

**Petersburg
Municipal
Power & Light**

Contract Documents
for the General Construction of:

**Blind Slough Hydroelectric
Project Upgrades
(Petersburg, AK)**

Volume 1
Technical Specifications

Volume 2
Contract Drawings

ISSUED FOR BID



September 16, 2022

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BLIND SLOUGH HYDROELECTRIC PROJECT

CONTRACT DOCUMENTS
FOR
GENERAL CONSTRUCTION

ISSUED FOR BID ONLY



Issued By

PETERSBURG MUNICIPAL POWER & LIGHT.

11 S. Nordic Drive
P.O. Box 329
Petersburg, AK 99833

Prepared By

McMillen Jacobs
Associates. Seattle,
Washington

September 16, 2022

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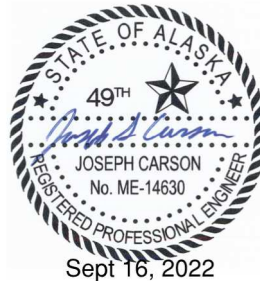
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Division 26 and 28 Specifications Prepared Under the Direct Supervision of Matt Lawson, P.E.:



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- END OF SECTION -

SECTION 00 21 13 - INSTRUCTIONS TO BIDDERS

1.1 Defined Terms

- A. Capitalized Terms used in these Instructions to Bidders are defined in the General Conditions, Section 00 72 00. The term "Successful Bidder" means the most convenient, qualified, responsible Bidder to whom the OWNER makes an award.

1.2 Copies of Bid Documents

- A. One complete set of Bid Documents will be provided to each Bidder at no charge.
- B. Complete sets of Bid Documents shall be used in preparation of Bids. Neither OWNER nor Engineer assumes any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bid Documents.
- C. OWNER and the Engineer in making copies of the Bid Documents available do so only for the purpose of obtaining Bids for the Work and do not confer a license or grant for any other use.

1.3 Qualifications of Bidder

- A. Bidder must have a current Alaska State Contractor's License.
- B. Bidder shall submit with its Bid: (1) a statement of Bidder's experience with the type and magnitude of work described in the Bid Documents, (2) Bidder's technical qualifications to perform the Work, and (3) Bidder's financial and work references. This statement shall be sufficient to enable OWNER to determine that Bidder has the necessary experience, organization, technical qualifications, financial resources, and ability to comply with time schedules, record of performance, integrity, and skill to properly and timely perform the Work described in the Bid Documents.
- C. Each Bidder shall submit with its Bid its work/delivery schedule including, if applicable, its proposed method of conducting the Work, and the list of equipment and other materials which it will use. This submittal data shall be sufficiently complete and detailed to show compliance with the Bid Documents.
- D. OWNER reserves the right to reject any Bid if OWNER's review of the above submittals and its investigation fail to establish that Bidder possesses, to the satisfaction of OWNER, in its discretion, the qualifications necessary to fully, properly, and timely carry out all obligations described in the Bid Documents.

1.4 Examination of CONTRACT DOCUMENTS and Site

- A. Before submitting a Bid, it is the responsibility of each Bidder to (a) thoroughly examine the CONTRACT DOCUMENTS, (b) become familiar with federal, state, and local laws, ordinances, rules, and regulations that may in any manner affect cost, progress, material or equipment deliveries, installation or performance of this work, (c) study and carefully correlate Bidder's observations with the CONTRACT DOCUMENTS and (d) study the site to become familiar with local access conditions, physical features, geographic location, etc. A mandatory pre-bid job meeting and site tour is mandatory for all potential Bidders (at his own expense) to examine the site. Please contact OWNER to make

arrangements. Before offering a Bid, Bidder shall make (at his own expense) such additional investigations, tests and inquiries as Bidder deems necessary to finalize his Bid in accordance with the CONTRACT DOCUMENTS.

- B. On request, OWNER will provide each Bidder access to the Project site to conduct such investigations as Bidder requires in preparing a Bid. A site visit is scheduled for October 24-25, 2022. After Bids have been submitted, Bidder shall not assert that there was a misunderstanding concerning the quantities of Work or of the nature of the Work to be done.
- C. The submission of a Bid will constitute an incontrovertible representation by Bidder that he has complied with or intends to comply with all provisions of these CONTRACT DOCUMENTS and that the CONTRACT DOCUMENTS are sufficient in scope and detail to indicate and convey understanding of all terms and conditions for performance of the Work.
- D. If a Bidder finds discrepancies in or omissions from the Bid Documents, or if the intent or meaning of the Bid Documents is unclear, obscure or ambiguous, or if a Bidder deems it necessary to qualify any condition or provision in the Bid Documents, Bidder shall at once forward to OWNER a written request for interpretation, clarification, correction or qualification before submitting its bid. Bidder making this request is solely responsible for its timely receipt. OWNER must receive all requests not later than 4:00 p.m., on November 18, 2022. OWNER will reply only in the form of addendum. OWNER shall neither be bound by, nor responsible for, any explanations, interpretations, clarifications, corrections or qualifications of the Bid Documents other than those given in written addendum as specified in this paragraph. A BIDDER'S FAILURE TO FOLLOW THE PROCEDURE DESCRIBED IN THIS PARAGRAPH SHALL BE A BASIS FOR REJECTING THE BID. No interpretation, clarification, correction, qualification, amendment, or modification shall be valid unless set forth in an addendum signed by OWNER. OWNER shall not be bound by, and hereby objects to, any term, condition, or other provision which is different from or in addition to that contained in the Bid Document or addenda. ATTEMPTS TO QUALIFY A BID PROPOSAL BY SUBMITTING WITH IT "STANDARD CONDITIONS", STANDARD TERMS", MODIFICATIONS TO THE GENERAL AND/OR SPECIAL CONDITIONS, OR THE LIKE WILL NOT BE ACCEPTED.

1.5 Interpretations

- A. All questions about the meaning or intent of the CONTRACT DOCUMENTS shall be addressed to Engineer and will be responded to in writing if the question warrants.
- B. Interpretations or clarifications critical to all Bidders shall be handled by written addendum mailed or faxed to all Bid Documents holders prior to the Bid opening. In the event sufficient time is not allowed to mail and review said addenda, either the Bid opening date will be postponed or necessary communications will be made by telephone or fax to each Bidder, to be followed up by written documentation. Bidders should understand that oral interpretations, or questions answered by anyone other than Engineer shall be without legal effect.

1.6 Contract Period

- A. The CONTRACT DOCUMENTS require Substantial Completion of the Work by the date stated in the Bid by CONTRACTOR. OWNER desires the Work to be a Substantially Complete by October 26, 2023.

1.7 Liquidated Damages

- A. Liquidated damages will be assessed for failure to perform within the conditions and specified completion periods stated in the CONTRACT DOCUMENTS. Liquidated damages shall be as described in Section 00 73 00 of the Supplemental Conditions.

1.8 Substitute Materials and Equipment

- A. The award of the Agreement will be made on the basis of the materials and equipment specified in these CONTRACT DOCUMENTS or as indicated on the Drawings without considerations of possible substitute or "or-equal" items. To evaluate all Bidders equally and fairly, Bidders shall prepare their Bids wholly on this basis. Bidders are cautioned that indications of substitutions or exceptions, if considered substantial enough by Engineer and OWNER, may cause a Bid to be rejected as "non-responsive". Whenever it is indicated in the Drawings or CONTRACT DOCUMENTS that a substitute or "or-equal" item may be provided with Engineer's approval, application for such acceptance will not be considered until after the execution of the Agreement. The procedure for submittal of any such application is set forth in Section 01 33 00 – Submittal Procedures.

1.9 Instructions for Completion of Bid Forms

- A. The required Bid Schedule is included within the CONTRACT DOCUMENTS; additional copies may be duplicated. Bid Schedules are to be completed in ink or be typewritten. The Bid price of each item is to be indicated in the space provided in either figures, words or both forms as indicated. In the case of conflict or discovered addition or multiplication error, written words and/or the correct sum shall take precedence.
- B. Bids by corporations must be executed in the corporate name by a corporate officer with contractual authority, and the corporate seal must be affixed and attested to in the appropriate space. Bids by partnerships must be executed in the partnership name and signed by a partner. All names must be typed or printed below the signature lines.
- C. Bidders shall acknowledge receipt of all addenda, the numbers of which shall be indicated on the Bid Schedule.
- D. The business address to which all communications regarding the Bid or other contractual matters is to be indicated in the space provided.
- E. Bidders shall give Engineer written notice of all conflicts, errors, or discrepancies that have been discovered in the Bid Documents.
- F. All costs and expenses of whatever kind incurred by the Bidder in the preparation of the Bid shall be borne entirely by the bidder and shall in no way be reimbursed or paid for by OWNER.
- G. Special Conditions to be Incorporated into the Bid Proposal:

1. In undertaking the development of the Project, OWNER has entered into a separate but interrelated contract for the Project for a Contract for Supply, Start-Up and Testing of Turbine, Generator, Controls and Associated Equipment (the "Turbine Contract"), under which the turbine manufacturer (also called turbine generator supply contractor or turbine contractor) will design, manufacture, deliver and oversee installation and commissioning/startup at the Project Site. The CONTRACTOR shall be responsible for the installation, commissioning and startup of the turbine and generator and associated equipment. CONTRACTOR acknowledges that it is required to be thoroughly familiar with the specifications and equipment requirements set forth in the Turbine Contract (see Appendix).
2. Bidders must describe in the Bid Proposal the approach proposed for the Work of the Contract:
 - a. Describe Bidders approach to (i) install new dam valve house bypass pipe to allow the release of hatchery flows during construction, (ii) install temporary erosion and sediment controls for ground disturbing work, (iii) demolition old penstocks and supports, (iv) install the new penstock pipe and powerhouse bypass system in such manner to integrate that equipment fully and satisfactorily with the Project, (v) to perform other repairs to the existing penstock, (vi) demolition and removal of existing powerhouse and substation equipment and foundations (vii) modifications to the tailrace pipe, (viii) prepare the powerhouse foundation for new Owner furnished and Contractor installed equipment, (ix) perform installation and commissioning of the Owner furnished turbine-generator and related equipment all under the oversight of the Turbine-Generator supplier technician; and (x) perform final grading and install permanent erosion and soil control measures and do final site cleanup.
 - b. Describe the proposed construction sequence with a detailed Project construction schedule. The proposed construction sequence and schedule is a significant part of the evaluation criteria. The supply of water to the Crystal Lake Fish Hatchery, operated by Southern Southeast Regional Aquaculture Association (SSRAA), is a major requirement of the Work of the Contract. Normally water is supplied from the Project tailrace directly to the hatchery. When the Project is shut down for the Work of the Contract, the normal supply of water to the Hatchery will be temporarily discontinued. Prior to that shut down the CONTRACTOR will construct a bypass at the dam to supply water to the hatchery using the Crystal Creek diversion reach. OWNER desires the time that the normal supply from the tailrace is stopped be minimized. SSRAA hatchery production risk increases after August and OWNER desires the return to flow to the hatchery from the tailrace (using the powerhouse bypass system) not later than August 1, 2023.
 - c. Each Bidder's proposed approach to the Work will be evaluated based on cost, the above hatchery schedule issues, quality and safety. Each Bidder's proposed approach to ensure the proper, seamless and timely resumption of hatchery flows using the powerhouse bypass system will be an evaluation factor. The timely installation of the turbine-generator equipment will similarly be evaluated based on schedule, cost and safety. Bidder will take into consideration the estimated delivery date of the new penstock and powerhouse bypass system materials,

the turbine generator and ancillary equipment to ensure that these components will be installed immediately upon delivery to the Project Site.

3. The OWNER furnished and Contractor installed turbine, generator and accessory equipment will to be delivered to the Project Site as indicated in the enclosed project schedule (see Appendix).
4. Bidder and its subcontractors shall cooperate fully and in good faith with the Turbine Generator Supply Contract field service engineers and other contractors hired by OWNER to perform work that must be accomplished in order for Bidder to reach Final Completion.
5. Bidder shall include in its Bid Proposal a list of the prospective subcontractors that it requires to perform the Work required of Bidder.

1.10 Submission of Bids

- A. The official signed Bids shall be submitted to OWNER (Mr. Karl Hagerman) on or before 4:00 pm (Alaska Local Time) November 28, 2022, in a sealed envelope, at the following address:

Mr. Karl Hagerman
Petersburg Municipal Power & Light
11 South Nordic Drive
P.O. Box 329
Petersburg, AK 99833

- B. A copy shall also be emailed to the ENGINEER, Don Jarrett, PE of McMillen Jacobs Associates, at the following address:

jarrett@mcmjac.com

- C. Bids delivered after the indicated time on the indicated date will be rejected.
- D. Bids and Bid information submitted for this project shall become the property of OWNER.

1.11 Modification and Withdrawal of Bids

- A. Bids may be modified or withdrawn by a letter of indication duly executed (in the same manner as the Bid itself) and delivered to OWNER at any time prior to the opening of Bids.
- B. No Bidder may withdraw a Bid within sixty (60) days after the actual date of the Bid opening. Should there be reasons why the Agreement cannot be awarded within the specified period, the time for award may be extended by mutual agreement between OWNER and the Successful Bidder.

1.12 Opening of Bids

- A. At the indicated Bid opening time, all Bids will be opened.

1.13 Bond Requirements

- A. Each Bid must be accompanied by a Bid Bond payable to OWNER for five percent (5%) of the total amount of the Bid. As soon as the Bid prices have been compared, OWNER will return the Bid Bonds of all except the three (3) lowest responsive Bidders. When the Agreement is executed the Bid Bonds of the two remaining unsuccessful Bidders will be returned. The Bid Bond of the successful Bidder will be retained until the Payment Bond and Performance Bond have been executed and approved, after which it will be returned. A certified check may be used in lieu of a Bid Bond.
- B. A Performance Bond and a Payment Bond each in the amount of one hundred percent (100%) of the Contract Price, with a corporate surety approved by OWNER and that has been rated by A.M. Best with a rating of A++ or higher, is required for the faithful performance of the Agreement.
- C. Attorneys-in-fact who sign Bid Bonds or Payment Bonds and Performance Bonds must file with each Bond a certified and effective dated copy of their power of attorney.
- D. The Successful Bidder will be required to execute the Agreement and submit to OWNER the Performance Bond and Payment Bond within ten (10) calendar days from the date when Notice of Award is delivered to the Successful Bidder. The Notice of Award shall be accompanied by the necessary Agreement and Bond forms. If Bidder fails to execute the Agreement, OWNER may consider Bidder in default, in which case the Bid Bond accompanying the proposal shall become the property of OWNER.
- E. Within ten (10) days after OWNER has received from the Successful Bidder the signed Agreement, the Performance Bond, and Payment Bond, each of which bonds shall be acceptable to OWNER, OWNER shall sign Agreement and return to the Successful Bidder an executed duplicate of the Agreement. If OWNER fails to execute the Agreement within such ten (10)-day period, Bidder may by Written Notice to OWNER withdraw the signed Agreement and the Performance and the Payment Bonds. Such notice of withdrawal shall be effective upon receipt of the notice by OWNER.

1.14 Failure to Furnish Performance Bond and/or Payment Bond

- A. If the Successful Bidder fails or refuses to furnish the Performance Bond or the Payment Bond within ten (10) days after written notification of the acceptance of the Bid Proposal by OWNER, Bidder shall be considered to have abandoned its Bid Proposal. In such event, OWNER shall be entitled (1) to enforce the Bid Bond in accordance with its terms, or (2) if a certified check (in lieu of a Bid Bond) has been delivered with the Bid Proposal, to retain from the proceeds of the certified check the difference (not exceeding the amount of the certified check) between the amount of the Bid Proposal and such larger amount for which OWNER may in good faith contract with another party to perform the Work. In such case, the term "Successful Bidder" shall be deemed to apply to the Bidder whose Bid Proposal is accepted in lieu of the Bidder who has previously refused or has been unable to furnish a satisfactory Performance Bond or Payment Bond.

1.15 AWARD OF AGREEMENT

- A. OWNER reserves the right to reject any and all Bids, including, without limitation, all nonconforming, non-responsive or conditional Bids, and to waive any and all informalities and to negotiate terms with the Successful Bidder. OWNER intends to award the Agreement as expeditiously as possible following the Bid opening (subject to the approval of the Borough Assembly at its regularly scheduled meeting in December 2023) and will seek to do so within thirty (30) days following the Bid opening, although this intent is not to be construed as imposing any legal obligation upon OWNER to act within this 30-day period and is subject to approval by the elected Borough Assembly. Bids will be compared and analyzed pursuant to Paragraph 1.10 Bid Evaluation, Section 00 24 13, considering such factors as price, efficiency, delivery times, quality of equipment, experience of the Bidder and other factors.
- B. In the Bid evaluation process, OWNER may make such investigations as it deems necessary to determine the ability of Bidder to perform the Work in accordance with the CONTRACT DOCUMENTS, and Bidder shall furnish to OWNER all such information and data for this purpose as OWNER may request. OWNER reserves the right to reject any Bid if the evidence submitted by, or investigation of, such Bidder fails to satisfy OWNER that such Bidder is properly qualified to carry out the obligations of the Agreement and to complete the Work contemplated therein and in accordance with THE CONTRACT DOCUMENTS.
- C. The Notice to Proceed will be issued within ten (10) days of the execution of the Agreement by OWNER. Should there be reasons why the Notice to Proceed cannot be issued within such period, the time may be extended by mutual agreement between OWNER and Contractor. If the Notice to Proceed has not been issued within the ten (10) day period or within the period mutually agreed upon, Contractor may terminate the Agreement without further liability on the part of either party.
- D. The Agreement will be awarded to a single Contractor which as the Successful Bidder has demonstrated through the Bid process that award of the Agreement to the Successful Bidder will be in the best interests of OWNER.

1.16 EXECUTION OF CONTRACT FORMS

- A. All CONTRACT DOCUMENTS that are forms required to be executed will be prepared as three (3) original documents, to be distributed to OWNER, Engineer, and Contractor. Additional copies required for the Contractor's Surety or for other purposes will be supplied upon request.

B. ENGINEER

McMillen Jacobs Associates
1011 Western Avenue, Suite 706
Seattle, WA 98104
Attn: Donald Jarrett, PE
Telephone: (425)-503-5315
Email: jarrett@mcmjac.com

C. OWNER

Petersburg Municipal Power & Light
Mr. Karl Hagerman
11 South Nordic Drive
P.O. Box 329
Petersburg, Alaska 99833
Telephone: (907) 772-4203
Email: khagerman@petersburgak.gov

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SECTION 00 24 13 BID PROPOSAL

BIDDER: _____

BID DATE: _____

SIGNATURE: _____

TITLE: _____

PART 1 -- GENERAL

1.1 This Bid Proposal shall be submitted to OWNER at its office in a sealed envelope as follows:

Petersburg Municipal Power & Light
Attn: Mr. Karl Hagerman
11 South Nordic Drive
P.O. Box 329
Petersburg, Alaska 99833
(907) 772-4203
khagerman@petersburgak.gov

1.2 BID SUBMITTAL PROCEDURE

A. To submit a Bid Proposal, Bidders shall remove this Section 00 24 13 from the CONTRACT DOCUMENTS and submit it, fully filled out and signed, as the Bid.

1.3 BID OPENING DATE:

A. Bids will be opened at the offices of OWNER at 4:00 p.m., November 28, 2022.

1.4 The undersigned Bidder proposes and agrees if this Bid is accepted to enter into an Agreement with OWNER, on the form included in the CONTRACT DOCUMENTS, to complete all Work as specified or indicated in the CONTRACT DOCUMENTS for the Total Bid Price presented, within the Contract Period, and in accordance with the terms and conditions of the CONTRACT DOCUMENTS.

1.5 Bidder accepts all of the terms and conditions of the Instructions for Bidders and the CONTRACT DOCUMENTS. This Bid will remain subject to acceptance for sixty (60) days after the actual Bid opening date. Bidder agrees to sign the Agreement and submit it with the indicated Contract Security and other required documents within ten (10) days after the date of the OWNER's Notice of Award.

1.6 In submitting this Bid, Bidder represents that:

A. Bidder has examined copies of all the CONTRACT DOCUMENTS and of the following Addenda; receipt of which is hereby acknowledged:

Addendum No.

Title

Dated

- B. Bidder is familiar with the content of the CONTRACT DOCUMENTS and with legal requirements (federal, state, and local) which apply to the completion of this Work and with conditions affecting cost, progress or performance, and completion of this Work.
- C. This Bid is genuine and not made in the interest of or on behalf of any undisclosed person, firm or corporation and is not submitted in conformity with any agreement or rules of any group, association, organization or corporation; Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham bid; Bidder has not solicited any person, firm or corporation to refrain from bidding; Bidder has not sought by collusion to obtain an unfair advantage over any other Bidder or over OWNER.
- D. Bidder has given Engineer written notice of all conflicts, errors, or discrepancies that have been discovered in the CONTRACT DOCUMENTS, and the written resolution thereof by Engineer is acceptable to Bidder.
- E. The Work will be completed on or before the completion times as bid in the Bid Form. Bidder also accepts the provisions of the CONTRACT DOCUMENTS as to liquidated damages in the event of failure to complete the Work ontime.
- F. OWNER reserves the right to award the Agreement based on the best interest of OWNER.

1.7 GENERAL DESCRIPTION PRICING

- A. Bidder proposes to provide all labor, equipment, tools, materials, supervision and all other items necessary to perform the Work listed below in strict accordance with the Specifications and Drawings which are attached hereto and made a part of the CONTRACT DOCUMENTS. Contractor retains full responsibility for shipment of all of the equipment hereunder from Contractor's manufacturing factory all the way to the Project site.

