACCESSORIES

A. Spray Nozzle:

1. Install at bottom end of suction can sediment jetting pipe as shown on Drawings.
2. Zero degree spray angle (solid stream), Type 303 stainless steel, 1-1/4 inch NPT inlet connection.
3. Capacity: 100 gpm at 20 psid.
4. Manufacturers and Products:
   a. Spray Systems Co.; Veejet, Model U.
   b. “Or-equal.”

B. Equipment Identification Plate:

1. A stainless steel nameplate shall be attached to each pump on the motor stand and 1/4-inch die-stamped with the following information:
   a. Owner’s designated equipment number.
   b. Manufacturer’s name.
   c. Manufacturer’s size and model designation.
   d. Serial number.
   e. Rated capacity and head.
   f. Rated speed.
   g. Impeller adjustment clearance.
   h. Lubrication requirements.
   i. Direction of rotation.

C. Lifting Eye Bolts: Provide removable lifting eye bolts attached to the baseplate.

D. Anchor Bolts: Sized by equipment manufacturer, and as specified in Section 05 50 00, Metal Fabrications. Coat in accordance with Section 09 90 00, Painting and Coating.

2.10 SOURCE QUALITY CONTROL

A. Factory Tests:

1. Pumps:
   a. Tests shall be in conformance with the test standards of the Hydraulic Institute (ANSI/HI) as modified herein.
   b. Hydrostatic Tests: Hydrostatic test all pump assemblies.
   c. Performance Tests:
      1) Performance tests shall be conducted at the manufacturer’s facilities on all bowl assemblies at rated speed.

2) Tests shall be conducted domestically, unless witness is provided at the manufacturer's expense.
3) Tests shall be conducted using a calibrated lab motor or a job motor that has received complete and certified tests.
4) Acceptance Level 1U in accordance with ANSI/HI 14.6.
5) Test at specified minimum submergence.
6) Log a minimum of 12 test data points.
7) Test reports shall include raw and normalized test data sheets and curves of test results. Normalize test data to correct for column and discharge head losses, and for job motor rpm.
8) Test data sheets shall be certified correct by a professional engineer registered in the State of California.

2. Motors: Testing in accordance with Section 26 20 00, Low-Voltage AC Induction Motors.

PART 3 EXECUTION

3.01 GENERAL

A. The manufacturer shall prepare the pumps for shipment and be responsible for them until they are received by the Contractor.

B. Pumps shall be shipped assembled.

3.02 INSTALLATION

A. General:

1. Install in accordance with HIS 14.3, HIS 14.4, and as specified herein.
2. Any proposed variations from specified installation procedures shall be specifically identified and submitted to Engineer for review at least 30 days in advance of the proposed installation date.

B. Anchor Bolts:

1. Cast-in-place type, with sleeves. Accurately place using templates and as specified in Section 05 50 00, Metal Fabrications.
2. Fill annular space between anchor bolts and anchor bolt sleeves with RTV silicone.

C. Prepare mating surfaces of soleplate and concrete foundation in accordance with epoxy grout manufacturer's recommendations.

D. Coat soleplate leveling screws and anchor bolts with nonbinding material to prevent adhesion of grout.

E. Set and level soleplate independently of the pump. Set soleplate to the proper elevation and level by means of leveling screws bearing against 4-inch square by 1/4-inch thick stainless steel leveling plates set in the pump foundation using epoxy grout. Secure soleplate in position by lightly snugging anchor bolt nuts against top of soleplate, then recheck level.

F. After soleplate has been aligned to the proper elevation and leveled, grout space between bottom of soleplate and concrete foundation with epoxy grout as specified in Section 03 62 00, Grouting. Confirm level during and after grouting operation.

G. After grout has fully hardened, remove leveling screws and fill holes with RTV silicone. Tighten anchor bolts in accordance with pump manufacturer's recommendations.