1.8 BID PROPOSAL ITEMS AND PRICING

BID ITEM #	DESCRIPTION	BID QUANTITY	BID UNIT	UNIT PRICE	AMOUNT
1	Mobilization/Demobilization (Not to exceed 5% of Lump Sum Total)	1	LS	\$	\$
2	Temporary Erosion and Sediment Control Measures and Temp Facilities	1	LS	\$	\$
3	All Demolition work inside of Powerhouse	1	LS	\$	\$
4	All Demolition work outside of Powerhouse	1	LS	\$	\$
5	Supply and install of new tailrace pipe and interconnection to new bypass system and hatchery pipe.	1	LS	\$	\$
6	Furnish and install of new 20" dia. steel Penstock and Specials (including pipe supports) STA10+00 to STA 11+50	1	LS	\$	\$
7	Furnish and install of new powerhouse bypass steel pipeline (including all fittings, pipe supports, installation of OWNER furnished equipment and accessories)	1	LS	\$	\$
8	Furnish and install of new dam valve house bypass steel pipeline (including all fittings, pipe supports, and installation of OWNER furnished equipment and accessories)	1	LS	\$	\$
9	Provision of all Maintenance Repairs to existing Penstock pipeline and supports (from STA 11+40 to STA 54+00)	1	LS	\$	\$
10	New penstock thrust blocks including new penstock thrust block at powerhouse and new thrust block at STA 11+50	1	LS	\$	\$
11	Powerhouse structural and architectural modifications	1	LS	\$	\$
12	Furnishing of all Mechanical and Electrical Equipment of Non-OFE equipment in Powerhouse	1	LS	\$	\$
13	Mechanical installation of all Equipment in Powerhouse Supplied by OWNER	1	LS	\$	\$

14	Electrical Subcontract for all electrical WORK inside and outside of powerhouse	1	LS	\$	\$
15	Instrumentation and Control Subcontract for all I&C WORK inside and outside of powerhouse	1	LS	\$	\$
16	Project Start-up, Commissioning, and training	1	LS	\$	\$
17	Final grading, install permanent erosion and sediment control BMP and final site revegetation in areas affected by ground disturbing activity	1	LS	\$	\$
18	All Other WORK items to complete all conditions of the Contract as directed by the OWNER (No greater than 5% of Contract Lump Sum Ttl)	1	LS	\$	\$
				Contract Lump Sum Total:	\$
Optional Bid Adder Price Items					
BID ITEM #	DESCRIPTION	BID QUANTITY	BID UNIT	UNIT PRICE	AMOUNT
1	Install of OWNER furnished new fiber optic cable from dam to powerhouse	1	LS		

If it becomes necessary to add or delete quantities from those depicted in the Contract Drawings, CONTRACTOR shall provide unit prices to install the items listed below as a basis of payment. No payment will be made for these items without prior written consent from OWNER.

Item	Unit Item Description	Units	Unit Price (\$)
1.	Rock Excavation	CY	\$
2.	Common Excavation	CY	\$

1.9 BIDDER GUARANTEES PERFORMANCE IN ACCORDANCE WITH THE FOLLOWING SCHEDULE: Based on Contract Notice to Proceed on OWNER's Target Date of January 2, 2023.

Milestone	OWNER Target Date (mo/day/yr)	Bidder Guaranteed No. of Calendar Days from Notice to Proceed (Number of Days)
1. Mobilize to site and start work.	May 1, 2023	
2. Shutdown Project (after hatchery flow has been spilled for 7-days at dam).	May 31, 2023	
3. Complete penstock and powerhouse bypass work such that spill at dam can be stopped and hatchery flows can be delivered through the penstock.	September 11, 2023	
4. Work under the Agreement is complete enough and the turbine/generator system is ready to begin start-up and Commissioning WORK.	September 12, 2023	
5. Work under the Agreement is Substantially Complete, and the powerhouse is generating electricity for the use of the OWNER	October 26, 2023	
5. Completion of 100% of the WORK (including punch-list items, demobilization and project closeout) under this Contract.	December 1, 2023	

1.10 OWNER TARGET DATES:

- A. **All Turbine/Generator Equipment delivered to Project Site:** February 28, 2023. During construction, Contractor shall refer to the Turbine/Generator design and installation contract schedule for the exact date. CONTRACTOR shall request, at a minimum, a monthly update of this schedule from OWNER to verify this date is still accurate.

1.11 ADDITIONAL ITEMS TO SUBMIT WITH BID

- A. General description of Bidder or Bidder's company, including date formed, types of projects performed, and overall size of the firm.
- B. General information on the financial condition of Bidder, including gross income for the previous three years and confirmation of by Bidder's bonding agent that bonds can be provided as required in these bid documents.
- C. One financial reference from financial institution familiar with Bidder.
- D. Bidder must submit references including names, addresses, phone numbers and email addresses for which the Bidder provided services on similar projects or installations that indicate the Bidder's capability to construct a project such as this one. Include construction and installation experience of similar projects. Comparable contracts should include the following:
1. Contract value of at least \$5 million;
 2. Major structures for water resource, pipelines or water navigation; and
 3. Installation and startup of similar projects to that specified.

If necessary, to cover the above criteria, up to 6 reference projects may be submitted.

- E. Bidder must submit a detailed schedule for performing the work and a description of the sequence of Work activities (Work Plan). **Provide a detailed description of methods and procedures for major activities, particularly installation of steel pipe and turbine-generator equipment installation.**
- F. Submit a worker safety plan.
- G. Submit documentation of Bidder's safety record on recent projects.
- H. Submit a list of major equipment and temporary facilities that Bidder anticipates using, such as cranes, scaffolding, etc. State whether bidder owns or will lease equipment, and whether Subcontractors will be used for this equipment.
- I. Submit an organizational chart and resumes for Bidder's project team. Bidder's project team should include the following key members:
1. Home office project manager;
 2. On-site project manager;

3. Project superintendent;
4. Office Engineer or assistant project manager;
5. Equipment installation superintendent or lead installer;
 - a. Each of the team members listed above shall have at least eight years of engineering or construction/installation experience including at least four or more years in a position comparable to that proposed for this Project. Include names, titles and phone numbers for two (2) client references for each key team member. In addition to needed technical skills and experience, OWNER desires professionals who are particularly effective communicators and collaborators, with a demonstrated capability and ability to work well in a construction environment where rapid decision- making skill, creative problem-solving skills, excellent planning and scheduling and close coordination with OWNER's Project Representative and design will be required. Please provide any specific credentials, training or expertise each key project member possesses to implement a collaborative, problem-solving project implementation approach on this type of project.
 - b. The proposed team shall not be modified without written authorization of OWNER. OWNER intends to confirm in its Agreement that the key project staff proposed by Contractor will be obligated to perform on the project team, and that Contractor will provide management and financial commitments to assure that the key project team members complete their project responsibilities without replacement by others, except with the consent of OWNER.
 - c. For Bidder's proposed project team, submit a list of projects that demonstrate:
 - 1) Experience with installation of large diameter pipelines.
 - 2) Experience with installation and startup similar to this Project.
 - 3) Experience with hydroelectric project work.
 - d. Note that it is desirable that these projects are ones where the proposed project team has worked on together. This is not a requirement, but experience of the proposed team, as a team on other projects, is preferred. Provide names, titles and phone numbers of references for each project listed.

J. SUBCONTRACTOR QUALIFICATIONS

1. Provide two project references for comparable work for all listed in Part 1.11. For each such Subcontractor provide the name of the project, a narrative description identifying the scope of Subcontractor's work, dollar value, owner, owner contact name, email and telephone number. If these portions of the Work are not subcontracted, the above references should be provided as part of Bidder's qualifications in addition to the references required in Paragraph C above.

Failure to provide above information will result in an incomplete and non-responsive bid.

1.12 BID EVALUATION

- A. The Agreement will not be awarded until OWNER is satisfied that the successful bidder is reasonably familiar with the class of work and has the necessary capital, tools, and experience to satisfactorily perform the same. Completion of the Work within the time stated is essential, time is of the essence, and prior commitments of the bidder, failure to complete other work on time, or reasonable doubt as to whether the bidder would complete the work on time, may cause for rejection of any bid.
- B. All elements or factors, whether or not specifically provided for in the CONTRACT DOCUMENTS including, but not limited to, the bidder's work safety record, which may affect the final cost to and the benefits to be derived by OWNER, may be considered by OWNER in determining the award of Contract.
- C. Evaluation of the Bid Proposals will consider the following criteria:
 - 1. First, the overall qualifications of each Bidder will be reviewed, including:
 - a. Experience of Bidder with projects of this size and type
 - b. Overall bid responsiveness
 - c. Bidder bondability
 - 2. Each Bidder will be evaluated as to whether they are qualified. Bidders judged to be unqualified will have their Bids rejected and returned. Bids of qualified Bidders will be evaluated by:
 - a. Total bid price
 - b. Guaranteed schedule and its cost impact on OWNER
 - c. Approach to work execution with respect to:
 - 1) Safety
 - 2) Efficiency
 - 3) How the bidder will assure the supply of water to the hatchery.
 - 4) How the Bidder intends to perform the penstock work in a timely manner.
 - 5) How Bidder intends to ensure the existing powerhouse will be made ready for OWNER - procured turbine and generator equipment installation as soon as possible. Installation to be supervised by Turbine manufacturer field service engineer.

1.13 SUBCONTRACTORS

- A. The turbine, generator, controls and associated equipment are being supplied by Gilbert Gilkes and Gordon LTD, Canal Head North, Kendal, Cumbria LA9 7BZ United Kingdom.

PART 2 -- BID SIGNATURES AND EXECUTION

This Bid is submitted By:

Bidder's Name

Street Address

City/State/Zip Code

Telephone Number Email Address

Submitted this _____ day of _____, 2017.

By _____
Signature of Authorized Person

Title _____

Phone No. _____ Corporate Seal (Affix corporate seal above)

Fax No. _____

Communications or questions concerning this Bid should be addressed to:

McMillen Jacobs Associates
1011 Western Avenue, Suite 706
Seattle, WA 98104
Attn: Don Jarrett,
P.E.
jarrett@mcmjac.com
425-503-5315

- END OF SECTION -

SECTION 00 30 00 BID BOND

KNOW ALL MEN BY THESE PRESENTS, that we, the undersigned, _____

_____ (name of Bidder) _____

_____ (address of Bidder) _____

_____ as a corporation, hereinafter called

Principal, and _____ (Name of Surety with A.M Best Rating

_____) hereinafter called Surety, are held and firmly bound unto Petersburg Municipal Power and Light, hereinafter called OWNER, in the total aggregate penal sum of

_____ Dollars (\$ _____) (5% of the Bid Price) in lawful money of the United States, for the payment of which sum, well and truly to be made, we hereby jointly and severally bind ourselves, our heirs, executors, administrators, successors and assigns.

Signed, this _____ day of _____, 2023.

The condition of the above obligation is such that whereas the Principal has submitted to OWNER a certain Bid, attached hereto and hereby made a part hereof to enter into an Agreement in writing, for the General Construction of the Blind Slough Hydroelectric Project.

NOW THEREFORE,

(a) If said Bid shall be rejected, or

(b) If said Bid shall be accepted and the Principal shall execute and deliver the Agreement in the form of Agreement, attachment hereto (properly completed in accordance with said Bid), and shall furnish all bonds required by the CONTRACT DOCUMENTS of which the Agreement is a part, and shall in all other respects perform the Agreement created by the acceptance of said Bid;

then this obligation shall be void; otherwise the same shall remain in force and effect; it being expressly understood and agreed that the liability of the Surety for any and all claims hereunder shall, in no event, exceed the penal amount of this obligation as herein stated.

The Surety, for value received, hereby stipulates and agrees that the obligations of said Surety and its Bond shall be in no way impaired or affected by any extension of the time within which OWNER may accept such Bid; and said Surety does hereby waive notice of any such extension.

(Intentionally Left Blank]

IN WITNESS WHEREOF, the Principal and the Surety have hereunto set their hands and seals, and such of them as are corporation have caused their corporate seals to be hereto affected and these presents to be signed by their proper officers, the day and year first set forth above.

_____(L.S.)
Principal

(Principal) Secretary

SEAL

By: _____
Title: _____

(address)

(address)

(Witness as to Principal)

(address)

(address)

Surety (A.M. Best Rating of____)

ATTEST:

(Witness as to Surety)

By: _____
Attorney-in-Fact

(address)

(address)

By: _____
(SEAL)

END OF SECTION

SECTION 00 50 00 – AGREEMENT BETWEEN OWNER AND CONTRACTOR
FOR CONSTRUCTION CONTRACT (STIPULATED PRICE)

This Agreement is by and between **Petersburg Borough dba Petersburg Municipal Power & Light** (“Owner”) and **[name of contracting entity]** (“Contractor”).

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

Owner and Contractor hereby agree as follows:

ARTICLE 1—WORK

- 1.01 Contractor shall complete all Work as specified or indicated in the Contract Documents. The Work is generally described as follows: The Work of this Contract is to refurbish and repair the Blind Slough Hydroelectric Project.
- 1.02 The powerhouse is an existing above ground structure housing one horizontal-shaft, single jet Pelton-type hydraulic turbine, directly connected synchronous generator, and controls. The existing turbine-generator, controls and auxiliary equipment will be replaced with a new turbine generating unit controls and auxiliary equipment. The OWNER has purchased a new turbine-generator equipment system (described herein) from the Turbine-Generator Equipment Supplier (TGES) for the refurbishment of the project. The TGES will deliver the turbine-generator and auxiliary equipment to the project site (or at a storage warehouse in Petersburg). The TGES is Gilbert, Gilkes & Gordon, LTD. On-site storage, handling and all installation and startup services of the TGES system shall be by the CONTRACTOR under this Contract.
- 1.03 Other work includes modifications to the lower part of the penstock, and new thrust blocks, and powerhouse bypass system off the lower part of the penstock and a new dam valve house bypass system (to provide Crystal Lake Fish Hatchery flows during construction), temporary erosion and sediment control, final grading, etc.
- 1.04 A major constraint of the Work of the Contract is the requirement to provide water to the Crystal Lake Fish Hatchery at all times in accordance with the FERC license requirements.

ARTICLE 2—THE PROJECT

- 2.01 The Project, of which the Work under the Contract Documents is a part, is generally described as follows: The Blind Slough Hydroelectric Project is an existing hydroelectric facility located south of the City of Petersburg, Alaska (see Google Earth map below). The existing project consists of a dam (which impounds the Crystal Lake Reservoir), a 4,600-foot-long penstock and a powerhouse with a single 2.1

MW turbine-generator unit. The existing facility is a hydroelectric project licensed by the Federal Energy Regulatory Commission, project P-201.

ARTICLE 3—ENGINEER

- 3.01 The Owner has retained **McMillen Jacobs Associates** (“Engineer”) to act as Owner’s representative, assume all duties and responsibilities of Engineer, and have the rights and authority assigned to Engineer in the Contract.
- 3.02 The part of the Project that pertains to the Work has been designed by Engineer.

ARTICLE 4—CONTRACT TIMES

4.01 *Time is of the Essence*

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

4.02 *Contract Times: Days*

- A. The Work will be substantially complete within **the number of days bid** after the date when the Contract Times commence to run as provided in Paragraph 4.01 of the General Conditions, and completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions within **[number]** days after the date when the Contract Times commence to run.

4.04 *Milestones*

- A. Parts of the Work must be substantially completed on or before the following Milestone(s):
1. **Milestone 1: Mobilization to the site within 119 days**
 2. **Milestone 2: Shutdown Project (provide hatchery flows by spill at the dam for 7-days) within 149 days**
 3. **Milestone 3: Complete penstock and powerhouse bypass system, refill the penstock and provide fish hatchery flow with powerhouse bypass within 254 days**
 4. **Milestone 4: Work sufficiently complete that startup and commissioning can begin within 253 days.**
 4. **Milestone 5: Substantial Completion (startup and commissioning complete and Project online and producing power) within 297 days.**

4.05 *Liquidated Damages*

- A. Contractor and Owner recognize that time is of the essence as stated in Paragraph 4.01 above and that Owner will suffer financial and other losses if the Work is not completed and Milestones not achieved within the Contract Times, as duly modified. 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):
1. *Substantial Completion:* Contractor shall pay Owner **\$2,500** for each day that expires after the time (as duly adjusted pursuant to the Contract) specified above for Substantial Completion, until the Work is substantially complete.

2. *Completion of Remaining Work:* After Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Times (as duly adjusted pursuant to the Contract) for completion and readiness for final payment, Contractor shall pay Owner **\$1,000** for each day that expires after such time until the Work is completed and ready for final payment.
 4. Liquidated damages for failing to timely attain Milestones, Substantial Completion, and final completion are not additive, and will not be imposed concurrently.
- B. If Owner recovers liquidated damages for a delay in completion by Contractor, then such liquidated damages are Owner's sole and exclusive remedy for such delay, and Owner is precluded from recovering any other damages, whether actual, direct, excess, or consequential, for such delay, except for special damages (if any) specified in this Agreement.

4.06 *Special Damages*

- A. Contractor shall reimburse Owner (1) for any fines or penalties imposed on Owner as a direct result of the Contractor's failure to attain Substantial Completion according to the Contract Times, and (2) for the actual costs reasonably incurred by Owner for engineering, construction observation, inspection, and administrative services needed after the time specified in Paragraph 4.02 for Substantial Completion (as duly adjusted pursuant to the Contract), until the Work is substantially complete.
- B. After Contractor achieves Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Times, Contractor shall reimburse Owner for the actual costs reasonably incurred by Owner for engineering, construction observation, inspection, and administrative services needed after the time specified in Paragraph 4.02 for Work to be completed and ready for final payment (as duly adjusted pursuant to the Contract), until the Work is completed and ready for final payment.
- C. The special damages imposed in this paragraph are supplemental to any liquidated damages for delayed completion established in this Agreement.

ARTICLE 5—CONTRACT PRICE

- 5.01 Owner shall pay Contractor for completion of the Work in accordance with the Contract Documents, the amounts that follow, subject to adjustment under the Contract:
- A. For all Work other than Unit Price Work, a lump sum of **[\$number]**.
All specific cash allowances are included in the above price in accordance with Paragraph 13.02 of the General Conditions.
- B. Unit Price Work : None..
- C. Total of Lump Sum Amount and Unit Price Work (subject to final Unit Price adjustment) **[\$number]**.
- D. For all Work, at the prices stated in Contractor's Bid, attached hereto as an exhibit.

ARTICLE 6—PAYMENT PROCEDURES

6.01 *Submittal and Processing of Payments*

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

6.02 *Progress Payments; Retainage*

- A. Owner shall make progress payments on the basis of Contractor's Applications for Payment on or about the **5th** day of each month during performance of the Work as provided in Paragraph 6.02.A.1 below, provided that such Applications for Payment have been submitted in a timely manner and otherwise meet the requirements of the Contract. All such payments will be measured by the Schedule of Values established as provided in the General Conditions (and in the case of Unit Price Work based on the number of units completed) or, in the event there is no Schedule of Values, as provided elsewhere in the Contract.
 - 1. Prior to Substantial Completion, progress payments will be made in an amount equal to the percentage indicated below but, in each case, less the aggregate of payments previously made and less such amounts as Owner may withhold, including but not limited to liquidated damages, in accordance with the Contract.
 - a. **95%** percent of the value of the Work completed (with the balance being retainage).
 - 1) If 50 percent or more of the Work has been completed, as determined by Engineer, and if the character and progress of the Work have been satisfactory to Owner and Engineer, then as long as the character and progress of the Work remain satisfactory to Owner and Engineer, there will be no additional retainage; and
 - b. **100%** percent of cost of materials and equipment not incorporated in the Work (with the balance being retainage).
- B. Upon Substantial Completion, Owner shall pay an amount sufficient to increase total payments to Contractor to **100%** percent of the Work completed, less such amounts set off by Owner pursuant to Paragraph 15.01.E of the General Conditions, and less **100%** percent of Engineer's estimate of the value of Work to be completed or corrected as shown on the punch list of items to be completed or corrected prior to final payment.

6.03 *Final Payment*

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

6.04 *Consent of Surety*

- A. Owner will not make final payment, or return or release retainage at Substantial Completion or any other time, unless Contractor submits written consent of the surety to such payment, return, or release.

6.05 *Interest*

- A. All amounts not paid when due will bear interest at the rate of **[number]** percent per annum.

ARTICLE 7—CONTRACT DOCUMENTS

7.01 *Contents*

- A. The Contract Documents consist of all of the following:
1. This Agreement.
 2. Bonds:
 - a. Performance bond (together with power of attorney).
 - b. Payment bond (together with power of attorney).
 3. General Conditions.
 4. Supplementary Conditions.
 5. Specifications as listed in the table of contents of the project manual (copy of list attached).
 6. Drawings (not attached but incorporated by reference) consisting of **[number]** sheets with each sheet bearing the following general title: **[title on Drawings]**.
 8. Addenda (numbers **[number]** to **[number]**, inclusive).
 9. Exhibits to this Agreement (enumerated as follows):
 - a. **Contractor's bid**
 10. The following which may be delivered or issued on or after the Effective Date of the Contract and are not attached hereto:
 - a. Notice to Proceed.
 - b. Work Change Directives.
 - c. Change Orders.
 - d. Field Orders.
 - e. Warranty Bond, if any.
- B. The Contract Documents listed in Paragraph 7.01.A are attached to this Agreement (except as expressly noted otherwise above).
- C. There are no Contract Documents other than those listed above in this Article 7.
- D. The Contract Documents may only be amended, modified, or supplemented as provided in the Contract.

ARTICLE 8—REPRESENTATIONS, CERTIFICATIONS, AND STIPULATIONS

8.01 *Contractor's Representations*

- A. In order to induce Owner to enter into this Contract, Contractor makes the following representations:
1. Contractor has examined and carefully studied the Contract Documents, including Addenda.
 2. Contractor has visited the Site, conducted a thorough visual examination of the Site and adjacent areas, and become familiar with the general, local, and Site conditions that may affect cost, progress, and performance of the Work.

3. Contractor is familiar with all Laws and Regulations that may affect cost, progress, and performance of the Work.
4. Contractor has carefully studied the reports of explorations and tests of subsurface conditions at or adjacent to the Site and the drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, with respect to the Technical Data in such reports and drawings.
5. Contractor has carefully studied the reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, with respect to Technical Data in such reports and drawings.
6. Contractor has considered the information known to Contractor itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Contract Documents; and the Technical Data identified in the Supplementary Conditions or by definition, with respect to the effect of such information, observations, and Technical Data on (a) the cost, progress, and performance of the Work; (b) the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor; and (c) Contractor's safety precautions and programs.
7. Based on the information and observations referred to in the preceding paragraph, Contractor agrees that no further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract.
8. 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.
9. Contractor has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Contractor has discovered in the Contract Documents, and of discrepancies between Site conditions and the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.
10. The Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.
11. Contractor's entry into this Contract constitutes an incontrovertible representation by Contractor that without exception all prices in the Agreement are premised upon performing and furnishing the Work required by the Contract Documents.

8.02 *Contractor's Certifications*

- A. Contractor certifies that it has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for or in executing the Contract. For the purposes of this Paragraph 8.02:
 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 the Contract execution;
 2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process or the execution of the Contract to the detriment of Owner, (b) to establish Bid or Contract prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;

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

8.03 *Standard General Conditions*

- A. Owner stipulates that if the General Conditions that are made a part of this Contract are EJCDC® C-700, Standard General Conditions for the Construction Contract (2018), published by the Engineers Joint Contract Documents Committee, and if Owner is the party that has furnished said General Conditions, then Owner has plainly shown all modifications to the standard wording of such published document to the Contractor, through a process such as highlighting or “track changes” (redline/strikeout), or in the Supplementary Conditions.

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

This Agreement will be effective on **[indicate date on which Contract becomes effective]** (which is the Effective Date of the Contract).

Owner:

Contractor:

(typed or printed name of organization)

(typed or printed name of organization)

By: _____
(individual's signature)

By: _____
(individual's signature)

Date: _____
(date signed)

Date: _____
(date signed)

Name: _____
(typed or printed)

Name: _____
(typed or printed)

Title: _____
(typed or printed)

Title: _____
(typed or printed)

(If [Type of Entity] is a corporation, a partnership, or a joint venture, attach evidence of authority to sign.)

Attest: _____
(individual's signature)

Attest: _____
(individual's signature)

Title: _____
(typed or printed)

Title: _____
(typed or printed)

Address for giving notices:

Address for giving notices:

Designated Representative:

Designated Representative:

Name: _____
(typed or printed)

Name: _____
(typed or printed)

Title: _____
(typed or printed)

Title: _____
(typed or printed)

Address:

Address:

Phone: _____

Phone: _____

Email: _____

Email: _____

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

License No.: _____
(where applicable)

State: _____

SECTION 00 51 00 - NOTICE OF AWARD

To: _____

Project Description: General Construction of the Blind Slough Hydroelectric Project. OWNER has considered the Bid Proposal submitted by you for the above-described Work in response to its Request for Bids dated _____ and for Instruction for Bidders.

You are hereby notified that your Bid has been accepted in the amount of

\$ _____ Dollars

\$ _____ (without tax).

You are required by the Instruction for Bidders to execute the Agreement and furnish the required Contractor's Performance Bond, Payment Bond, and certificates of insurance within ten (10) calendar days from the date of this Notice to you.

1. You must deliver with the executed Agreement, the Contract Security (Bonds) as specified in the General Conditions.
2. You must deliver the required Certificates of Insurance naming OWNER and others as additional insureds as required in Paragraph 26 of the General Conditions.

If you fail to execute the Agreement and to furnish the Bonds within ten (10) days from the date of this Notice, OWNER will be entitled to consider all your rights arising out of OWNER's acceptance of your Bid as abandoned and as a forfeiture of your Bid Bond. OWNER will be entitled to such other rights as may be granted by law.

You are required to return an acknowledged copy of this Notice of Award by OWNER. Dated this _____ day of ___, 2023.

Petersburg Municipal Power and Light. (OWNER)

By: _____

Title: _____

ACCEPTANCE OF NOTICE OF AWARD

Receipt of the above Notice of Award is hereby acknowledged:

CONTRACTOR:

By: _____

Title: _____

Date: _____, 2022

- END OF SECTION -

SECTION 00 55 00 – NOTICE-TO-PROCEED

TO: _____

DATE: _____, 2022

PROJECT: General Construction of Blind Slough Hydroelectric Project.

You are hereby notified to commence Work in accordance with the Agreement dated _____, 2023, on or before _____, 2023, and you are to achieve Substantial Completion of the Work within 297 consecutive calendar days thereafter. The date of Substantial Completion of all Work is therefore October 26, 2023.

OWNER:
Petersburg Municipal Power and Light

By: _____

Title: _____

ACCEPTANCE OF NOTICE

Receipt of the above Notice to Proceed is hereby acknowledged by:

on _____, 2022

By _____ Title _____

Employer Identification Number _____

Issued for Review

- END OF SECTION -

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SECTION 00 61 00 PERFORMANCE BOND

<p>Contractor Name: [Full formal name of Contractor] Address <i>(principal place of business)</i>: [Address of Contractor's principal place of business]</p>	<p>Surety Name: [Full formal name of Surety] Address <i>(principal place of business)</i>: [Address of Surety's principal place of business]</p>
<p>Owner Name: [Full formal name of Owner] Mailing address <i>(principal place of business)</i>: [Address of Owner's principal place of business]</p>	<p>Contract Description <i>(name and location)</i>: [Owner's project/contract name, and location of the project] Contract Price: [Amount from Contract] Effective Date of Contract: [Date from Contract]</p>
<p>Bond Bond Amount: [Amount] Date of Bond: [Date] <i>(Date of Bond cannot be earlier than Effective Date of Contract)</i></p> <p>Modifications to this Bond form: <input type="checkbox"/> None <input type="checkbox"/> See Paragraph 16</p>	
<p>Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth in this Performance Bond, do each cause this Performance Bond to be duly executed by an authorized officer, agent, or representative.</p>	
<p>Contractor as Principal</p>	<p>Surety</p>
<p>_____ <i>(Full formal name of Contractor)</i></p>	<p>_____ <i>(Full formal name of Surety) (corporate seal)</i></p>
<p>By: _____ <i>(Signature)</i></p>	<p>By: _____ <i>(Signature)(Attach Power of Attorney)</i></p>
<p>Name: _____ <i>(Printed or typed)</i></p>	<p>Name: _____ <i>(Printed or typed)</i></p>
<p>Title: _____</p>	<p>Title: _____</p>
<p>Attest: _____ <i>(Signature)</i></p>	<p>Attest: _____ <i>(Signature)</i></p>
<p>Name: _____ <i>(Printed or typed)</i></p>	<p>Name: _____ <i>(Printed or typed)</i></p>
<p>Title: _____</p>	<p>Title: _____</p>
<p><i>Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party is considered plural where applicable.</i></p>	

1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner for the performance of the Construction Contract, which is incorporated herein by reference.
2. If the Contractor performs the Construction Contract, the Surety and the Contractor shall have no obligation under this Bond, except when applicable to participate in a conference as provided in Paragraph 3.
3. If there is no Owner Default under the Construction Contract, the Surety's obligation under this Bond will arise after:
 - 3.1. The Owner first provides notice to the Contractor and the Surety that the Owner is considering declaring a Contractor Default. Such notice may indicate whether the Owner is requesting a conference among the Owner, Contractor, and Surety to discuss the Contractor's performance. If the Owner does not request a conference, the Surety may, within five (5) business days after receipt of the Owner's notice, request such a conference. If the Surety timely requests a conference, the Owner shall attend. Unless the Owner agrees otherwise, any conference requested under this Paragraph 3.1 will be held within ten (10) business days of the Surety's receipt of the Owner's notice. If the Owner, the Contractor, and the Surety agree, the Contractor shall be allowed a reasonable time to perform the Construction Contract, but such an agreement does not waive the Owner's right, if any, subsequently to declare a Contractor Default;
 - 3.2. The Owner declares a Contractor Default, terminates the Construction Contract and notifies the Surety; and
 - 3.3. The Owner has agreed to pay the Balance of the Contract Price in accordance with the terms of the Construction Contract to the Surety or to a contractor selected to perform the Construction Contract.
4. Failure on the part of the Owner to comply with the notice requirement in Paragraph 3.1 does not constitute a failure to comply with a condition precedent to the Surety's obligations, or release the Surety from its obligations, except to the extent the Surety demonstrates actual prejudice.
5. When the Owner has satisfied the conditions of Paragraph 3, the Surety shall promptly and at the Surety's expense take one of the following actions:
 - 5.1. Arrange for the Contractor, with the consent of the Owner, to perform and complete the Construction Contract;
 - 5.2. Undertake to perform and complete the Construction Contract itself, through its agents or independent contractors;
 - 5.3. Obtain bids or negotiated proposals from qualified contractors acceptable to the Owner for a contract for performance and completion of the Construction Contract, arrange for a contract to be prepared for execution by the Owner and a contractor selected with the Owners concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Construction Contract, and pay to the Owner the amount of damages as described in Paragraph 7 in excess of the Balance of the Contract Price incurred by the Owner as a result of the Contractor Default; or
 - 5.4. Waive its right to perform and complete, arrange for completion, or obtain a new contractor, and with reasonable promptness under the circumstances:
 - 5.4.1 After investigation, determine the amount for which it may be liable to the Owner and, as soon as practicable after the amount is determined, make payment to the Owner; or
 - 5.4.2 Deny liability in whole or in part and notify the Owner, citing the reasons for denial.
6. If the Surety does not proceed as provided in Paragraph 5 with reasonable promptness, the Surety shall be deemed to be in default on this Bond seven days after receipt of an additional written notice from the Owner to the Surety demanding that the Surety perform its obligations under this Bond, and the Owner shall be

entitled to enforce any remedy available to the Owner. If the Surety proceeds as provided in Paragraph 5.4, and the Owner refuses the payment, or the Surety has denied liability, in whole or in part, without further notice, the Owner shall be entitled to enforce any remedy available to the Owner.

7. If the Surety elects to act under Paragraph 5.1, 5.2, or 5.3, then the responsibilities of the Surety to the Owner will not be greater than those of the Contractor under the Construction Contract, and the responsibilities of the Owner to the Surety will not be greater than those of the Owner under the Construction Contract. Subject to the commitment by the Owner to pay the Balance of the Contract Price, the Surety is obligated, without duplication for:
 - 7.1. the responsibilities of the Contractor for correction of defective work and completion of the Construction Contract;
 - 7.2. additional legal, design professional, and delay costs resulting from the Contractor's Default, and resulting from the actions or failure to act of the Surety under Paragraph 5; and
 - 7.3. liquidated damages, or if no liquidated damages are specified in the Construction Contract, actual damages caused by delayed performance or non-performance of the Contractor.
8. If the Surety elects to act under Paragraph 5.1, 5.3, or 5.4, the Surety's liability is limited to the amount of this Bond.
9. The Surety shall not be liable to the Owner or others for obligations of the Contractor that are unrelated to the Construction Contract, and the Balance of the Contract Price will not be reduced or set off on account of any such unrelated obligations. No right of action will accrue on this Bond to any person or entity other than the Owner or its heirs, executors, administrators, successors, and assigns.
10. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders, and other obligations.
11. Any proceeding, legal or equitable, under this Bond must be instituted in any court of competent jurisdiction in the location in which the work or part of the work is located and must be instituted within two years after a declaration of Contractor Default or within two years after the Contractor ceased working or within two years after the Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this paragraph are void or prohibited by law, the minimum periods of limitations available to sureties as a defense in the jurisdiction of the suit will be applicable.
12. Notice to the Surety, the Owner, or the Contractor must be mailed or delivered to the address shown on the page on which their signature appears.
13. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement will be deemed deleted therefrom and provisions conforming to such statutory or other legal requirement will be deemed incorporated herein. When so furnished, the intent is that this Bond will be construed as a statutory bond and not as a common law bond.
14. Definitions
 - 14.1. *Balance of the Contract Price*—The total amount payable by the Owner to the Contractor under the Construction Contract after all proper adjustments have been made including allowance for the Contractor for any amounts received or to be received by the Owner in settlement of insurance or other claims for damages to which the Contractor is entitled, reduced by all valid and proper payments made to or on behalf of the Contractor under the Construction Contract.
 - 14.2. *Construction Contract*—The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and changes made to the agreement and the Contract Documents.
 - 14.3. *Contractor Default*—Failure of the Contractor, which has not been remedied or waived, to perform or otherwise to comply with a material term of the Construction Contract.

- 14.4. *Owner Default*—Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.
- 14.5. *Contract Documents*—All the documents that comprise the agreement between the Owner and Contractor.
15. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond will be deemed to be Subcontractor and the term Owner will be deemed to be Contractor.
16. Modifications to this Bond are as follows: **[Describe modification or enter “None”]**

- END OF SECTION -

SECTION 00 62 00 - PAYMENT BOND

PAYMENT BOND

<p>Contractor Name: [Full formal name of Contractor] Address <i>(principal place of business)</i>: [Address of Contractor's principal place of business]</p>	<p>Surety Name: [Full formal name of Surety] Address <i>(principal place of business)</i>: [Address of Surety's principal place of business]</p>
<p>Owner Name: [Full formal name of Owner] Mailing address <i>(principal place of business)</i>: [Address of Owner's principal place of business]</p>	<p>Contract Description <i>(name and location)</i>: [Owner's project/contract name, and location of the project] Contract Price: [Amount, from Contract] Effective Date of Contract: [Date, from Contract]</p>
<p>Bond Bond Amount: [Amount] Date of Bond: [Date] <i>(Date of Bond cannot be earlier than Effective Date of Contract)</i> Modifications to this Bond form: <input type="checkbox"/> None <input type="checkbox"/> See Paragraph 18</p>	
<p>Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth in this Payment Bond, do each cause this Payment Bond to be duly executed by an authorized officer, agent, or representative.</p>	
Contractor as Principal	Surety
<i>(Full formal name of Contractor)</i>	<i>(Full formal name of Surety) (corporate seal)</i>
By: _____ <i>(Signature)</i>	By: _____ <i>(Signature)(Attach Power of Attorney)</i>
Name: _____ <i>(Printed or typed)</i>	Name: _____ <i>(Printed or typed)</i>
Title: _____	Title: _____
Attest: _____ <i>(Signature)</i>	Attest: _____ <i>(Signature)</i>
Name: _____ <i>(Printed or typed)</i>	Name: _____ <i>(Printed or typed)</i>
Title: _____	Title: _____
<p><i>Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party is considered plural where applicable.</i></p>	

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

attorney's fees the Claimant incurs thereafter to recover any sums found to be due and owing to the Claimant.

8. The Surety's total obligation will not exceed the amount of this Bond, plus the amount of reasonable attorney's fees provided under Paragraph 7.3, and the amount of this Bond will be credited for any payments made in good faith by the Surety.
9. Amounts owed by the Owner to the Contractor under the Construction Contract will be used for the performance of the Construction Contract and to satisfy claims, if any, under any construction performance bond. By the Contractor furnishing and the Owner accepting this Bond, they agree that all funds earned by the Contractor in the performance of the Construction Contract are dedicated to satisfying obligations of the Contractor and Surety under this Bond, subject to the Owner's priority to use the funds for the completion of the work.
10. The Surety shall not be liable to the Owner, Claimants, or others for obligations of the Contractor that are unrelated to the Construction Contract. The Owner shall not be liable for the payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligation to make payments to or give notice on behalf of Claimants, or otherwise have any obligations to Claimants under this Bond.
11. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders, and other obligations.
12. No suit or action will be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the state in which the project that is the subject of the Construction Contract is located or after the expiration of one year from the date (1) on which the Claimant sent a Claim to the Surety pursuant to Paragraph 5.1.2 or 5.2, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Construction Contract, whichever of (1) or (2) first occurs. If the provisions of this paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit will be applicable.
13. Notice and Claims to the Surety, the Owner, or the Contractor must be mailed or delivered to the address shown on the page on which their signature appears. Actual receipt of notice or Claims, however accomplished, will be sufficient compliance as of the date received.
14. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement will be deemed deleted here from and provisions conforming to such statutory or other legal requirement will be deemed incorporated herein. When so furnished, the intent is that this Bond will be construed as a statutory bond and not as a common law bond.
15. Upon requests by any person or entity appearing to be a potential beneficiary of this Bond, the Contractor and Owner shall promptly furnish a copy of this Bond or shall permit a copy to be made.
16. Definitions
 - 16.1. *Claim*—A written statement by the Claimant including at a minimum:
 - 16.1.1. The name of the Claimant;
 - 16.1.2. The name of the person for whom the labor was done, or materials or equipment furnished;

- 16.1.3. A copy of the agreement or purchase order pursuant to which labor, materials, or equipment was furnished for use in the performance of the Construction Contract;
 - 16.1.4. A brief description of the labor, materials, or equipment furnished;
 - 16.1.5. The date on which the Claimant last performed labor or last furnished materials or equipment for use in the performance of the Construction Contract;
 - 16.1.6. The total amount earned by the Claimant for labor, materials, or equipment furnished as of the date of the Claim;
 - 16.1.7. The total amount of previous payments received by the Claimant; and
 - 16.1.8. The total amount due and unpaid to the Claimant for labor, materials, or equipment furnished as of the date of the Claim.
- 16.2. *Claimant*—An individual or entity having a direct contract with the Contractor or with a subcontractor of the Contractor to furnish labor, materials, or equipment for use in the performance of the Construction Contract. The term Claimant also includes any individual or entity that has rightfully asserted a claim under an applicable mechanic's lien or similar statute against the real property upon which the Project is located. The intent of this Bond is to include without limitation in the terms of "labor, materials, or equipment" that part of the water, gas, power, light, heat, oil, gasoline, telephone service, or rental equipment used in the Construction Contract, architectural and engineering services required for performance of the work of the Contractor and the Contractor's subcontractors, and all other items for which a mechanic's lien may be asserted in the jurisdiction where the labor, materials, or equipment were furnished.
- 16.3. *Construction Contract*—The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and all changes made to the agreement and the Contract Documents.
- 16.4. *Owner Default*—Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.
- 16.5. *Contract Documents*—All the documents that comprise the agreement between the Owner and Contractor.
17. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond will be deemed to be Subcontractor and the term Owner will be deemed to be Contractor.
18. Modifications to this Bond are as follows: **[Describe modification or enter "None"]**

This document has important legal consequences; consultation with an attorney is encouraged with respect to its use or modification. This document should be adapted to the particular circumstances of the contemplated Project and the controlling Laws and Regulations.

STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

Prepared By



Endorsed By



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STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

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 document prepared by Contractor, in a form acceptable to Engineer, to request 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; 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; 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.
- 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.
 - c. A demand or assertion by Owner or Contractor, duly submitted in compliance with the procedural requirements set forth herein, made pursuant to Paragraph 12.01.A.4, concerning disputes arising after Engineer has issued a recommendation of final payment.
 - d. 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), lead-based paint (as defined by the HUD/EPA standard), hazardous waste, and any substance, product, waste, or other material of any nature whatsoever that is or becomes listed, regulated, or addressed pursuant to Laws and Regulations 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 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. *Electronic Document*—Any Project-related correspondence, attachments to correspondence, data, documents, drawings, information, or graphics, including but not limited to Shop Drawings and other Submittals, that are in an electronic or digital format.
 21. *Electronic Means*—Electronic mail (email), upload/download from a secure Project website, or other communications methods that allow: (a) the transmission or communication of Electronic Documents; (b) the documentation of transmissions, including sending and receipt; (c) printing of the transmitted Electronic Document by the

recipient; (d) the storage and archiving of the Electronic Document by sender and recipient; and (e) the use by recipient of the Electronic Document for purposes permitted by this Contract. Electronic Means does not include the use of text messaging, or of Facebook, Twitter, Instagram, or similar social media services for transmission of Electronic Documents.

22. *Engineer*—The individual or entity named as such in the Agreement.
23. *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.
24. *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.
 - a. The presence at the Site of materials that are necessary for the execution of the Work, or that are to be incorporated into the Work, and that are controlled and contained pursuant to industry practices, Laws and Regulations, and the requirements of the Contract, is not a Hazardous Environmental Condition.
 - b. The presence of Constituents of Concern that are to be removed or remediated as part of the Work is not a Hazardous Environmental Condition.
 - c. The presence of Constituents of Concern as part of the routine, anticipated, and obvious working conditions at the Site, is not a Hazardous Environmental Condition.
25. *Laws and Regulations; Laws or Regulations*—Any and all applicable laws, statutes, rules, regulations, ordinances, codes, and binding decrees, resolutions, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.
26. *Liens*—Charges, security interests, or encumbrances upon Contract-related funds, real property, or personal property.
27. *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.
28. *Notice of Award*—The written notice by Owner to a Bidder of Owner's acceptance of the Bid.
29. *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.
30. *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.
31. *Progress Schedule*—A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising Contractor's plan to accomplish the Work within the Contract Times.
32. *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.

33. *Resident Project Representative*—The authorized representative of Engineer assigned to assist Engineer at the Site. As used herein, the term Resident Project Representative (RPR) includes any assistants or field staff of Resident Project Representative.
34. *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.
35. *Schedule of Submittals*—A schedule, prepared and maintained by Contractor, of required submittals and the time requirements for Engineer’s review of the submittals.
36. *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.
37. *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.
38. *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 or areas furnished by Owner which are designated for the use of Contractor.
39. *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.
40. *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.
41. *Submittal*—A written or graphic document, prepared by or for Contractor, which the Contract Documents require Contractor to submit to Engineer, or that is indicated as a Submittal in the Schedule of Submittals accepted by Engineer. Submittals may include Shop Drawings and Samples; schedules; product data; Owner-delegated designs; sustainable design information; information on special procedures; testing plans; results of tests and evaluations, source quality-control testing and inspections, and field or Site quality-control testing and inspections; warranties and certifications; Suppliers’ instructions and reports; records of delivery of spare parts and tools; operations and maintenance data; Project photographic documentation; record documents; and other such documents required by the Contract Documents. Submittals, whether or not approved or accepted by Engineer, are not Contract Documents. Change Proposals, Change Orders, Claims, notices, Applications for Payment, and requests for interpretation or clarification are not Submittals.
42. *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 of such Work.