H. Install pump on soleplate and adjust pump assemblies such that driving units are properly aligned, plumb, and level with driven units and interconnecting shafts and couplings. Do not compensate for misalignment by use of flexible couplings.

I. Connect discharge piping without imposing strain to pump nozzle.

J. Lubricants: The Contractor shall furnish all necessary oil and grease for initial operation and shall install prior to testing.

3.03 FIELD QUALITY CONTROL

A. Confirm bolt torque at column and bowl flange joints following shipment and prior to startup.

B. The installed pumps and motors shall be thoroughly inspected and certified by the manufacturer's representative prior to startup.

C. Field Tests:

1. Functional Test: The manufacturer's representative shall check operation of each pump with regard to proper alignment, excessive or unusual noises, overheating, properly functioning lubrication system, and overall satisfactory performance.
2. Vibration Test: The manufacturer's representative shall check and verify that each operating pump does not have amplitudes of vibration

exceeding the applicable limits recommended by the standards of the Hydraulic Institute.

3. Flow Output: As measured by plant instrumentation.
4. Monitor bearing areas on pump and motor for abnormally high temperatures.

3.04 MANUFACTURER'S SERVICES

A. Manufacturer's Representative present at Site or classroom designated by Owner, for minimum person-days listed below, travel time excluded:

1. 2 person-days for installation assistance and inspection.
2. 2 person-days for functional and performance testing and completion of Manufacturer's Certificate of Proper Installation.
3. 1 person-day for post-startup training of Owner's personnel.

B. See Section 01 43 33, Manufacturers' Field Services, and Section 01 91 14, Equipment Testing and Facility Startup.

3.05 SUPPLEMENTS

A. The supplement listed below, following "End of Section," is part of this Specification.

1. Irrigation Supply Pump Motor Data Sheet.

END OF SECTION

IRRIGATION SUPPLY PUMP MOTOR DATA SHEET

Project: Elkhorn Pumping Plant Replacement

Owner: Natomas Mutual Water Company

Equipment Name: Irrigation Supply Pump Motor

Equipment Tag Number(s): EPP-P-1, EPP-P-2

Type: Squirrel-cage induction meeting requirements of NEMA MG 1

Hazardous Location: ☐ Furnish motors for hazardous (classified) locations that conform to UL 674 and have an applied UL listing mark

Motor Horsepower: 200

Voltage: 460

Phase: 3

Frequency: 60 Hz

Synchronous Speed: 720

☐ Multispeed, Two-Speed:

_____ / _____ rpm

☐ Constant Horsepower

☒ Variable Torque

☐ Constant Torque

Winding: ☒ One ☐ Two

☒ Class F Insulation

☒ Premium Efficiency

Rated Ambient Temperature
☐ 40ºC ☒ 50ºC

Guaranteed Minimum Efficiency at Full Load ___percent

Guaranteed Minimum Power Factor at Full Load ___percent

Service Factor (@ rated max. amb. temp.): *See Special Features*

Enclosure Type: WP-II

Mounting Type: ☐ Horizontal ☒ Vertical

☒ Vertical Shaft: ☒ Solid ☐ Hollow

☐ Vertical Thrust Capacity (lb): Up _____ Down _____

☒ Adjustable Speed Drive: See Section 26 29 23, Low Voltage Adjustable Frequency Drive System

Adjustable Frequency Drive System

Operating Speed Range: 60% to 100% of Rated Speed

☒ Thermal Protection: Thermal switches

☒ Space Heater: 120 volts, single phase

☒ Oversize main terminal (conduit) box for motors

☒ Terminal for connection of equipment grounding wire in each terminal box

☒ Non-reverse ratchet

Special Features:
1) See Section 26 20 00, Low-Voltage AC Induction Motors.
2) Provide inverter duty-rated motors.
3) Service Factor at Rated Ambient Temperature: 1.15 on sine wave power / 1.0 on inverter power.

PART 4

DRAWINGS
(BOUND SEPARATELY)