43. *Successful Bidder*—The Bidder to which the Owner makes an award of contract.
44. *Supplementary Conditions*—The part of the Contract that amends or supplements these General Conditions.
45. *Supplier*—A manufacturer, fabricator, supplier, distributor, 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.
46. *Technical Data*
- a. Those items expressly identified as Technical Data in the Supplementary Conditions, with respect to either (1) existing subsurface conditions at or adjacent to the Site, or existing physical conditions at or adjacent to the Site including existing surface or subsurface structures (except Underground Facilities) or (2) Hazardous Environmental Conditions at the Site.
 - b. If no such express identifications of Technical Data have been made with respect to conditions at the Site, then Technical Data is defined, with respect to conditions at the Site under Paragraphs 5.03, 5.04, and 5.06, as the data contained in boring logs, recorded measurements of subsurface water levels, assessments of the condition of subsurface facilities, laboratory test results, and other factual, objective information regarding conditions at the Site that are set forth in any geotechnical, environmental, or other Site or facilities conditions report prepared for the Project and made available to Contractor.
 - c. Information and data regarding the presence or location of Underground Facilities are not intended to be categorized, identified, or defined as Technical Data, and instead Underground Facilities are shown or indicated on the Drawings.
47. *Underground Facilities*—All active or not-in-service underground lines, pipelines, conduits, ducts, encasements, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or systems at the Site, including but not limited to those facilities or systems that produce, transmit, distribute, or convey telephone or other communications, cable television, fiber optic transmissions, power, electricity, light, heat, gases, oil, crude oil products, liquid petroleum products, water, steam, waste, wastewater, storm water, other liquids or chemicals, or traffic or other control systems. An abandoned facility or system is not an Underground Facility.
48. *Unit Price Work*—Work to be paid for on the basis of unit prices.
49. *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.
50. *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 Paragraphs 1.02.B, C, D, and E are not defined terms that require initial capital letters, but, when used in the Bidding Requirements or Contract Documents, have the indicated meaning.
- B. *Intent of Certain Terms or Adjectives:* 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:* The word “day” means a calendar day of 24 hours measured from midnight to the next midnight.
- D. *Defective:* The word “defective,” when modifying the word “Work,” refers to Work that is unsatisfactory, faulty, or deficient in that it:
1. does not conform to the Contract Documents;
 2. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents; or
 3. 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 Paragraph 15.04).
- E. *Furnish, Install, Perform, Provide*
1. The word “furnish,” when used in connection with services, materials, or equipment, means 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, means 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, means 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. *Contract Price or Contract Times*: References to a change in “Contract Price or Contract Times” or “Contract Times or Contract Price” or similar, indicate that such change applies to (1) Contract Price, (2) Contract Times, or (3) both Contract Price and Contract Times, as warranted, even if the term “or both” is not expressed.
- G. 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 Performance and Payment Bonds; Evidence of Insurance*

- A. *Performance and Payment Bonds*: When Contractor delivers the signed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner the performance bond and payment bond (if the Contract requires Contractor to furnish such bonds).
- B. *Evidence of Contractor’s Insurance*: When Contractor delivers the signed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner, with copies to each additional insured (as identified in the Contract), the certificates, endorsements, and other evidence of insurance required to be provided by Contractor in accordance with Article 6, except to the extent the Supplementary Conditions expressly establish other dates for delivery of specific insurance policies.
- C. *Evidence of Owner’s Insurance*: After receipt of the signed counterparts of the Agreement and all required bonds and insurance documentation, Owner shall promptly deliver to Contractor, with copies to each additional insured (as identified in the Contract), 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 signed 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 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 *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 the schedules submitted in accordance with Paragraph 2.03.A. No progress payment will 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.
 - 4. If a schedule is not acceptable, Contractor will have an additional 10 days to revise and resubmit the schedule.

2.06 *Electronic Transmittals*

- A. Except as otherwise stated elsewhere in the Contract, the Owner, Engineer, and Contractor may send, and shall accept, Electronic Documents transmitted by Electronic Means.
- B. If the Contract does not establish protocols for Electronic Means, then Owner, Engineer, and Contractor shall jointly develop such protocols.
- C. Subject to any governing protocols for Electronic Means, when transmitting Electronic Documents by Electronic Means, the transmitting party makes no representations as to long-term compatibility, usability, or readability of the Electronic Documents 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 Electronic Documents.

ARTICLE 3—CONTRACT DOCUMENTS: INTENT, REQUIREMENTS, REUSE

3.01 *Intent*

- A. The Contract Documents are complementary; what is required by one Contract Document 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 versions of the Contract Documents (including any printed copies derived from such electronic versions) and the printed record version, the printed record version will 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.
- F. Any provision or part of the Contract Documents held to be void or unenforceable under any Law or Regulation will be deemed stricken, and all remaining provisions will continue to be valid and binding upon Owner and Contractor, which agree that the Contract Documents will 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.
- G. Nothing in the Contract Documents creates:
 - 1. any contractual relationship between Owner or Engineer and any Subcontractor, Supplier, or other individual or entity performing or furnishing any of the Work, for the benefit of such Subcontractor, Supplier, or other individual or entity; or
 - 2. 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.

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, means 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, and no instruction of a Supplier, will be effective to change the duties or responsibilities of Owner, Contractor, or Engineer 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 or Engineer 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 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 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 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 in writing 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.

- 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 notify Owner and Contractor in writing 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 versions, 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 precludes 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 30th 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 60th day after the day of Bid opening or the 30th 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 may 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 must 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 will 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 Contract Price or 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. Such an adjustment will 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 third-party utility owners or other third-party entities (other than those third-party utility owners or other third-party entities performing other work at or adjacent to the Site as arranged by or under contract with Owner, as contemplated in Article 8); and
 - 4. Acts of war or terrorism.

- D. Contractor's entitlement to an adjustment of Contract Times or Contract Price is limited as follows:
1. Contractor's entitlement to an adjustment of the Contract Times is conditioned on the delay, disruption, or interference adversely affecting an activity on the critical path to completion of the Work, as of the time of the delay, disruption, or interference.
 2. Contractor shall not be entitled to an adjustment in Contract Price 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. Such a concurrent delay by Contractor shall not preclude an adjustment of Contract Times to which Contractor is otherwise entitled.
 3. Adjustments of Contract Times or Contract Price are subject to the provisions of Article 11.
- E. Each Contractor request or Change Proposal seeking an increase in Contract Times or Contract Price must be supplemented by supporting data that sets forth in detail the following:
1. The circumstances that form the basis for the requested adjustment;
 2. The date upon which each cause of delay, disruption, or interference began to affect the progress of the Work;
 3. The date upon which each cause of delay, disruption, or interference ceased to affect the progress of the Work;
 4. The number of days' increase in Contract Times claimed as a consequence of each such cause of delay, disruption, or interference; and
 5. The impact on Contract Price, in accordance with the provisions of Paragraph 11.07.
- Contractor shall also furnish such additional supporting documentation as Owner or Engineer may require including, where appropriate, a revised progress schedule indicating all the activities affected by the delay, disruption, or interference, and an explanation of the effect of the delay, disruption, or interference on the critical path to completion of the Work.
- F. 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, together with the provisions of Paragraphs 4.05.D and 4.05.E.
- G. Paragraph 8.03 addresses 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.

ARTICLE 5—SITE; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS

5.01 *Availability of Lands*

- A. Owner shall furnish the Site. Owner shall notify Contractor in writing 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, or to improvements, structures, utilities, or similar facilities located at such adjacent lands 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 7.13, 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 in a court of competent jurisdiction; 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 will 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 of explorations and tests of subsurface conditions at or adjacent to the Site that contain Technical Data;
2. Those drawings of existing physical conditions at or adjacent to the Site, including those drawings depicting existing surface or subsurface structures at or adjacent to the Site (except Underground Facilities), that contain Technical Data; and
3. Technical Data contained in such reports and drawings.

- B. *Underground Facilities:* Underground Facilities are shown or indicated on the Drawings, pursuant to Paragraph 5.05, and not in the drawings referred to in Paragraph 5.03.A. Information and data regarding the presence or location of Underground Facilities are not intended to be categorized, identified, or defined as Technical Data.

- C. *Reliance by Contractor on Technical Data:* 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 Paragraph 1.01.A.46.b.

- D. *Limitations of Other Data and Documents:* 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;
2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings;
3. the contents of other Site-related documents made available to Contractor, such as record drawings from other projects at or adjacent to the Site, or Owner's archival documents concerning the Site; or
4. 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:
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;
 2. is of such a nature as to require a change in the Drawings or Specifications;
 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 whether it is necessary for Owner to obtain 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; 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. *Early Resumption of Work:* If at any time Engineer determines that Work in connection with the subsurface or physical condition in question may resume prior to completion of Engineer's review or Owner's issuance of its statement to Contractor, because the condition in question has been adequately documented, and analyzed on a preliminary basis, then the Engineer may at its discretion instruct Contractor to resume such Work.
- E. *Possible Price and Times Adjustments*
1. Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times, 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 subject to the provisions of Paragraphs 4.05.D and 4.05.E.
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;
 - 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 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, then any such adjustment will 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, 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.
- F. *Underground Facilities; Hazardous Environmental Conditions*: Paragraph 5.05 governs rights and responsibilities regarding the presence or location of Underground Facilities. Paragraph 5.06 governs rights and responsibilities regarding Hazardous Environmental Conditions. The provisions of Paragraphs 5.03 and 5.04 are not applicable to the presence or location of Underground Facilities, or to Hazardous Environmental Conditions.

5.05 *Underground Facilities*

- A. *Contractor's Responsibilities*: Unless it is otherwise expressly provided in the Supplementary Conditions, the cost of all of the following are included in the Contract Price, and Contractor shall have full responsibility for:
1. reviewing and checking all information and data regarding existing Underground Facilities at the Site;
 2. complying with applicable state and local utility damage prevention Laws and Regulations;

3. verifying the actual location of those Underground Facilities shown or indicated in the Contract Documents as being within the area affected by the Work, by exposing such Underground Facilities during the course of construction;
 4. coordination of the Work with the owners (including Owner) of such Underground Facilities, during construction; and
 5. 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 on the Drawings, or was not shown or indicated on the Drawings 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), notify Owner and Engineer in writing regarding such Underground Facility.
- C. *Engineer's Review:* Engineer will:
1. promptly review the Underground Facility and conclude whether such Underground Facility was not shown or indicated on the Drawings, or was not shown or indicated with reasonable accuracy;
 2. identify and communicate with the owner of the Underground Facility; prepare recommendations to Owner (and if necessary issue any preliminary instructions to Contractor) regarding the Contractor's resumption of Work in connection with the Underground Facility in question;
 3. obtain any pertinent cost or schedule information from Contractor; 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
 4. 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. *Early Resumption of Work:* If at any time Engineer determines that Work in connection with the Underground Facility may resume prior to completion of Engineer's review or Owner's issuance of its statement to Contractor, because the Underground Facility in question and conditions affected by its presence have been adequately documented, and analyzed on a preliminary basis, then the Engineer may at its discretion instruct Contractor to resume such Work.
- F. *Possible Price and Times Adjustments*
1. Contractor shall be entitled to an equitable adjustment in the Contract Price or Contract Times, to the extent that any existing Underground Facility at the Site that was not shown

or indicated on the Drawings, 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. 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;
 - b. Contractor's entitlement to an adjustment of the Contract Times is subject to the provisions of Paragraphs 4.05.D and 4.05.E; and
 - c. 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, then any such adjustment will 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, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the Underground Facility in question.
 4. The information and data shown or indicated on the Drawings with respect to existing Underground Facilities at the Site is based on information and data (a) furnished by the owners of such Underground Facilities, or by others, (b) obtained from available records, or (c) gathered in an investigation conducted in accordance with the current edition of ASCE 38, Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data, by the American Society of Civil Engineers. If such information or data is incorrect or incomplete, Contractor's remedies are limited to those set forth in this Paragraph 5.05.F.

5.06 *Hazardous Environmental Conditions at Site*

A. *Reports and Drawings:* The Supplementary Conditions identify:

1. those reports known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site;
2. drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site; 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 on the accuracy of the Technical Data as defined in Paragraph 1.01.A.46.b. 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;
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, as a result of such Work stoppage, such special conditions under which Work is agreed to be resumed by Contractor, or any costs or expenses incurred in response to the Hazardous Environmental Condition, 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. Entitlement to any such adjustment is subject to the provisions of Paragraphs 4.05.D, 4.05.E, 11.07, and 11.08.
- 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, 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.I obligates 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 obligates 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 Contractor's obligations under the Contract. These bonds must 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 terms of a prescribed bond form, the Supplementary Conditions, or other provisions of the Contract.
- B. Contractor shall also furnish such other bonds (if any) as are required by the Supplementary Conditions or other provisions of the Contract.
- C. All bonds must be in the form included in the Bidding Documents or otherwise specified by Owner prior to execution of the Contract, except as provided otherwise by Laws or

Regulations, and must be issued and signed by a surety named in “Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies” as published in Department Circular 570 (as amended and supplemented) by the Bureau of the Fiscal Service, 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 must show that it is effective on the date the agent or attorney-in-fact signed the accompanying bond.

- D. Contractor shall obtain the required bonds from surety companies that are duly licensed or authorized, in the state or jurisdiction in which the Project is located, to issue bonds in the required amounts.
- E. If the surety on a bond furnished by Contractor is declared bankrupt or becomes insolvent, or the surety ceases to meet the requirements above, then Contractor shall promptly notify Owner and Engineer in writing and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which must comply with the bond and surety requirements above.
- F. 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.
- G. Upon request to Owner from any Subcontractor, Supplier, or other person or entity claiming to have furnished labor, services, materials, or equipment used in the performance of the Work, Owner shall provide a copy of the payment bond to such person or entity.
- H. Upon request to Contractor from any Subcontractor, Supplier, or other person or entity claiming to have furnished labor, services, materials, or equipment used in the performance of the Work, Contractor shall provide a copy of the payment bond to such person or entity.

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. Alternative forms of insurance coverage, including but not limited to self-insurance and “Occupational Accident and Excess Employer’s Indemnity Policies,” are not sufficient to meet the insurance requirements of this Contract, unless expressly allowed in the Supplementary Conditions.
- D. Contractor shall deliver to Owner, with copies to each additional insured identified in the Contract, certificates of insurance and endorsements establishing that Contractor has obtained and is maintaining the policies and coverages 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, documentation of applicable self-insured retentions (if allowed) and deductibles, full disclosure of all relevant exclusions, and evidence of insurance required to be purchased and maintained by

- Subcontractors or Suppliers. In any documentation furnished under this provision, Contractor, Subcontractors, and Suppliers may block out (redact) (1) any confidential premium or pricing information and (2) any wording specific to a project or jurisdiction other than those applicable to this Contract.
- E. Owner shall deliver to Contractor, with copies to each additional insured identified in the Contract, certificates of insurance and endorsements establishing that Owner has obtained and is maintaining the policies and coverages 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, documentation of applicable self-insured retentions (if allowed) and deductibles, and full disclosure of all relevant exclusions. In any documentation furnished under this provision, Owner may block out (redact) (1) any confidential premium or pricing information and (2) any wording specific to a project or jurisdiction other than those relevant to this Contract.
 - F. 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, will not be construed as a waiver of the other party's obligation to obtain and maintain such insurance.
 - G. In addition to the liability insurance required to be provided by Contractor, the Owner, at Owner's option, may purchase and maintain Owner's own liability insurance. 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.
 - H. Contractor shall require:
 - 1. Subcontractors to purchase and maintain worker's compensation, commercial general liability, and other insurance that is appropriate for their participation in the Project, and to name as additional insureds Owner and Engineer (and any other individuals or entities identified in the Supplementary Conditions as additional insureds on Contractor's liability policies) on each Subcontractor's commercial general liability insurance policy; and
 - 2. Suppliers to purchase and maintain insurance that is appropriate for their participation in the Project.
 - I. If either party does not purchase or maintain 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.
 - J. If Contractor has failed to obtain and maintain required insurance, Contractor's entitlement to enter or remain at the Site will end immediately, and Owner may impose an appropriate set-off against payment for any associated costs (including but not limited to the cost of purchasing necessary insurance coverage), and exercise Owner's termination rights under Article 16.
 - K. Without prejudice to any other right or remedy, if a party has failed to obtain required insurance, the other party may elect (but is in no way obligated) 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 will be adjusted accordingly.

- L. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor or Contractor's interests. Contractor is responsible for determining whether such coverage and limits are adequate to protect its interests, and for obtaining and maintaining any additional insurance that Contractor deems necessary.
- M. The insurance and insurance limits required herein will not be deemed as a limitation on Contractor's liability, or that of its Subcontractors or Suppliers, under the indemnities granted to Owner and other individuals and entities in the Contract or otherwise.
- N. All the policies of insurance required to be purchased and maintained under this Contract will contain a provision or endorsement that the coverage afforded will not be canceled, 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 and Engineer.

6.03 *Contractor's Insurance*

- A. *Required Insurance:* Contractor shall purchase and maintain Worker's Compensation, Commercial General Liability, and other insurance pursuant to the specific requirements of the Supplementary Conditions.
- B. *General Provisions:* The policies of insurance required by this Paragraph 6.03 as supplemented must:
 - 1. include at least the specific coverages required;
 - 2. be written for not less than the limits provided, or those required by Laws or Regulations, whichever is greater;
 - 3. remain in effect at least until the Work is complete (as set forth in Paragraph 15.06.D), and longer if expressly required elsewhere in this Contract, 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;
 - 4. apply with respect to the performance of the Work, whether such performance is 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; and
 - 5. include all necessary endorsements to support the stated requirements.
- C. *Additional Insureds:* The Contractor's commercial general liability, automobile liability, employer's liability, umbrella or excess, pollution liability, and unmanned aerial vehicle liability policies, if required by this Contract, must:
 - 1. include and list as additional insureds Owner and Engineer, and any individuals or entities identified as additional insureds in the Supplementary Conditions;
 - 2. include coverage for the respective officers, directors, members, partners, employees, and consultants of all such additional insureds;
 - 3. afford primary coverage to these additional insureds for all claims covered thereby (including as applicable those arising from both ongoing and completed operations);

4. not seek contribution from insurance maintained by the additional insured; and
5. as to commercial general liability insurance, apply to additional insureds with respect to liability caused in whole or in part by Contractor's acts or omissions, or the acts and omissions of those working on Contractor's behalf, in the performance of Contractor's operations.

6.04 *Builder's Risk and Other 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 Work's full insurable replacement cost (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). The specific requirements applicable to the builder's risk insurance are set forth in the Supplementary Conditions.
- B. *Property Insurance for Facilities of Owner Where Work Will Occur*: Owner is responsible for obtaining and maintaining property insurance covering each existing structure, building, or facility in which any part of the Work will occur, or to which any part of the Work will attach or be adjoined. Such property insurance will be written on a special perils (all-risk) form, on a replacement cost basis, providing coverage consistent with that required for the builder's risk insurance, and will be maintained until the Work is complete, as set forth in Paragraph 15.06.D.
- C. *Property Insurance for Substantially Complete Facilities*: Promptly after Substantial Completion, and before actual occupancy or use of the substantially completed Work, Owner will obtain property insurance for such substantially completed Work, and maintain such property insurance at least until the Work is complete, as set forth in Paragraph 15.06.D. Such property insurance will be written on a special perils (all-risk) form, on a replacement cost basis, and provide coverage consistent with that required for the builder's risk insurance. The builder's risk insurance may terminate upon written confirmation of Owner's procurement of such property insurance.
- 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 advance notice of such occupancy or use to the builder's risk insurer, and obtain an endorsement consenting to the continuation of coverage prior to commencing such partial occupancy or use.
- E. *Insurance of Other Property; Additional Insurance*: If the express insurance provisions of the Contract do not require or address the insurance of a property item or interest, then the entity or individual owning such property item will be responsible for insuring it. 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 6.04, it may do so at Contractor's expense.

6.05 *Property Losses; Subrogation*

- A. The builder's risk insurance policy purchased and maintained in accordance with Paragraph 6.04 (or an installation floater policy if authorized by the Supplementary Conditions), will contain provisions to the effect that in the event of payment of any loss or damage the insurer 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.

1. 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, risks, 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 individuals or entities identified in the Supplementary Conditions as builder's risk or installation floater 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.
 2. None of the above waivers extends 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. Any property insurance policy maintained by Owner covering any loss, damage, or consequential loss to Owner's existing structures, buildings, or facilities in which any part of the Work will occur, or to which any part of the Work will attach or adjoin; to adjacent structures, buildings, or facilities of Owner; or to part or all of the completed or substantially completed Work, 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, will contain provisions to the effect that in the event of payment of any loss or damage the insurer will have no rights of recovery against any insureds thereunder, or against Contractor, Subcontractors, or Engineer, or the officers, directors, members, partners, employees, agents, consultants, or subcontractors of each and any of them, and that the insured is allowed to waive the insurer's rights of subrogation in a written contract executed prior to the loss, damage, or consequential loss.
1. 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 all losses and damages caused by, arising out of, or resulting from fire or any of the perils, risks, or causes of loss covered by such policies.
- C. The waivers in this Paragraph 6.05 include the waiver of rights 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 insured peril, risk, or cause of loss.
- D. Contractor shall be responsible for assuring that each Subcontract 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 fire or other peril, risk, or cause of loss covered by builder's risk insurance, installation floater, and any other property insurance applicable to the Work.

6.06 *Receipt and Application of Property Insurance Proceeds*

- A. Any insured loss under the builder's risk and other policies of property insurance required by Paragraph 6.04 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 6.04 shall maintain such proceeds in a segregated account, and 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, Contractor shall repair or replace the damaged Work, using allocated insurance proceeds.

ARTICLE 7—CONTRACTOR'S RESPONSIBILITIES

7.01 *Contractor's Means and Methods of Construction*

- A. Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction.
- B. If the Contract Documents note, or Contractor determines, that professional engineering or other design services are needed to carry out Contractor's responsibilities for construction means, methods, techniques, sequences, and procedures, or for Site safety, then Contractor shall cause such services to be provided by a properly licensed design professional, at Contractor's expense. Such services are not Owner-delegated professional design services under this Contract, and neither Owner nor Engineer has any responsibility with respect to (1) Contractor's determination of the need for such services, (2) the qualifications or licensing of the design professionals retained or employed by Contractor, (3) the performance of such services, or (4) any errors, omissions, or defects in such services.

7.02 *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.
- B. At all times during the progress of the Work, Contractor shall assign a competent resident superintendent who will not be replaced without written notice to Owner and Engineer except under extraordinary circumstances.

7.03 *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 maintain good discipline and order at the Site.

- B. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of Contractor's employees; of Suppliers and Subcontractors, and their employees; and of any other individuals or entities performing or furnishing any of the Work, just as Contractor is responsible for Contractor's own acts and omissions.
- C. 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 will 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.

7.04 *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 must be new and of good quality, except as otherwise provided in the Contract Documents. All special warranties and guarantees required by the Specifications will 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 must 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.

7.05 *"Or Equals"*

- A. *Contractor's Request; Governing Criteria:* Whenever an item of equipment or material is specified or described in the Contract Documents by using the names of one or more proprietary items or specific Suppliers, 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 equipment or material, or items from other proposed Suppliers, under the circumstances described below.
 - 1. If Engineer in its sole discretion determines that an item of equipment or material proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, Engineer will deem it an "or equal" item. For the purposes of this paragraph, a proposed item of equipment or material will be considered functionally equal to an item so named if:
 - a. in the exercise of reasonable judgment Engineer determines that the proposed item:
 - 1) is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;

- 2) 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) has a proven record of performance and availability of responsive service; and
 - 4) is not objectionable to Owner.
- b. Contractor certifies that, if the proposed item is approved and incorporated into the Work:
- 1) there will be no increase in cost to the Owner or increase in Contract Times; and
 - 2) the item 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 will result in any change in Contract Price. The Engineer's denial of an "or-equal" request will be final and binding, and may not be reversed through an appeal under any provision of the Contract.
- E. *Treatment as a Substitution Request:* If Engineer determines that an item of equipment or material proposed by Contractor does not qualify as an "or-equal" item, Contractor may request that Engineer consider the item a proposed substitute pursuant to Paragraph 7.06.

7.06 *Substitutes*

- A. *Contractor's Request; Governing Criteria:* Unless the specification or description of an item of equipment or material 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 equipment or material under the circumstances described below. To the extent possible such requests must 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 equipment or material from anyone other than Contractor.
 2. The requirements for review by Engineer will be as set forth in Paragraph 7.06.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 equipment or material that Contractor seeks to furnish or use. The application:
 - a. will 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 the item specified; and
 - 3) be suited to the same use as the item 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 the item specified; and
 - 2) available engineering, sales, maintenance, repair, and replacement services.
 - d. will 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 will be final and binding, and may not be reversed through an appeal under any provision of the Contract. Contractor may challenge the scope of reimbursement costs imposed under Paragraph 7.06.D, by timely submittal of a Change Proposal.

7.07 *Concerning Subcontractors and Suppliers*

- A. Contractor may retain Subcontractors and Suppliers for the performance of parts of the Work. Such Subcontractors and Suppliers must be acceptable to Owner. The Contractor's retention of a Subcontractor or Supplier for the performance of parts of the Work will not relieve Contractor's obligation to Owner to perform and complete the Work in accordance with the Contract Documents.
- B. Contractor shall retain specific Subcontractors and Suppliers 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 or Supplier 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 5 days.
- E. Owner may require the replacement of any Subcontractor or Supplier. 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 or Suppliers 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 or Supplier so identified solely on the basis of substantive, reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor or Supplier.
- F. If Owner requires the replacement of any Subcontractor or Supplier retained by Contractor to perform any part of the Work, then Contractor shall be entitled to an adjustment in Contract Price or Contract Times, 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 or Supplier, whether initially or as a replacement, will 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 solely responsible for scheduling and coordinating the work of Subcontractors and Suppliers.
- J. The divisions and sections of the Specifications and the identifications of any Drawings do not control Contractor in dividing the Work among Subcontractors or Suppliers, or in delineating the Work to be performed by any specific trade.
- K. All Work performed for Contractor by a Subcontractor or Supplier must be pursuant to an appropriate contractual agreement that specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract for the benefit of Owner and Engineer.
- L. Owner may furnish to any Subcontractor or Supplier, to the extent practicable, information about amounts paid to Contractor for Work performed for Contractor by the Subcontractor or Supplier.
- M. Contractor shall restrict all Subcontractors and Suppliers from communicating with Engineer or Owner, except through Contractor or in case of an emergency, or as otherwise expressly allowed in this Contract.

7.08 *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 an 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 will be disclosed 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.

7.09 *Permits*

- A. Unless otherwise provided in the Contract Documents, Contractor shall obtain and pay for all construction permits, licenses, and certificates of occupancy. 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.

7.10 *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.

7.11 *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. 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 is not Contractor's responsibility to make certain that the Work described in the Contract Documents is in accordance with Laws and Regulations, but this does not relieve Contractor of its obligations under Paragraph 3.03.
- C. Owner or Contractor may give written 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 written notice Contractor may submit a Change Proposal, or Owner may initiate a Claim.

7.12 *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.

7.13 *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.
- B. Contractor shall designate a qualified and experienced safety representative whose duties and responsibilities are the prevention of Work-related accidents and the maintenance and supervision of safety precautions and programs.
- C. 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.
- D. All damage, injury, or loss to any property referred to in Paragraph 7.13.C.2 or 7.13.C.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).
- E. 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.
- F. Contractor shall notify Owner; the owners of adjacent property; the owners of Underground Facilities and other utilities (if the identity of such owners is known to Contractor); and other contractors and utility owners performing work at or adjacent to the Site, in writing, when Contractor knows that 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.
- G. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. Any Owner's safety programs that are applicable to the Work are identified or included in the Supplementary Conditions or Specifications.
- H. 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.

- I. Contractor's duties and responsibilities for safety and protection will continue until all the Work is completed, Engineer has issued a written notice to Owner and Contractor in accordance with Paragraph 15.06.C that the Work is acceptable, and Contractor has left the Site (except as otherwise expressly provided in connection with Substantial Completion).
- J. Contractor's duties and responsibilities for safety and protection will 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.

7.14 *Hazard Communication Programs*

- A. Contractor shall be responsible for coordinating any exchange of safety data sheets (formerly known as 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 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 by an emergency, or are required as a result of Contractor's response to an emergency. If Engineer determines that a change in the Contract Documents is required because of an emergency or Contractor's response, a Work Change Directive or Change Order will be issued.

7.16 *Submittals*

A. *Shop Drawing and Sample Requirements*

- 1. Before submitting a Shop Drawing or Sample, Contractor shall:
 - a. review and coordinate the Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;
 - b. determine and verify:
 - 1) all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect to the Submittal;
 - 2) 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
 - 3) all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto;
 - c. confirm that the Submittal is complete with respect to all related data included in the Submittal.
- 2. Each Shop Drawing or Sample must 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 Shop Drawing or Sample, Contractor shall give Engineer specific written notice of any variations that the Submittal may have from the requirements of the Contract Documents. This notice must be set forth in a written communication separate from the Submittal; and, in addition, in the case of a Shop Drawing by a specific notation made on the Shop Drawing itself.
- B. *Submittal Procedures for Shop Drawings and Samples:* Contractor shall label and submit Shop Drawings and Samples to Engineer for review and approval in accordance with the accepted Schedule of Submittals.
1. *Shop Drawings*
 - a. Contractor shall submit the number of copies required in the Specifications.
 - b. Data shown on the Shop Drawings must 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.C.
 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.C.
 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. *Engineer's Review of Shop Drawings and Samples*
1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the accepted Schedule of Submittals. 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, comply with the requirements of 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 will 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 or other appropriate Contract modification.

5. Engineer's review and approval of a Shop Drawing or Sample will not relieve Contractor from responsibility for complying with the requirements of Paragraphs 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, will 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 or Sample will 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.C.4.

D. Resubmittal Procedures for Shop Drawings and Samples

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 Shop Drawing and Sample submittals with sufficient information and accuracy to obtain required approval of an item with no more than two resubmittals. Engineer will record Engineer's time for reviewing a third or subsequent resubmittal of a Shop Drawing or Sample, and Contractor shall be responsible for Engineer's charges to Owner for such time. Owner may impose a set-off against payments due Contractor to secure reimbursement for such charges.
3. If Contractor requests a change of a previously approved Shop Drawing or Sample, Contractor shall be responsible for Engineer's charges to Owner for its review time, and Owner may impose a set-off against payments due Contractor to secure reimbursement for such charges, unless the need for such change is beyond the control of Contractor.

E. Submittals Other than Shop Drawings, Samples, and Owner-Delegated Designs

1. The following provisions apply to all Submittals other than Shop Drawings, Samples, and Owner-delegated designs:
 - a. Contractor shall submit all such Submittals to the Engineer in accordance with the Schedule of Submittals and pursuant to the applicable terms of the Contract Documents.
 - b. Engineer will provide timely review of all such Submittals in accordance with the Schedule of Submittals and return such Submittals with a notation of either Accepted or Not Accepted. Any such Submittal that is not returned within the time established in the Schedule of Submittals will be deemed accepted.
 - c. Engineer's review will be only to determine if the Submittal is acceptable under the requirements of the Contract Documents as to general form and content of the Submittal.

- d. If any such Submittal is not accepted, Contractor shall confer with Engineer regarding the reason for the non-acceptance, and resubmit an acceptable document.
 2. Procedures for the submittal and acceptance of the Progress Schedule, the Schedule of Submittals, and the Schedule of Values are set forth in Paragraphs 2.03, 2.04, and 2.05.
- F. Owner-delegated Designs: Submittals pursuant to Owner-delegated designs are governed by the provisions of Paragraph 7.19.

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 is entitled to rely on Contractor's warranty and guarantee.
- B. Owner's rights under this warranty and guarantee are in addition to, and are not limited by, Owner's rights under the correction period provisions of Paragraph 15.08. The time in which Owner may enforce its warranty and guarantee rights under this Paragraph 7.17 is limited only by applicable Laws and Regulations restricting actions to enforce such rights; provided, however, that after the end of the correction period under Paragraph 15.08:
1. Owner shall give Contractor written notice of any defective Work within 60 days of the discovery that such Work is defective; and
 2. Such notice will be deemed the start of an event giving rise to a Claim under Paragraph 12.01.B, such that any related Claim must be brought within 30 days of the notice.
- C. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:
1. abuse, or improper modification, 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.
- D. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents is absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents, a release of Contractor's obligation to perform the Work in accordance with the Contract Documents, or a release of Owner's warranty and guarantee rights under this Paragraph 7.17:
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. The end of the correction period established in Paragraph 15.08;
 8. Any inspection, test, or approval by others; or

9. Any correction of defective Work by Owner.
- E. 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 will 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 losses, damages, costs, and judgments (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 from third-party claims or actions relating to or resulting from the performance or furnishing of the Work, provided that any such claim, action, loss, cost, judgment or damage is attributable to bodily injury, sickness, disease, or death, or to damage 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 will 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.

7.19 *Delegation of Professional Design Services*

- A. Owner may require Contractor to provide professional design services for a portion of the Work by express delegation in the Contract Documents. Such delegation will specify the performance and design criteria that such services must satisfy, and the Submittals that Contractor must furnish to Engineer with respect to the Owner-delegated design.
- B. Contractor shall cause such Owner-delegated professional design services to be provided pursuant to the professional standard of care by a properly licensed design professional, whose signature and seal must appear on all drawings, calculations, specifications, certifications, and Submittals prepared by such design professional. Such design professional must issue all certifications of design required by Laws and Regulations.
- C. If a Shop Drawing or other Submittal related to the Owner-delegated design is prepared by Contractor, a Subcontractor, or others for submittal to Engineer, then such Shop Drawing or other Submittal must bear the written approval of Contractor's design professional when submitted by Contractor to Engineer.

- D. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy, and completeness of the services, certifications, and approvals performed or provided by the design professionals retained or employed by Contractor under an Owner-delegated design, subject to the professional standard of care and the performance and design criteria stated in the Contract Documents.
- E. Pursuant to this Paragraph 7.19, Engineer's review, approval, and other determinations regarding design drawings, calculations, specifications, certifications, and other Submittals furnished by Contractor pursuant to an Owner-delegated design will be only for the following limited purposes:
 - 1. Checking for conformance with the requirements of this Paragraph 7.19;
 - 2. Confirming that Contractor (through its design professionals) has used the performance and design criteria specified in the Contract Documents; and
 - 3. Establishing that the design furnished by Contractor is consistent with the design concept expressed in the Contract Documents.
- F. Contractor shall not be responsible for the adequacy of performance or design criteria specified by Owner or Engineer.
- G. Contractor is not required to provide professional services in violation of applicable Laws and Regulations.

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 third-party utility work that Owner has arranged to take place at or adjacent to the Site, Owner shall provide such information to Contractor.
- C. Contractor shall afford proper and safe access to the Site to each contractor that performs such other work, each utility owner performing other work, and Owner, if Owner is performing other work with Owner's employees, and provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work.
- D. 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.

- E. If the proper execution or results of any part of Contractor's Work depends upon work performed by others, 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.
- F. The provisions of this article are not applicable to work that is performed by third-party utilities or other third-party entities without a contract with Owner, or that is performed without having been arranged by Owner. If such work occurs, then any related delay, disruption, or interference incurred by Contractor is governed by the provisions of Paragraph 4.05.C.3.

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 for Owner at or adjacent to the Site, the Owner's employees, any other contractor working for Owner, or any utility owner that Owner has arranged to perform work, 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. 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 will 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, and any remedies available to Contractor under Laws or Regulations concerning utility action or inaction. When applicable, any such equitable adjustment in Contract Price will 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 or Contract Price is subject to the provisions of Paragraphs 4.05.D and 4.05.E.

- 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.
 - 1. 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 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 8.03.B.
 - 2. 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 Contractor.
- C. 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 will 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 (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 10.07. 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 *Resident 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 the Supplementary Conditions and in Paragraph 10.07.
- B. If Owner designates an individual or entity who is not Engineer's consultant, agent, or employee to represent Owner at the Site, then the responsibilities and authority of such individual or entity will be as provided in the Supplementary Conditions.

10.04 *Engineer's Authority*

- A. Engineer has the authority to reject Work in accordance with Article 14.
- B. Engineer's authority as to Submittals is set forth in Paragraph 7.16.
- C. Engineer's authority as to design drawings, calculations, specifications, certifications and other Submittals from Contractor in response to Owner's delegation (if any) to Contractor of professional design services, is set forth in Paragraph 7.19.
- D. Engineer's authority as to changes in the Work is set forth in Article 11.

E. Engineer's authority as to Applications for Payment is set forth in Article 15.

10.05 *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.

10.06 *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.

10.07 *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, will 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 Contractor under 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 10.07 also apply to the Resident Project Representative, if any.

10.08 *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 of which Engineer has been informed.

ARTICLE 11—CHANGES TO THE CONTRACT

11.01 *Amending and Supplementing the Contract*

- A. The Contract may be amended or supplemented by a Change Order, a Work Change Directive, or a Field Order.
- B. If an amendment or supplement to the Contract includes a change in the Contract Price or the Contract Times, such amendment or supplement must be set forth in a Change Order.
- C. All changes to the Contract that 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, must be supported by Engineer's recommendation. Owner and Contractor may amend other terms and conditions of the Contract without the recommendation of the Engineer.

11.02 *Change Orders*

- A. Owner and Contractor shall execute appropriate Change Orders covering:
 - 1. Changes in 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 11.05, (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 that embody the substance of any final and binding results under: Paragraph 11.03.B, resolving the impact of a Work Change Directive; Paragraph 11.09, concerning Change Proposals; Article 12, Claims; Paragraph 13.02.D, final adjustments resulting from allowances; Paragraph 13.03.D, final adjustments relating to determination of quantities for Unit Price Work; and similar provisions.
- B. If Owner or Contractor refuses to execute a Change Order that is required to be executed under the terms of Paragraph 11.02.A, it will be deemed to be of full force and effect, as if fully executed.

11.03 *Work Change Directives*

- A. 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 11.07 regarding change of Contract Price.

- B. If Owner has issued a Work Change Directive and:
 - 1. Contractor believes that an adjustment in Contract Times or Contract Price is necessary, then Contractor shall submit any Change Proposal seeking such an adjustment no later than 30 days after the completion of the Work set out in the Work Change Directive.
 - 2. Owner believes that an adjustment in Contract Times or Contract Price is necessary, then Owner shall submit any Claim seeking such an adjustment no later than 60 days after issuance of the Work Change Directive.

11.04 *Field Orders*

- A. 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.
- B. If Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, then before proceeding with the Work at issue, Contractor shall submit a Change Proposal as provided herein.

11.05 *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. Changes involving the design (as set forth in the Drawings, Specifications, or otherwise) or other engineering or technical matters will be supported by Engineer's recommendation.
- B. Such changes in the Work 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 must be performed under the applicable conditions of the Contract Documents.
- C. Nothing in this Paragraph 11.05 obligates 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.

11.06 *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.C.2.

11.07 *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 must comply with the provisions of Paragraph 11.09. Any Claim for an adjustment of Contract Price must 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);
 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 11.07.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 11.07.C).
- C. *Contractor's Fee:* When applicable, the Contractor's fee for overhead and profit will 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 will be 15 percent;
 - b. For costs incurred under Paragraph 13.01.B.3, the Contractor's fee will be 5 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 11.07.C.2.a and 11.07.C.2.b is that the Contractor's fee will be based on: (1) a fee of 15 percent of the costs incurred under Paragraphs 13.01.B.1 and 13.01.B.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 5 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 will be no greater than 27 percent of the costs incurred by the Subcontractor that actually performs the Work;
 - d. No fee will 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 of the Work will be the amount of the actual net decrease in Cost of the Work and a deduction of an additional amount equal to 5 percent of such actual net decrease in Cost of the Work; and
 - f. When both additions and credits are involved in any one change or Change Proposal, the adjustment in Contractor's fee will be computed by determining the sum of the costs in each of the cost categories in Paragraph 13.01.B (specifically, payroll costs, Paragraph 13.01.B.1; incorporated materials and equipment costs, Paragraph 13.01.B.2; Subcontract costs, Paragraph 13.01.B.3; special consultants costs, Paragraph 13.01.B.4; and other costs, Paragraph 13.01.B.5) and applying to each such cost category sum the appropriate fee from Paragraphs 11.07.C.2.a through 11.07.C.2.e, inclusive.

11.08 *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 must comply with the provisions of Paragraph 11.09. Any Claim for an adjustment in the Contract Times must comply with the provisions of Article 12.
- B. Delay, disruption, and interference in the Work, and any related changes in Contract Times, are addressed in and governed by Paragraph 4.05.

11.09 *Change Proposals*

- A. *Purpose and Content:* Contractor shall submit a Change Proposal to Engineer to request an adjustment in the Contract Times or Contract Price; contest an initial decision by Engineer concerning the requirements of the Contract Documents or relating to the acceptability of the Work under the Contract Documents; challenge a set-off against payment due; or seek other relief under the Contract. The Change Proposal will specify any proposed change in Contract Times or Contract Price, or other proposed relief, and explain the reason for the proposed change, with citations to any governing or applicable provisions of the Contract Documents. Each Change Proposal will address only one issue, or a set of closely related issues.

B. *Change Proposal Procedures*

1. *Submittal:* Contractor shall submit each Change Proposal to Engineer within 30 days after the start of the event giving rise thereto, or after such initial decision.
2. *Supporting Data:* 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.
 - a. Change Proposals based on or related to delay, interruption, or interference must comply with the provisions of Paragraphs 4.05.D and 4.05.E.
 - b. Change proposals related to a change of Contract Price must include full and detailed accounts of materials incorporated into the Work and labor and equipment used for the subject Work.

The supporting data must 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.

3. *Engineer's Initial Review:* Engineer will advise Owner regarding the Change Proposal, and consider any comments or response from Owner regarding the Change Proposal. If in its discretion Engineer concludes that additional supporting data is needed before conducting a full review and making a decision regarding the Change Proposal, then Engineer may request that Contractor submit such additional supporting data by a date specified by Engineer, prior to Engineer beginning its full review of the Change Proposal.
4. *Engineer's Full Review and Action on the Change Proposal:* Upon receipt of Contractor's supporting data (including any additional data requested by Engineer), Engineer will conduct a full review of each Change Proposal and, within 30 days after such receipt of the Contractor's supporting data, either approve the Change Proposal in whole, deny it in whole, or approve it in part and deny it in part. Such actions must 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.

5. *Binding Decision*: Engineer's decision is final and binding upon Owner and Contractor, unless Owner or Contractor appeals the decision by filing a Claim under Article 12.
- C. *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 in writing that the Engineer is unable to resolve the Change Proposal. For purposes of further resolution of such a Change Proposal, such notice will be deemed a denial, and Contractor may choose to seek resolution under the terms of Article 12.
- D. *Post-Completion*: Contractor shall not submit any Change Proposals after Engineer issues a written recommendation of final payment pursuant to Paragraph 15.06.B.

11.10 *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 are subject 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;
 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; and
 4. Subject to the waiver provisions of Paragraph 15.07, any dispute arising after Engineer has issued a written recommendation of final payment pursuant to Paragraph 15.06.B.
- 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 rests with the party making the Claim. In the case of a Claim by Contractor seeking an increase in the Contract Times or Contract Price, 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 will 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 will 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 will 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 will 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 will 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 will 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 will be incorporated in a Change Order or other written document 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. When needed 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 will be in amounts no higher than those commonly incurred in the locality of the Project, will not include any of the costs itemized in Paragraph 13.01.C, and will 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 in advance of the subject Work. Such employees include, without limitation, superintendents, foremen, safety managers, safety representatives, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work will be apportioned on the basis of their time spent on the Work. Payroll costs include, but are not limited to, salaries and wages plus the cost of fringe benefits, which include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, 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, will 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 accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts will accrue to Owner. All trade discounts, rebates, and refunds and returns from sale of surplus materials and equipment will 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, which 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 will 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 or retained for services specifically related to the Work.
 5. Other costs consisting of 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, 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.

- 1) In establishing included costs for materials such as scaffolding, plating, or sheeting, consideration will be given to the actual or the estimated life of the material for use on other projects; or rental rates may be established on the basis of purchase or salvage value of such items, whichever is less. Contractor will not be eligible for compensation for such items in an amount that exceeds the purchase cost of such item.

c. *Construction Equipment Rental*

- 1) Rentals of all construction equipment and machinery, and the parts thereof, in accordance with rental agreements approved by Owner as to price (including any surcharge or special rates applicable to overtime use of the construction equipment or machinery), and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs will be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts must cease when the use thereof is no longer necessary for the Work.
- 2) Costs for equipment and machinery owned by Contractor or a Contractor-related entity will be paid at a rate shown for such equipment in the equipment rental rate book specified in the Supplementary Conditions. An hourly rate will be computed by dividing the monthly rates by 176. These computed rates will include all operating costs.
- 3) With respect to Work that is the result of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price ("changed Work"), included costs will be based on 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 any such equipment or machinery, or parts thereof, must cease to accrue when the use thereof is no longer necessary for the changed 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 builder's risk or other property insurance established in accordance with Paragraph 6.04), 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 include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses will 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 does not include any of the following items:

- 1. Payroll costs and other compensation of Contractor's officers, executives, principals, general managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expeditors, timekeepers, clerks, and other personnel employed by Contractor, whether at the Site or in Contractor's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in Paragraph 13.01.B.1 or specifically covered by Paragraph 13.01.B.4. The payroll costs and other compensation excluded here are to be considered administrative costs covered by the Contractor's fee.
- 2. The cost of purchasing, renting, or furnishing small tools and hand tools.
- 3. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.
- 4. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.
- 5. 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.
- 6. Expenses incurred in preparing and advancing Claims.
- 7. 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*

- 1. When the Work as a whole is performed on the basis of cost-plus-a-fee, then:
 - a. Contractor's fee for the Work set forth in the Contract Documents as of the Effective Date of the Contract will be determined as set forth in the Agreement.
 - b. for any Work covered by a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price on the basis of Cost of the Work, Contractor's fee will be determined as follows:
 - 1) When the fee for the Work as a whole is a percentage of the Cost of the Work, the fee will automatically adjust as the Cost of the Work changes.
 - 2) When the fee for the Work as a whole is a fixed fee, the fee for any additions or deletions will be determined in accordance with Paragraph 11.07.C.2.
- 2. When the Work as a whole is performed on the basis of a stipulated sum, or any other basis other than cost-plus-a-fee, then Contractor's fee for any Work covered by a Change

Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price on the basis of Cost of the Work will be determined in accordance with Paragraph 11.07.C.2.

- E. *Documentation and Audit*: Whenever the Cost of the Work for any purpose is to be determined pursuant to this Article 13, Contractor and pertinent Subcontractors will establish and maintain records of the costs in accordance with generally accepted accounting practices. Subject to prior written notice, Owner will be afforded reasonable access, during normal business hours, to all Contractor's accounts, records, books, correspondence, instructions, drawings, receipts, vouchers, memoranda, and similar data relating to the Cost of the Work and Contractor's fee. Contractor shall preserve all such documents for a period of three years after the final payment by Owner. Pertinent Subcontractors will afford such access to Owner, and preserve such documents, to the same extent required of Contractor.

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 for any of the foregoing will be valid.
- C. *Owner's Contingency Allowance*: Contractor agrees that an Owner's 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 for Work covered by allowances, and the Contract Price will 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, and the final adjustment of Contract Price will be set forth in a Change Order, subject to the provisions of the following paragraph.

E. *Adjustments in Unit Price*

1. Contractor or Owner shall be entitled to an adjustment in the unit price with respect to an item of Unit Price Work if:
 - a. the quantity of the item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement; and
 - b. Contractor's unit costs to perform the item of Unit Price Work have changed materially and significantly as a result of the quantity change.
2. The adjustment in unit price will account for and be coordinated with any related changes in quantities of other items of Work, and in Contractor's costs to perform such other Work, such that the resulting overall change in Contract Price is equitable to Owner and Contractor.
3. Adjusted unit prices will apply to all units of that item.

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 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 with such procedures and programs 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 will 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 will 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 will 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 written 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 will 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 additional 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, 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 will 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 defective Work as required by Engineer, then Owner may, after 7 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 for 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.
 - 2. 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 must also be accompanied by: (a) a bill of sale, invoice, copies of subcontract or purchase order payments, or other documentation

establishing full payment by Contractor for the materials and equipment; (b) at Owner's request, documentation warranting that Owner has received the materials and equipment free and clear of all Liens; and (c) 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.

3. Beginning with the second Application for Payment, each Application must include an affidavit of Contractor stating that all previous progress payments received by Contractor have been applied to discharge Contractor's legitimate obligations associated with prior Applications for Payment.
4. 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;
 - b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto;
 - c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work;
 - d. to make any examination to ascertain how or for what purposes Contractor has used the money paid by Owner; 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 based on Contractor's conduct in the performance or furnishing of the Work, or Owner has incurred costs, losses, or damages resulting from 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 has occurred that would constitute a default by Contractor and therefore justify a termination for cause;
 - j. Liquidated or other 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; or
 - l. Other items entitle 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 will 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 will be treated as an amount due as determined by Paragraph 15.01.D.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 7 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 will 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 7 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 15.03.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 6.04 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 7.12), and other documents, Contractor may make application for final payment.
2. The final Application for Payment must 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 duly pending Change Proposals and Claims; 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 Final Application and Recommendation of Payment:* 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 10 days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of final payment and present the final Application for Payment to Owner for payment. Such recommendation will 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. 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. *Notice of Acceptability:* In support of its recommendation of payment of the final Application for Payment, Engineer will also give written notice to Owner and Contractor that the Work is acceptable, subject to stated limitations in the notice and to the provisions of Paragraph 15.07.
- D. *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 and issuance of notice of the acceptability of the Work.
- E. *Final Payment Becomes Due:* Upon receipt from Engineer of the final Application for Payment and accompanying documentation, Owner shall set off against the amount recommended by Engineer for final payment any further sum to which Owner is entitled, including but not limited to set-offs for liquidated damages and set-offs allowed under the provisions of this Contract with respect to progress payments. Owner shall pay the resulting balance due to Contractor within 30 days of Owner's receipt of the final Application for Payment from Engineer.

15.07 *Waiver of Claims*

- A. By making final payment, Owner waives its claim or right to liquidated damages or other damages for late completion by Contractor, except as set forth in an outstanding Claim,

appeal under the provisions of Article 17, set-off, or express reservation of rights by Owner. Owner reserves all other claims or rights after final payment.

- 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 as a Claim, 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 Supplementary Conditions or the terms of any applicable special guarantee required by the Contract Documents), Owner gives Contractor written notice that any Work has been found to be defective, or that Contractor's repair of any damages to the Site or adjacent areas has been found to be defective, then after receipt of such notice of defect 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 adjacent areas;
 - 2. correct such defective Work;
 - 3. remove the defective Work from the Project and replace it with Work that is not defective, if the defective Work has been rejected by Owner, 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 from the corrective measures.
- B. Owner shall give any such notice of defect within 60 days of the discovery that such Work or repairs is defective. If such notice is given within such 60 days but after the end of the correction period, the notice will be deemed a notice of defective Work under Paragraph 7.17.B.
- C. If, after receipt of a notice of defect within 60 days and within the correction period, 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 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). Contractor's failure to pay such costs, losses, and damages within 10 days of invoice from Owner will be deemed the start of an event giving rise to a Claim under Paragraph 12.01.B, such that any related Claim must be brought within 30 days of the failure to pay.
- D. 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.
- E. 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.

- F. Contractor's obligations under this paragraph are in addition to all other obligations and warranties. The provisions of this paragraph are not to 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 directly attributable to any such suspension. Any Change Proposal seeking such adjustments must 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) 10 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) written 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 7 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 will govern over any inconsistent provisions of Paragraphs 16.02.B and 16.02.D.

16.03 *Owner May Terminate for Convenience*

- A. Upon 7 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 for any loss of anticipated profits or revenue, post-termination overhead costs, 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 7 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, 7 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, pursuant to Article 12; and
 2. Disputes between Owner and Contractor concerning the Work, or obligations under the Contract Documents, that arise 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;
 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 requires the giving of written notice to Owner, Engineer, or Contractor, it will be deemed to have been validly given only if delivered:
1. in person, by a commercial courier service or otherwise, to the recipient's place of business;
 2. by registered or certified mail, postage prepaid, to the recipient's place of business; or
 3. by e-mail to the recipient, with the words "Formal Notice" or similar in the e-mail's subject line.

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 will not constitute a waiver of that provision, nor will 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 of the Contract or 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 *Assignment of Contract*

- A. Unless expressly agreed to elsewhere in the Contract, no assignment by a party to this Contract of any rights under or interests in the Contract will be binding on the other party without the written consent of the party sought to be bound; and, specifically but without limitation, money that may become due and money that is 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 will release or discharge the assignor from any duty or responsibility under the Contract.

18.09 *Successors and Assigns*

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

18.10 *Headings*

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

SECTION 00 73 00

SUPPLEMENTAL CONDITIONS OF THE CONTRACT BETWEEN OWNER AND CONTRACTOR

Article 1 - Owner's Engineer

Owner's Engineer is the following firm:

McMillen Jacobs Associates, 1401 Shoreline Drive, Suite 100
Boise, Idaho 83702 – Project Manager Donald Jarrett, P.E. (425) 503-5315 jarrett@mcmjac.com

Article 2 - Site Security

Contractor shall be responsible to establish site security upon the start of the Work. Site security measures furnished by the Contractor shall include all temporary fencing and gates as deemed necessary by the Contractor to protect tools, equipment and the facilities and at a minimum as shown on the drawings. Contractor shall provide, as he deems necessary, all guards and watchmen, surveillance equipment, access control at the site, and any other security measures he deems necessary to protect the site, all Owner's existing facilities, and all of the Contractor's equipment and facilities on the site. Any theft or security-related losses that occur at the site are the responsibility of the Contractor to remedy.

Article 3 - Insurance Supplemental Conditions

3.1 Insurance provided by the Contractor referenced in Article 6 of the General Conditions shall have the following coverage limits:

- A. Workers' Compensation - Employer Liability and Worker's Compensation as required by Alaska State Workers Compensation Statutes.
- B. Commercial General Liability - \$10 million combined limit per occurrence, and \$5 million Limit per accident. .
- C. Builders All-Risk Insurance – Total Contract Amount
- D. Automobile, Owned and Non-owned - \$1 million Combined limit per occurrence

3.2 Additional Insurance Requirements:

- A. Certificate of Insurance for Alaska Worker's Compensation, or an "other states" endorsement on Contractor's home state Worker's Compensation policy, is required prior to execution of a Contract or commencement of any Contract performance, if any in-state visits or Work is required or anticipated.
- B. Contractor shall provide Aircraft and Watercraft Liability insurance for all owned and non-owned aircraft or watercraft used in the Work, with limits not less than \$2 million per occurrence

Article 4 - Resident Project Representative

The Owner intends to utilize a Resident Project Representative (RPR) as referenced in paragraph 10.03 of the General Conditions. The duties of the RPR shall include the following:

1. Observe daily construction activities.
2. Serve as local point of contact for the Owner for delivery of communications.
3. Carry out the Owner's Quality Control and Inspection Program.

Article 5 - Dispute Resolution

- 5.1 If a dispute arises out of or relates to this Contract, or the breach thereof or any Change Order, and if said dispute cannot be settled through negotiations between the Parties, the parties agree first to try in good faith to settle the dispute by mediation under the Construction Industry Mediation Rules (but not under the auspices) of the American Arbitration Association, except to the extent that those rules are inconsistent with this paragraph, before resorting to arbitration, litigation or any other dispute resolution procedure. The parties shall appoint a single mediator acceptable to both parties, who shall be an attorney.
- 5.2 Although the parties agree to submit disputes to mediation, as provided in Section 5.1 above, the parties agree to submit any dispute arising under or related to this Agreement for resolution by binding arbitration in the of State Alaska. Arbitration shall be initiated by one party sending the other party a written demand for arbitration. The arbitration shall be conducted in accordance with the Construction Industry Arbitration Rules (but not under the auspices) of the American Arbitration Association, except to the extent that those rules are inconsistent with this paragraph. A single arbitrator, who is an attorney, shall be appointed by the parties. If the parties cannot agree on the designation of an arbitrator within thirty (30) days of the date of the written demand for arbitration, then an arbitrator shall be appointed by each party selecting an interim arbitrator, who shall be an attorney, and then the two interim arbitrators shall select the arbitrator, who shall be an attorney. The interim arbitrators shall then withdraw from any other involvement in the process.
- 5.3 Unless otherwise agreed in writing, the Contractor shall diligently carry on the Work and maintain its progress during any mediation or arbitration in accordance with the Owner's directions, and the Owner shall continue to make payments to the Contractor in accordance with the Contract Documents.
- 5.4 The process set forward in this Article 5 shall be the sole and exclusive method of settlement of disputes, except by execution of a Change Order in accordance with the General Conditions. Contractor and Owner waive and disclaim any right to initiate or participate in any judicial proceeding regarding such disputes. This agreement to arbitrate may be specifically enforced under the prevailing arbitration or other law of any court having jurisdiction. Judgment may be entered upon the decision of the arbitrator rendered in accordance with this Article 5 by any court having jurisdiction and will not be subject to modification or appeal except to the extent permitted by law.

5.5 The location of dispute resolution shall be Juneau, Alaska, unless otherwise agreed to by Owner.

Article 6 - Supplemental Warranty Requirements

6.1 Contractor warrants to Owner that all materials and equipment furnished under this Agreement will be new, unless otherwise specified, and that all work shall be performed in a competent and workmanlike manner. Contractor further warrants that, when complete, the Project will be free from improper workmanship and defective material and shall conform with the Drawings and Specifications in all respects. Contractor agrees to correct all work performed by it under this Agreement which proves to be defective in material or workmanship within a period of **two (2) years** from the date of Substantial Completion. Warranty shall include the responsibility to remove, repair and reinstall any equipment furnished and installed by the Contractor if any failure occurs during the warranty period. Any part repaired or replaced by the Contractor within the warranty period shall have its own warranty period limited to two (2) years after the date of completion of the repair or replacement of the equipment. New or replaced parts supplied or installed after the expiration of this warranty shall be covered by the manufacturer's standard new parts warranty.

6.2 In addition to the warranties provided pursuant to General Terms and Conditions, with respect to each Contractor supplied new manufactured equipment, (hereinafter referred to as "Equipment"), Contractor further warrants that all Contractor supplied equipment is: (a) fit for its intended purpose; (b) of the kind and quality required by the Specifications; (c) new and free from defects in workmanship and material; (d) of good and merchantable quality; and, (e) installed in a competent, diligent manner in accordance with accepted professional standards.

6.3 At its sole cost and expense, and not as part of the Lump Sum Price, Contractor will diligently repair or replace any Contractor supplied Equipment which does not conform to the warranties stated in here or in the General Terms and Conditions Article 6.19, provided only that Owner delivers to Contractor a written notice describing the nonconformity within the warranty period described in Article 7.17 of the General Conditions. Contractor shall have the right to dispose of parts replaced by it under this Article 6.3. The warranty regarding workmanship, materials or Contractor supplied equipment stated herein shall be the Owner's exclusive remedy against Contractor and all Subcontractors with respect to these items, whether in contract, in tort, or under any other legal theory.

6.4 If Contractor has not repaired or replaced any nonconforming equipment, materials or workmanship identified in a notice given in accordance with General Terms and Conditions Article 7.13 within thirty (30) days following receipt of such notice, or made arrangements reasonably satisfactory to Owner to do so, then Contractor authorizes Owner to repair or replace the nonconforming equipment, materials or workmanship and agrees to pay Owner the entire cost thereof, including all removal, freight and installation costs or expenses.

Article 7 - Safety

7.1 Contractor shall initiate, maintain, and supervise all safety precautions and programs

necessary to comply, and will comply, with all applicable provisions of all applicable safety laws, codes, regulations and requirements to prevent accidents or injury to persons or property on, about or adjacent to the Project Site. It shall erect and properly maintain, at all times, as required by the conditions and progress of the Work, necessary safeguards for the protection of workmen and the public. Contractor shall eliminate or abate safety hazards created by or otherwise resulting from any work at the Project Site carried on by any persons or firms directly employed by Contractor, any subcontractor or any person supplying Project materials or equipment for use by any of them. Contractor shall familiarize himself with and utilize the Owner's safety procedures, including lockout/tagout and confined spaces. All hot work shall require a Contractor administered hot work permit with appropriate precautions and monitoring. All work carried out on site shall comply with the local codes, the Alaska Occupational Safety and Health (AKOSH) requirements and other industry standards related to safety.

7.2 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. The Contractor shall establish an on-site safety program to encourage all workers employed at the site to maintain a safe working environment and safe work procedures. Contractor shall also establish an Alcohol and Drug Abuse Reduction Program on the jobsite to foster the goals of a drug and alcohol free work environment.

7.3 Contractor will take such action in response to any emergency endangering life or property as may be reasonable and necessary to prevent, avoid or reduce threatened damage, injury or loss, and shall report such action to Owner at the earliest practicable time.

Article 8 - Confidentiality

Not used.

Article 9 - Substantial Completion Supplemental Conditions

Partial Substantial Completion- Paragraph 15.04 of the General Conditions references the possibility for a partial Certificate of Substantial Completion. Contractor may apply for a Partial Certificate of Substantial Completion if and when generating equipment is substantially complete enough that electricity can be reliably generated and the penstock can be sed to deliver water to the Crystal Lake Fish Hatchery and used by the Owner in accordance with Section 00 72 00, Article 15 above.

Article 10 - Design Alternatives and Incentives

Not used.

Article 11 - Coordination With Others

Not used.

Article 12 – Hazardous Materials

Owner has furnished reports on lead and asbestos hazardous materials known to be present at the project to the Contractor.

Article 13 – Price Adjustment

Not used.

Article 14 – Performance and Payment Bonds

Performance and Payment Bond(s): The Contractor must, within thirty (30) days after the Owner forwards to it a Notice to Proceed for each Phase, furnish a Performance and Payment Bond for that Work in the amount of 100% percent (one hundred percent) of the total price for all Work specified in the Order to Proceed, which Performance and Payment Bond must be submitted on the form included in these Contract Documents. Each Performance and Payment Bond shall include the Warranty Period, and shall remain in full force and effect until the Contractor fully performs and completes all its obligations under the Contract for that Phase. Each Performance and Payment Bond shall be executed as Surety by a corporation with a Best's Rating of at least "A", acceptable to the Owner and authorized to issue surety bonds in the State of Alaska. Each Performance and Payment Bond shall be accompanied by a certified copy of the power of attorney authorizing the attorney-in-fact of the corporate Surety to execute and deliver the Bond on behalf of the Surety, together with a currently executed certificate of an authorized officer of the Surety stating that the power of attorney is in full force and effect. Contractor's failure to provide a Performance and Payment Bond for any Unit, in full compliance with the Contract Documents, shall constitute a material breach of the entire Contract.

Article 15 – Prevailing Wages

- 15.1 The Contractor shall comply with and require each of its subcontractors to comply with all applicable State of Alaska laws governing the payment of prevailing wages (AAC Title 8 Labor). No individual who performs work for which this payment of prevailing wage is required shall be paid less than the prevailing wage rate set by the State of Alaska Department of Labor and Workforce Development (Department).
- 15.2 The Contractor and all Subcontractors shall be responsible for paying the State prevailing wage. If the Contractor or any subcontractor claim any exemption from the requirements of payment of prevailing wages the Contractor shall be solely responsible for providing to the Owner documentation approved by the Department of Labor and Industries verifying that the exemption applies.
- 15.3 As a precondition to any payment, the Contractor and all Subcontractors shall be responsible for providing certified payrolls to both the City, the Engineer and the State of Alaska, Department of Labor, Wage and Hour Division on a weekly basis utilizing the appropriate agency's form(s).
- 15.4 All fees and costs associated with the submittal and approval of any "Notice of Work" (NOW) made to the Department shall be the exclusive responsibility of the Contractor and shall be included in Bidder's Bid Price. Contractor shall provide a copy of the NOW to Owner prior to beginning work on the site.

- 15.5 As a precondition to final payment, the Contractor shall file with the Department the “Notice of Completion” (NOC). After approval by the Department, Contractor shall submit the approved NOC to the Owner and final payment can be made in accordance with the requirements of the General Conditions.
- 15.6 The Contractor is solely responsible for informing itself about local labor conditions such as the length of the workday or work week, overtime compensation, health and welfare contributions, other fringe benefits, labor supply, tribal ordinances relating to labor or employment, and prospective adjustments to wage rates. No increase in the Contract Price will be allowed or authorized on account of the payment of wage rates in excess of those referred to herein.
- 15.7 If any dispute arises about what is the prevailing rate of wage for work and the parties (including labor and management representatives) cannot resolve this dispute, the matter shall be referred for arbitration to the Department of Labor and Workforce Development of the State of Alaska, whose decision shall be final, conclusive and binding upon the parties.
- 15.8 WHEN PREVAILING WAGE RATES APPLY, THE CONTRACTOR SHALL BE RESPONSIBLE FOR FILING WITH THE OWNER PROPERLY EXECUTED AND APPROVED PREVAILING WAGE RATE STATEMENTS OF ITS SUBCONTRACTORS.
- 15.9 The Owner does not guarantee that labor can be procured for the minimum wages shown on the referenced schedules. The rates listed are minimum only, below which the Contractor cannot pay.

Article 16 - Copyright and Other Intellectual Property

Not used.

Article 17 - Paragraph 16.03 of the General Conditions

17.1 The Contractor shall ensure that its agreements with Subcontractors contain similar provisions, for termination for convenience and limiting the Subcontractor’s entitlement, to the same effect as Article 16 of the General Conditions.

17.2 Paragraph 16.03.B applies regardless of the reason or cause giving rise to the election by the Owner to terminate, and, if the Owner so elects, overrides any obligation of the Owner to indemnify for such cause or reason. For example, if the Owner elects to terminate due to Hazardous Environmental Conditions, then the Owner will not by virtue of paragraph 5.06.E of the General Conditions be required to indemnify for lost profits or revenues, and paragraph 16.03.B will govern.

Article 18 - Defective Work and “cost to complete”

18.1 At all times the Owner may withhold from payment otherwise due to the Contractor:

A. twice the value, as reasonably determined by the Owner, of all defective Work; and (without duplication)

B. the value of uncompleted Work, according to the greater of: (1) the Schedule of Values; and (2) the Owner’s reasonable estimate, from time to time as the Work progresses, of the cost to complete all remaining uncompleted Work.

18.2 For this purpose, identification or characterization of defective Work, as opposed to uncompleted Work, shall be as reasonably determined from time to time by the Owner.

Article 19 - Acceleration or additional resources to make the Schedule

19.1 The Owner may from time to time, by written directive to the Contractor, accelerate the time for performance or completion of the Work or any part of the Work by requiring the Contractor to take such action as may be reasonable and practical in the circumstances, including without limitation the provision of additional labor, supervision, resources and equipment, working additional shifts and providing overtime work. The Contractor shall promptly comply with all such written directives.

19.2 If the Owner orders acceleration of the Work under paragraph 19.1, the Owner shall reimburse the Contractor for incremental costs resulting directly therefrom, and deducting therefrom costs that would not have been required had the Contractor satisfied the construction schedule, provided that the Contractor has delivered to the Owner a written notice of claim specifying the Contractor’s estimate of the claim within five (5) Working Days after delivery of the written directive for acceleration from the Owner.

Article 20 – Commencement of the Work

20.1 It is a fundamental term of the Contract that the Contractor commence the Work on the Site on or before the date stipulated therefore. If the Contractor fails, refuses or is unable for any reason to do so, then the Owner shall have the right to terminate the Contract forthwith by written notice to the Contractor. If the Contract is so terminated, then the Contractor shall have no claim against the Owner for any loss, damage, cost or expense which the Contractor or any other party may suffer or incur as a result of such termination.

Article 21 – Completion of Work and Correction of Deficiencies

21.1 For all purposes of the Contract, the Work and any portion of the Work will not be considered to have been completed, and deficiencies and defects will not be considered to be corrected, until all of the following have occurred:

A. any and all applicable inspections and approvals and other requisite inspections and approvals have been obtained, relative thereto;

B. the Contractor has reported in writing (by way of an application for payment, or otherwise), that the Work or the said portion thereof has been completed and the deficiencies and defects have been corrected, as the case may be; and that any and all applicable inspections and approvals and other requisite inspections and approvals have been obtained, relative thereto, and the Contractor has provided to the Owner such evidence thereof as reasonably required by the Owner;

21.2 all requirements of the Contract Documents have been complied with;

21.3 the Owner's Representative has certified and reported to the Owner that such Work has been completed and the deficiencies and defects have been corrected, as the case may be, and the Owner's Representative has been afforded a reasonable opportunity, after the matters under this paragraph have been satisfied, to do so; and

21.4 in the case of Substantial Performance of the Work:

paragraph 21.1.3 of this article has been complied with; and

the Owner's Representative has certified and reported to the Owner that the value, as reasonably determined by the Owner's Representative, of (in the aggregate) uncompleted Work and Work to be corrected (including all deficiencies and defects) is not more than the retainage, and the Owner's Representative has been afforded a reasonable opportunity, after the matters under this paragraph have been satisfied, to do so.

Any requirements prescribed under paragraphs 21.1.1 to paragraph 21.1.4 of this article that have not been satisfied or performed and are outstanding will be treated as uncompleted Work and the value assigned to such uncompleted Work will (despite the Schedule of Values) be equal to \$25,000 plus 1% of the Contract Price.

21.5 Prior to the making application for Substantial Completion of the Work, the Contractor shall submit to the Owner's Representative:

the following items (except those, if any, which the Contractor cannot practicably obtain at or before the Substantial Completion of the Work, and such exceptions will be submitted by the Contractor within 30 days following Substantial Completion of the Work):

Letters of Assurance for Professional Design and Review from those Professionals engaged by the Contractor under the provisions of the Contract, including applicable sealed Shop Drawings.

All required manufacturer's inspections, certifications, guarantees, warranties as specified in the Contract Documents.

All maintenance manuals, operating instructions, maintenance and operating tools, replacement parts or materials as specified in the Contract Documents.

Certificates issued by all permit issuing authorities indicating approval of all installations, work and improvements requiring permits.

Certificates issued by all testing, commissioning, cleaning, inspection authorities and associations as applicable or specified in the Contract Documents.

All required record Drawings and as built and as-installed documents in the form specified in the Contract Documents.

Certificates issued by Workers Compensation Board confirming that the Contractor has paid all assessments.

A statement indicating reconciliation of all Change Orders, Change Directives / Site Work Orders and any and all claims arising out of the Contract which the Contractor has or intends to make;

A statement: listing and giving particulars (including a reasonable estimate of the amount(s) thereof) of any and all claims whatsoever against the Owner or the Owner's Representative arising out of the Contract including, without limiting the generality of the foregoing, any claims for Change Orders, Change Directives / Site Work Orders, extra work, delay to the work, impact on the work, compression of work and acceleration of work, howsoever arising; and

A statement warranting that the Contractor shall not make any further claims whatsoever against the Owner or the Owner's Representative arising out of the Contract including, without limiting the generality of the foregoing, any claims for Change Orders, Change Directives / Site Work Orders, extra work, delay to the work, impact on the work, compression of work and acceleration of work, howsoever arising.

Any items which would be required in order to enable the Owner to use or occupy the Work shall be submitted to the Owner's Representative prior to Substantial Completion of the Work, and if any such items are outstanding then: (1) such outstanding items will be treated as uncompleted Work; (2) in determining whether Substantial Completion of the Work has been achieved, the value assigned to such uncompleted items will (despite the Schedule of Values) be equal to \$25,000 plus 1% of the Contract Price.

Article 22 – Liquidated Damages for Late Completion

Liquidated Damages for late completion of the work shall be calculated based on paragraph 4.05 of Section 00 50 00, Agreement. Liquidated damages shall be calculated, based on calendar days, as the number of days that Work is substantially complete is finally Complete after the number of days guaranteed in the Agreement.

The liquidated damages for late completion shall not exceed 15% of the Total Contract Price.

Article 23 – Liquidated Damages for Failure to Meet Performance Guarantees

Not used.

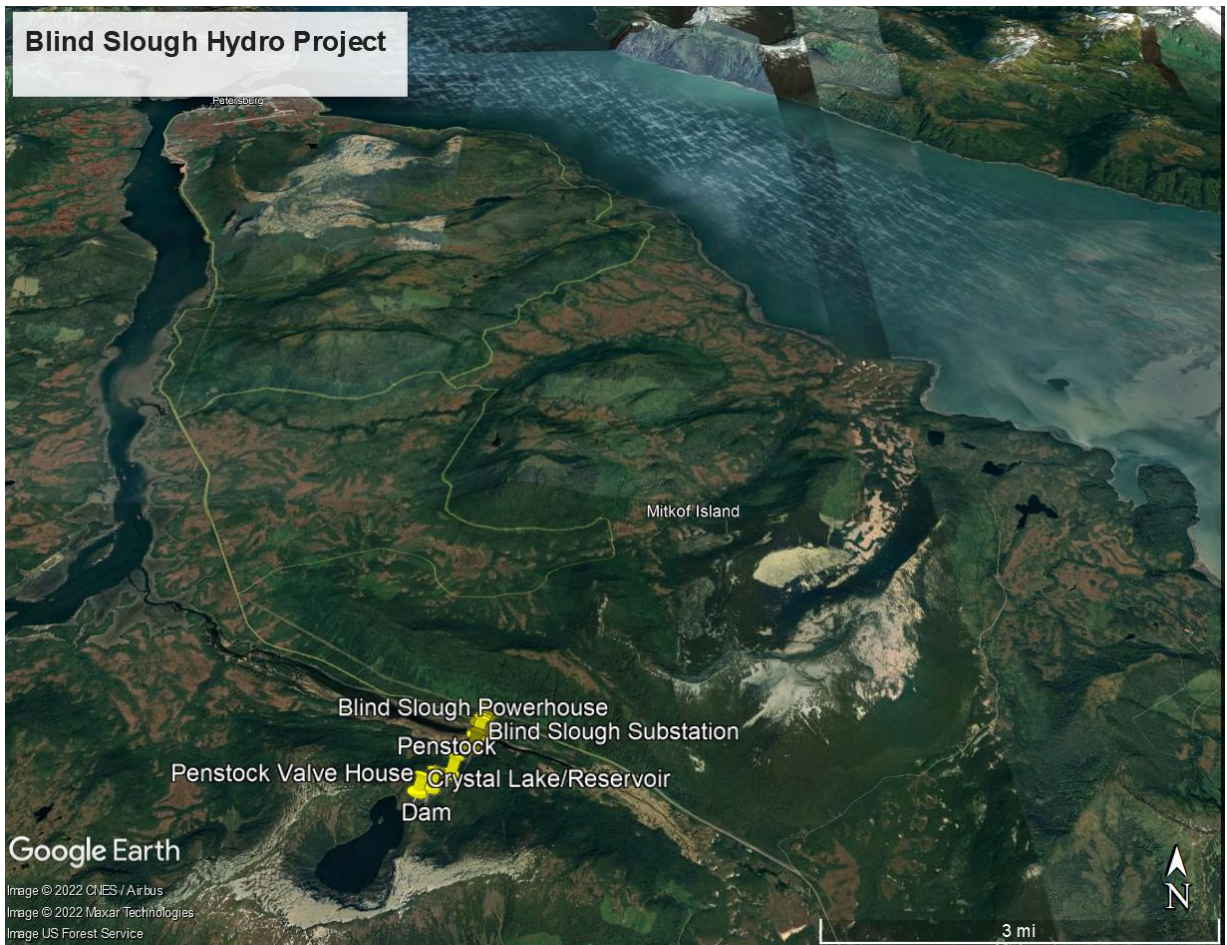
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SECTION 01 11 00 - SUMMARY OF WORK

PART 1 -- GENERAL

1.1 SUMMARY AND BACKGROUND

- A. The WORK to be performed under this Contract shall consist of furnishing plant, tools, equipment, materials, supplies, and manufactured articles, and furnishing all labor, transportation, and services, including fuel, power, water, and essential communications, and performing all work or other operations required for the fulfillment of the Contract in strict accordance with the Contract Documents. The WORK shall be complete, and all work, materials, and services not expressly indicated or called for in the Contract Documents which may be necessary for the complete and proper construction of the WORK in good faith shall be provided by the CONTRACTOR as though originally so indicated, at no increase in cost to the OWNER.
- B. The Work of this Contract is to refurbish and repair the Blind Slough Hydroelectric Project. The Blind Slough Hydroelectric Project is an existing hydroelectric facility located south of the City of Petersburg, Alaska (see Google Earth map below). The existing project consists of a dam (which impounds the Crystal Lake Reservoir), a 4,600-foot-long penstock and a powerhouse with a single 2.1 MW turbine-generator unit.



- C. Petersburg Municipal Power and Light (OWNER) has a FERC License authorizing the project. The project has been in existence since 1924 and was last refurbished in 1954. The OWNER is in the process of obtaining a FERC license Amendment to allow the project refurbishment.
- D. The powerhouse is an existing above ground structure housing one horizontal-shaft, single jet Pelton-type hydraulic turbine, directly connected synchronous generator, and controls. The existing turbine-generator, controls and auxiliary equipment will be replaced with a new turbine generating unit controls and auxiliary equipment. The OWNER has purchased a new turbine-generator equipment system (described herein) from the **Turbine-Generator Equipment Supplier (TGES)** for the refurbishment of the project. The TGES will deliver the turbine-generator and auxiliary equipment to the project site. The TGES is Gilbert, Gilkes & Gordon, LTD. On-site storage, handling and all installation and startup services of the TGES system shall be by the CONTRACTOR under this Contract.
- E. **Owner Supplied New Turbine-Generator Equipment.** The new Pelton wheel turbine-generator will be rated to produce approximately 2,130 kW at 25 cubic feet per second flow. The new generating unit will be designed for fully automatic shutdown and for one-button start-up. The plant control system will be located at the powerhouse. The powerhouse may need to be checked daily, but a full-time operator shall not be necessary. The equipment is designed with a SCADA remote operator's terminal) system that will allow remote monitoring and control of the plant. Design parameters of the new turbine-generator unit include the following:
- | | |
|------------------------------------|-------------------------|
| 1. Normal Max Reservoir Elevation: | 1294.0 ft |
| 2. Turbine Centerline Elevation: | 38.3 ft |
| 3. Gross Head: | 1255.7 ft |
| 4. Net Head at 20 cfs flow: | 1169 ft (approximately) |
| 5. Net Head at 25 cfs flow: | 1125 ft (approximately) |
| 6. Maximum Flow rate: | 25 cfs |
| 7. Minimum Flow rate: | 8 cfs |
- F. **Generator Electrical, HPU and Accessories.** The new synchronous generator output will be 2588 kVA (2,200 kW at 0.85 power factor), 2,400 volts AC, 60 Hz. Hydraulic actuators, complete with high pressure unit (HPU) pumps and controls, are provided by the TGES to adjust the position of the two needle jets, as well as the deflectors.
- G. Other Contract improvement works to the existing powerhouse building include new lighting, heating, access doors, and miscellaneous appurtenances.
- H. **Penstock Inlet Water Supply.** The turbine-generator unit is to be supplied water through the existing 20-inch outside diameter steel penstock of approximate length of 4600 feet. An approximate 150-ft section of existing 18-inch OD lower penstock pipe will be replaced under this Contract with new 20-inch OD steel pipe and concrete thrust blocks, per the Contract Drawings. Other modification Work required to the existing

penstock pipe supports, couplings and hardware, access steps, and other miscellaneous items are identified on Contract Drawings GC006 thru GC008.

- I. **Tailrace Discharge Water and Crystal Lake Fish Hatchery.** The water exiting the powerhouse will flow into an existing 30-inch buried steel tailrace pipe and discharged into the Crystal Lake Fish Hatchery (Crystal LFH) emergency storage pond. This discharge water is the sole water supply to meet the Crystal LFH water requirements.
 - 1. The Blind Slough Hydroelectric Project is required to provide minimum monthly Crystal Lake FH flows in accordance with its FERC license. These minimum flows must be maintained at all times during construction or operation:

Month	Flow (cubic feet per second)	Month	Flow (cubic feet per second)
January	12.5	June	9.3
February	13.0	July	11.6
March	14.0	August	12.2
April	13.9	Sept through Dec	12.3
May	8.2		

- 2. **New Bypass Pipeline to Crystal LFH.** The Project WORK includes construction of a new, mostly 12-inch diameter, steel bypass pipeline that draws water from upstream of the new turbine isolation valve and passes the water thru a pressure reduction facility consisting of dual fixed sleeve valves. The new bypass is designed to pass flows ranging from 12 to 14 cfs in accordance with the Crystal LFH flow requirements as shown in the table above. The bypass water discharges into the existing tailrace pipe which then flows thru existing infrastructure pipelines to reach the fish hatchery.
- J. **New Dam Valve House Bypass Outlet Pipe to Crystal Creek.** The Project WORK includes construction of a new pipe and valve system to release flows to the Crystal Creek diversion reach at the top end of the project. This WORK shall be a priority of the construction since the Project cannot be shutdown until hatchery flows can be spilled down Crystal Creek to the Crystal LFH emergency storage pond at the barrier dam. The hatchery will pump water for hatchery operations from the emergency storage pond during the period of time the penstock is dewatered for construction.

1.2 PROJECT COORDINATION

- A. **OWNER’s Project Lead.** The OWNER's Project Lead for the Project shall be Mr. Karl Hagerman. The Project Lead shall be the OWNER’s sole agent for purposes of the Contract, except where the OWNER is legally required to act through its City Manager. CONTRACTOR shall coordinate all construction management activities through the Project Lead. Unless otherwise specified, all communications required to be delivered to the OWNER shall be delivered to the Project Lead.

- B. **Change Modifications to the Contract.** No verbal change-order, modification of the Contract Documents, or other direction from the OWNER or OWNER's representative or ENGINEER shall be binding upon the OWNER unless reduced to writing and signed by the Project Lead, except as otherwise required by the OWNER's procedures. The PROJECT LEAD shall act as the OWNER's Representative for purposes of this Contract.
1. Any and all changes to these specifications or plans, except for those that cannot reasonably be anticipated at the time of the Notice to Proceed, shall be approved by the ProjectLead in writing prior to commencing any WORK.

1.3 PREVAILING WAGES

- A. In addition to the requirements of the General Conditions, the CONTRACTOR shall be required to post on the job site a copy of the intent form to pay prevailing wages.
- B. As identified in the General Conditions, the CONTRACTOR shall comply with state law regarding prevailing wages. These rules apply to any CONTRACTOR who does business with the OWNER, including owner/operators.
- C. All contractors or subcontractors who perform work on a public construction contract for the state or for a political subdivision of the state shall, before the Friday of every second week, file with the Department of Labor and Workforce Development a sworn affidavit for the previous reporting period, setting out in detail the number of persons employed, wages paid, job classification of each employee, hours worked each day and week, and other information on a form provided by the Department of Labor and Workforce Development.
- D. Before commencing work on a public construction contract, the person entering into the contract with a contracting agency shall designate a primary contractor for purposes of this section. Before work commences, the primary contractor shall file a notice of work with the Department of Labor and Workforce Development. The notice of work must list work to be performed under the public construction contract by each contractor who will perform any portion of work on the contract and the contract price being paid to each contractor. The primary contractor shall pay all filing fees for each contractor performing work on the contract, including a filing fee based on the contract price being paid for work performed by the primary contractor's employees. The filing fee payable shall be the sum of all fees calculated for each contractor. The filing fee shall be one percent of each contractor's contract price. The total filing fee payable by the primary contractor under this subsection may not exceed \$5,000. In this subsection, "contractor" means an employer who is using employees to perform work on the public construction contract under the contract or a subcontract.
- E. Upon completion of all work on the public construction contract, the CONTRACTOR shall file with the Department of Labor and Workforce Development a notice of completion together with payment of any additional filing fees owed due to increased contract amounts. Within 30 days after the department's receipt of the primary contractor's notice of completion, the department shall inform the contracting agency of the amount, if any, to be withheld from the final payment.
- F. Payments cannot be released by the OWNER until certification of these filings is received.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

- A. The WORK to be performed under this Contract shall consist of the CONTRACTOR furnishing plant, tools, equipment, materials, supplies, and manufactured articles, and furnishing all labor, transportation, and services, including fuel, power, water, and essential communications, and performing all work or other operations required for the fulfillment of the Contract in strict accordance with the Contract Documents. The WORK shall be complete, and all work, materials, and services not expressly indicated or called for in the Contract Documents which may be necessary for the complete and proper construction of the WORK in good faith shall be provided by the CONTRACTOR as though originally so indicated, at no increase in cost to the OWNER.
1. The term “*furnish*” used herein shall mean the supplying of all materials, transport of such materials, and installation of such materials for a complete and operable system.
 2. Portions of the WORK involve the CONTRACTOR's installation of equipment and materials to be supplied by the OWNER.
- B. The Contract WORK for the Blind Slough Hydroelectric Project includes, but is not limited to the following:
1. Mobilization/demobilization (not to exceed 5% of contract amount): CONTRACTOR shall furnish construction equipment, materials, supplies, appurtenances, manned and ready for commencing and executing the WORK.
 2. Temporary facilities. CONTRACTOR shall furnish construction facilities other than those provided by the OWNER. Such facilities shall include set up of field offices, temporary power, communications, and sanitary facilities for the CONTRACTOR and OWNER personnel.
 3. Temporary and Permanent Erosion and Sediment Control Facilities. CONTRACTOR shall furnish and maintain all temporary erosion and sediment control measures including all associated work and materials necessary for a complete installation as indicated on the Contract Documents. Contractor shall develop a construction specific Stormwater Pollution Prevention Plan (SWPPP). CONTRACTOR shall construct permanent erosion and sediment control facilities as indicated on the Contract Documents.
 - a. Provide marking of clearing limits, silt fences, wattles or other erosion control measures.
 - b. Provide all construction of site stabilization measures and permanent erosion control measures.
 4. CONTRACTOR shall provide clearing and grubbing work as required by the Contract Documents to be cleared including areas along the lower penstock replacement.
 5. Miscellaneous Site Civil Work. CONTRACTOR shall furnish civil site work including excavation and material hauling, surveying, installation and placement of fill, finish grading and road resurfacing Work. Additional Work shall include:

- a. Powerhouse site preparation including final grading and repair of all project driveways and roads.
 - b. Related work for maintenance and installation of erosion and sedimentation control measures.
 - c. Preparation and furnishing of miscellaneous culverts (14 to 20-inch diameter) as required for site drainage improvements.
 - d. Final revegetation of all areas where the ground was disturbed during construction activities.
6. Licensed Survey Work. The CONTRACTOR shall furnish services of a State of Alaska Professional Licensed Surveyor for establishment of lines, grades, and survey staking as necessary for the execution and completion of the Work, including slope stakes and other working points.
7. New Penstock and Pipeline Work: The CONTRACTOR shall furnish new penstock steel pipe, as shown on the Contract Drawings for the realignment of the lower end of the penstock pipe. Includes all supply, unloading and temporary storage of the pipe on-site, excavation for new buried alignment, care of surface water and runoff during construction, installation, welding and testing of lined and coated steel pipe and appurtenances. WORK includes but is not limited to:
- a. Construction of all new penstock pipe supports and thrust blocks,
 - b. Installation and welding and/or assembly of new section of penstock pipe. All welding shall be performed by approved welders certified in accordance with the Contract Documents.
 - c. Finish grading and revegetation of all disturbed areas.
 - d. Provision of field application of exterior and interior coating systems to joints after installation and repair of any coating damage.
 - e. Installation of any required penstock accessories including concrete manholes, air and vacuum release valves, flow meters, penstock drain lines and any other pipeline accessories shown on the Contract Documents.
8. Existing Penstock Coupling and Pipe Support Repairs. The CONTRACTOR shall furnish new penstock joint couplings and accessories (including coupling bolt and nut hardware and gaskets), as shown on the Contract Drawings for the refurbishment of the existing coupling systems.
- a. The existing coupling systems installed on the penstock, to the best of the OWNER's and ENGINEER'S knowledge are Dresser Style 38 couplings with a total of 12 bolts and nuts per coupling.
 - b. Provide refurbishment of existing penstock couplings as summarized on the Contract Drawings GC006 thru GC008 and Specifications.
 - c. Provide refurbishment of penstock supports as shown on the Contract Drawings and Specifications

9. Furnish new penstock supports, thrust blocks and new penstock thrust block as indicated on the Contract Documents.
10. Furnish a new steel bypass pipeline to supply Crystal LFH flows around the refurbished powerhouse, with supports, valves and appurtenances that supplies water to the existing tailrace for uninterrupted water supply to the Crystal Lake FH. The new bypass is designed with an electric valve actuator on Valve V-202 such that the bypass is to be programmed to divert water to the Crystal Lake FH anytime the new TIV valve is to be closed. Programming of the operation of new valve V-202 actuator shall be controlled thru the new PLC furnished by the Turbine-Generator System Supplier.
11. The Project WORK includes construction of a new pipe and valve system to release flows to the Crystal Creek diversion reach. This WORK shall be a priority of the construction since the Project cannot be shut down until hatchery flows can be spilled down Crystal Creek to the emergency storage pond at the barrier dam. The hatchery will pump water for hatchery operations from the emergency storage pond during the period of time the penstock is dewatered for construction.
12. The CONTRACTOR shall furnish construction staging and laydown areas.
13. Demolition Work Inside and Outside the Powerhouse. The CONTRACTOR shall furnish all demolition Work of existing equipment and materials as shown on the Contract Documents, including but not limited to:
 - a. Demolition of portions of the rock retaining wall and wall penetrations on the existing powerhouse
 - b. Demolition of existing portions of penstock and concrete thrust block on penstock, including valving and pipe appurtenances,
 - c. Powerhouse existing mechanical and electrical equipment demolition.
 - d. Powerhouse foundation modifications and structural demolition to prepare for the new turbine-generator equipment installation.
 - e. Demolition of existing bypass pipeline, valves and appurtenances that supply water to Crystal LFH via the tailrace pipe.
 - f. Other demolition work as shown on the Contract Documents
 - g. CONTRACTOR shall protect and salvage existing governor and turbine runner and store in a location in Petersburg as directed by the OWNER.
14. Furnish all materials and equipment for mechanical and electrical installation of security and access control systems, communications, and electrical equipment in the existing Powerhouse and Intake not supplied by OWNER. Such sub-systems shall include doors, miscellaneous piping, interior and exterior lighting, electrical receptacles, etc.)
15. Installation and wiring of OWNER supplied turbine, generator, control panels, and auxiliary equipment in the existing powerhouse. (See more complete list of OWNER-

supplied equipment detailed in Paragraph 1.6 in this Section.)

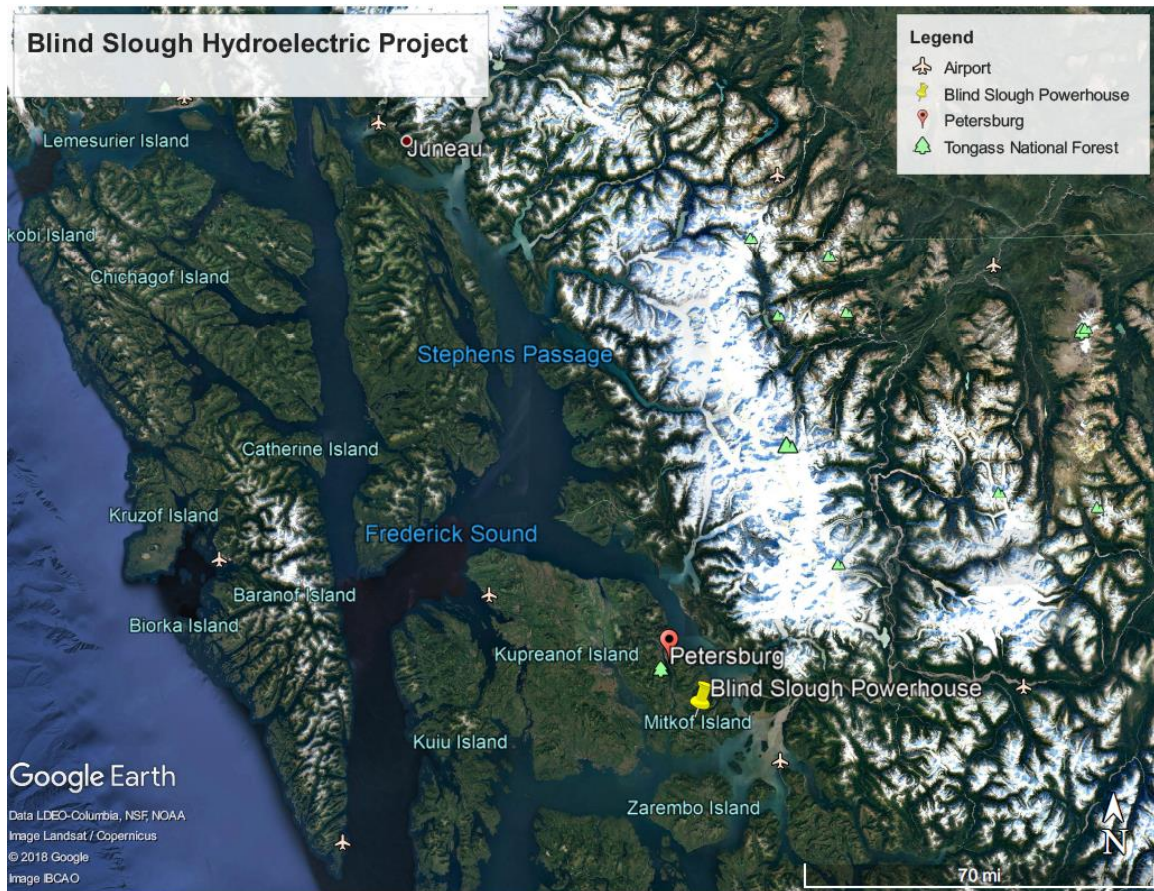
16. CONTRACTOR shall perform incidental work and activities as follows.

- a. Become familiar with the project site, required construction schedule, construction routes and specified materials.
- b. Prepare for and perform de-watering of excavated areas if required.
- c. Provide, at the CONTRACTOR's expense, suitable waste disposal sites for any waste materials if required beyond those supplied by the OWNER. The CONTRACTOR shall be responsible for the proper disposal offsite of all solid and liquid waste materials generated from the project at the local landfill.
- d. Restore to pre-construction conditions all road shoulders, ditches, and culverts and any other items or property disturbed by the CONTRACTOR's construction operations.

17. CONTRACTOR shall supply project commissioning and startup services, including testing of all installed components, and assisting OWNER's staff and TGES.

18. All other Contract WORK items as described in the Contract Bid Documents for a complete and operable Project.

C. The WORK is located at the OWNER's existing hydroelectric plant, off Mitkoff Highway approximately 13-miles south of the city of Petersburg, Alaska. The project is located as shown in the following map:



1.5 CONTRACT METHOD

- A. The WORK hereunder will be constructed under a lump sum and unit price contract.

1.6 OWNER SUPPLIED EQUIPMENT FOR PROJECT

- A. The major equipment items to be provided to the CONTRACTOR by the OWNER, for installation by the CONTRACTOR, shall include, but not be limited to, the following items. (A more detailed description of the exact item list of OWNER supplied equipment and materials and shop drawings is provided in the Appendix)
 1. One horizontal-shaft, single-runner, Pelton type 2-jet hydraulic turbine, including turbine isolation valve, valve operator, hydraulic pressure unit with associated hydraulic piping and tubing with fittings, turbine branch piping (inside the powerhouse).
 2. One synchronous generator with flywheel, brake, lube oil module with piping and fittings.
 3. Brushless excitation system, voltage regulator and associated equipment, including instrument transformers.
 4. All required anchor bolts and foundation plates for mounting of turbine, valves, and generator, but not electrical cabinets or panels.

5. Two turbine needle jets with actuators, turbine deflectors with actuator and instrumentation.
 6. Turbine controls / protection and instrumentation panels.
 7. Generator switchgear assembly, including generator breaker, station service breaker and instrument transformers.
 8. Neutral grounding equipment for generator.
 9. Station service equipment, including transformers, AC and DC panel boards, and inverter.
 10. Generator and turbine control system, including protective relays, RTU for utility communication, meters, instruments, synchronizing equipment, programmable logic controller (PLC), a panel mounted Human Machine Interface (HMI), and desktop SCADA PC based operator's terminal and monitor.
 11. An intake control panel including PLC and communications equipment for monitoring and remote control of the intake site.
 12. RTU and communications equipment to connect new plant to OWNER'S SCADA system.
 13. Interconnecting wiring drawings, including conductor type and size, terminal strip and conductor connection details and designations.
 14. A conduit routing drawing and schedule showing conduits, their sizes, starting and ending points, and number and sizes of conductors required in each conduit.
- B. The OWNER will also provide the following design services:
1. Programming of all plant control, PLC, and remote communications systems.
 2. Calculation of protective relay settings through performance of a relay coordination study. All protective relays shall then be pre-set at the factory before shipment.
- C. The OWNER will provide final design, drawings and technical data, including electrical schematic diagrams, control panel and field wiring diagrams, field interconnection diagrams, and conductor sizing and cable tray/conduit schedules of the turbine-generator equipment package, all for use by CONTRACTOR in their installation work.
- D. The OWNER will provide Field Assistance for the CONTRACTOR during startup and testing and commissioning, by engaging services of the turbine supplier to provide installation and start-up supervisors to provide advice and inspection on the installation of the turbine and generator unit.
- E. The OWNER will provide temporary power (240 / 120 VAC, 1-phase service) at the project site administration area for use by the CONTRACTOR.
- F. There is no phone or internet service available at the Project site. Cell phone service at the Project site depends on the provider.

1.7 CONTRACT DELIVERY SCHEDULE

- A. CONTRACTOR shall complete, to the level of substantial completion, all WORK requirements required under these Contract Documents within the number of calendar days bid in the Proposal Forms following the Notice-to-Proceed (NTP). Time shall be computed starting with the effective date of the NTP award from the OWNER.
- B. Upon receiving the NTP, CONTRACTOR shall submit Product Data, schedules and other specified data in accordance with Section 01 33 00 – Contractor Submittals.
- C. The Point of delivery of all OWNER supplied equipment has been designated as a storage location in Petersburg. The TGES is required to provide to the OWNER a four-week advance notice of shipping from the factory and a 48-hour confirming notice of impending arrival at site acceptable to OWNER. Within 1-day of receiving the 48-hour shipping confirming notice, the OWNER shall be responsible to provide to the CONTRACTOR's Project Manager and Superintendent this information by email communication. The Project site address is as follows:
- D. In all cases, the OWNER's Contract is with one (1) general CONTRACTOR and it is the general CONTRACTOR's responsibility to ensure all work required to provide a complete and operational facility is included in their bid. When possible, the OWNER has attempted to reference work which should be coordinated with various trades, but it is the CONTRACTOR's responsibility to coordinate and schedule the work of all subcontractors, trades, and suppliers to assure the proper and timely prosecution and completion of all items of work.
- E. The CONTRACTOR shall take field measurements and verify field conditions and shall carefully compare such field measurements and conditions and other information known to the CONTRACTOR with the contract documents before commencing activities. Errors, inconsistencies or omissions discovered shall be reported to the OWNER at once.

1.8 WORK BY OTHERS

- A. Where two or more contracts are being performed at one time on the same Site or adjacent land in such manner that work under one contract may interfere with work under another, the OWNER will determine the sequence and order of the Work in either or both contracts. When the Site of one contract is the necessary or convenient means of access for performance of work under another, the OWNER may grant privilege of access or other reasonable privilege to the contractor so desiring, to the extent, amount, and in manner and at time that the OWNER may determine. No OWNER determination of method or time or sequence or order of the work or access privilege shall be the basis for a claim for delay or damage except under provisions of the General Conditions for temporary suspensions of the work. The CONTRACTOR shall conduct its operations so as to cause a minimum of interference with the work of such other contractors, and shall cooperate fully with such contractors to allow continued safe access to their respective portions of the Site, as required to perform work under their respective contracts.
- B. **Interference With Work On Utilities:** The CONTRACTOR shall cooperate fully with all utility forces of the OWNER or forces of other public or private agencies engaged in the relocation, altering, or otherwise rearranging of any facilities which interfere with the

progress of the WORK, and shall schedule the WORK so as to minimize interference with said relocation, altering, or other rearranging of facilities.

1.9 WORK SEQUENCE

- A. The CONTRACTOR's attention is directed to the fact that during the Work of the Contract, no interruption in the Crystal LFH water flow can be accommodated, and the CONTRACTOR shall work with the OWNER to schedule its construction operations accordingly.
- B. The OWNER with the assistance of the CONTRACTOR will make releases of water from the reservoir to provide for Crystal LFH water flows. Such releases shall be coordinated with the CONTRACTOR and shall be requested a minimum of 7-days in advance in writing.
- C. Access to the site is limited to the hours of 0600 to 1800 during the work days of Monday thru Saturday.

1.10 CONTRACTOR USE OF SITE

- A. The CONTRACTOR's use of the Site shall be limited to its construction operations, including on-Site storage of materials, on-Site fabrication facilities, and field offices.
- B. The CONTRACTOR shall not cause an interruption of Crystal LFH flows during any of its construction operations.

1.11 OUTAGE PLAN AND REQUESTS

- A. Unless the Contract Documents indicate otherwise, the CONTRACTOR shall not remove from service, de-energize, or modify settings for the existing powerhouse, penstock, valves, equipment, structure, road, or any other facility without permission from the ENGINEER.
 - 1. Supply of Crystal LFH flows to the emergency storage pond, released at the dam, will be made using the dam valve house bypass outlet pipe facility. Releases of hatchery flows will be made for up to 7-days prior to shutdown of the project. Once construction of the bypass facility is complete and bypass has operated for up to 7-days, CONTRACTOR shall request an outage start date.
 - 2. Project shutdown (to allow dewatering the penstock, etc.), following the satisfactory establishment of hatchery flows from the dam to the hatchery emergency storage pond, will be approved after receipt of a formal notice in accordance with the outage plan.
 - 3. Following construction and acceptance by ENGINEER of the new lower penstock section with powerhouse bypass system, CONTRACTOR shall provide formal notice to OWNER for penstock filling and leak testing. Once leak testing is complete and satisfactory, CONTRACTOR, shall commence testing of the powerhouse bypass system. Upon satisfactory completion of the testing of the powerhouse bypass CONTRACTOR shall provide formal notice to Owner to establish hatchery flow using the penstock and powerhouse bypass system.

4. With hatchery flows resumed through the penstock and bypass system CONTRACTOR can complete powerhouse equipment install and dry testing of powerhouse systems. CONTRACTOR will be allowed a short outage, if needed, to make final preparatory turbine and turbine inlet valve work connections, however, penstock must not be dewatered. During that outage Crystal LFH flows will be provided using the powerhouse bypass system. CONTRACTOR shall formally request an outage for this purpose.
- B. The WORK requires modifications to existing facilities and construction of new facilities and connection of new facilities to existing facilities and the CONTRACTOR shall submit a detailed outage plan and schedule for the ENGINEER'S approval within four weeks of the notice to proceed (but not less than two (2) weeks before an outage will be taken).
 - C. A completed System Outage Request form shall accompany the outage plan. The outage plan shall be coordinated with the construction schedule and shall meet the restrictions and conditions of the Contract Documents. The outage plan shall describe the CONTRACTOR's method for minimizing the length of time required to complete the Work; any necessary temporary power, controls, instrumentation or alarms required to maintain control, monitoring, and alarms for the dam; and the manpower, plant, and equipment which the CONTRACTOR will furnish for the outage. All costs for preparing and implementing the outage plans shall be at no increase in cost to the OWNER.
 - D. The ENGINEER shall be notified in writing at least one week in advance of the required outage if the schedule for performing the work has changed or if revisions to the outage plan are required.
 - E. The CONTRACTOR shall provide written confirmation of the shutdown date and time two (2) working days prior to the actual shutdown.

1.12 OWNER USE OF THE SITE

- A. The OWNER may utilize all or part of the existing facilities during the entire period of construction for the conduct of the OWNER's normal operations (primarily reservoir operations and the maintenance of hatchery flows). The CONTRACTOR shall cooperate and coordinate with the OWNER to facilitate the OWNER's operations and to minimize interference with the CONTRACTOR's operations at the same time. In any event, the OWNER shall be allowed access to the Site during the period of construction.

1.13 PARTIAL UTILIZATION OF THE WORK BY OWNER

- A. The OWNER will take partial utilization of the WORK upon completion of the startup and commissioning of the new powerhouse. Partial utilization will involve the placing into service of the generating equipment for the purpose of supplying electricity to the OWNER.

1.14 PROJECT MEETINGS

A. **Preconstruction Conference**

1. Prior to the commencement of WORK at the Site, a preconstruction conference will be held in Petersburg, AK vicinity at a mutually agreed time and place. The conference shall be attended by the CONTRACTOR'S Project Manager, its

superintendent, and its subcontractors as the CONTRACTOR deems appropriate. Other attendees will be:

- a. ENGINEER and the Resident Project Representative.
 - b. Representatives of OWNER.
 - c. Governmental representatives as appropriate.
 - d. Others as requested by CONTRACTOR, OWNER, or ENGINEER.
2. The CONTRACTOR shall bring the preconstruction conference submittals in accordance with Section 01 33 00 - Contractor Submittals.
 3. The purpose of the conference is to designate responsible personnel and establish a working relationship. Matters requiring coordination will be discussed and procedures for handling such matters established. The complete agenda will be furnished to the CONTRACTOR prior to the meeting date. However, the CONTRACTOR should be prepared to discuss all of the items listed below.
 - a. Status of CONTRACTOR's insurance and bonds.
 - b. CONTRACTOR's tentative schedules.
 - c. Transmittal, review, and distribution of CONTRACTOR's submittals.
 - d. Processing applications for payment.
 - e. Maintaining record documents.
 - f. Critical work sequencing.
 - g. Field decisions and Change Orders.
 - h. Use of Site, office and storage areas, security, housekeeping, and OWNER's needs.
 - i. Major equipment deliveries and priorities.
 - j. CONTRACTOR's assignments for safety and first aid.
 - k. Daily Report Form which the ENGINEER will furnish.
 - l. Submittal Transmittal Form which the ENGINEER will furnish.
 4. The ENGINEER will preside at the preconstruction conference and will arrange for keeping and distributing the minutes to all persons in attendance.
 5. The CONTRACTOR and its subcontractors should plan on the conference taking no less than two (2) full working days. The first day will cover the items listed in paragraphs 2 and 3, and the following day(s) will be spent on reviewing the

Drawings and Specifications, in extensive detail, with the ENGINEER and the OWNER.

B. Progress Meetings

1. The ENGINEER will schedule and hold regular on-Site progress meetings at least weekly and at other times as requested by CONTRACTOR or as required by progress of the WORK. The CONTRACTOR, ENGINEER, and all subcontractors active on the Site shall attend each meeting. CONTRACTOR may at its discretion request attendance by representatives of its suppliers, manufacturers, and other subcontractors.
2. The ENGINEER will preside at the progress meetings and will arrange for keeping and distributing the minutes. The purpose of the meetings is to review the progress of the WORK, maintain coordination of efforts, discuss changes in scheduling, and resolve other problems which may develop. During each meeting, the CONTRACTOR shall present any issues that may impact its progress with a view to resolve these issues expeditiously.

1.15 SUBMITTALS

- A. Outage Plan – Submit to ENGINEER two weeks prior to Project outage
- B. Outage request – Submit request for each outage a minimum of two weeks prior to each outage activity.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION

3.1 GENERAL WORK SEQUENCE

- A. The actual work sequence used to perform this WORK is the CONTRACTOR's responsibility. In general, however, it is envisioned that the WORK could proceed in the following sequence to achieve the project goals and schedule requirements:
 1. Mobilization in early 2023 (see PMP&L Project schedule in the Appendix).
 2. Prepare submittals for long lead delivery items such as penstock materials, mobilize upon Notice to Proceed.
 3. Construct/rebuild access roads required to access all work locations (as necessary).
 4. Clearing and site preparation for development of CONTRACTOR's administration, laydown and staging areas.
 5. Construction of dam valve house bypass and release of hatchery flows to emergency storage pond.
 6. Site excavation and grading for powerhouse work as necessary.

7. Install temporary erosion control measures.
 8. Powerhouse equipment demolition.
 9. Demolition of lower penstock and powerhouse wall demolition in area of existing penstock.
 10. Installation of new lower penstock section/supports and new thrust block.
 11. Installation of powerhouse bypass system.
 12. Repair of existing penstock and supports.
 13. Filling of penstock and resumption of hatchery flows using powerhouse bypass system.
 14. Shut down of hatchery flows to emergency storage pond.
 15. Revegetation of areas above the powerhouse.
 16. Receive, unload, properly protect and install OWNER-supplied powerhouse and switchyard equipment.
 17. Installation of turbine, generator, inlet piping and turbine shutoff valve.
 18. Installation of remainder of equipment, both OWNER and CONTRACTOR supplied.
 19. Installation of all interconnection wiring and cable.
 20. Plant Start-up and commissioning.
 21. Clean up and revegetation of all other areas.
- B. Other Work sequences are possible. Development of the most efficient and actual work sequence is the CONTRACTOR's responsibility.
- C. The OWNER is targeting an on-line date for the Project of October 26, 2023. However, OWNER recognizes that the completion date is a function of the Notice to Proceed date.
- D. OWNER-supplied equipment has already been purchased. Guaranteed delivery dates are provided in the Turbine/Generator contract (see Appendix). The equipment supplier has indicated delivery dates for OWNER-supplied equipment are as follows:
1. Delivery Date: February 23, 2023
- E. CONTRACTOR shall provide a schedule of desired delivery dates within 14 calendar days of issuance of the Notice-to-Proceed.

- END OF SECTION -

SECTION 01 14 00 - CONSTRUCTION AND SCHEDULE CONSTRAINTS

PART 1 -- GENERAL

1.1 SUMMARY

- A. WORK shall be scheduled, sequenced, and performed in a manner which minimizes disruption to the operation and maintenance of existing facilities including the Crystal Lake Fish hatchery (Crystal LFH).
- B. The CONTRACTOR shall incorporate the construction and schedule constraints of this Section in preparing the construction schedules required under Section 01 32 16 - CPM Construction Schedule.
- C. OWNER requires the construction of the bypass at the Dam to be complete and operational before the shutdown of the Project. Flows to the Crystal LFH will be provided by the valve house bypass at the Dam, which comes off the penstock (see Drawing C130). The Crystal LFH will be receiving flows from the dam and will have to use the pumps in the emergency storage pond for the hatchery production during the period of time the penstock is dewatered for powerhouse equipment work, for construction of the new lower section of penstock (drawing C120) and construction of powerhouse bypass (drawing C121).
- D. OWNER requires completion of the lower penstock modifications and construction of the new powerhouse bypass as soon as practical. Owner requires flow to be provided to the Crystal LFH as quickly as possible using the penstock and powerhouse bypass piping.
- E. Flows are normally provided to the Crystal LFH by the turbine. Once the Project is shutdown this will not be possible until the new powerhouse equipment can be put into service, following startup and commissioning.

1.2 EXISTING HYDROPOWER PLANT

- A. The WORK will require an outage of the existing hydroelectric project.
- B. Unless indicated otherwise, temporary pumping, piping, power, lighting, controls, instrumentation, alarms, security devices, and safety devices shall be provided by the CONTRACTOR whenever its activity or interruption due to its activity affects the existing facility.
- C. The construction constraints in this Section do not include every item affecting the completion of the WORK, but are intended to describe the sequence of critical events necessary to minimize disruption to the ongoing Crystal LFH facility and to ensure compliance with FERC Permit requirements. It shall be understood and agreed by the CONTRACTOR that the critical events described are not inclusive and that additional items of WORK not included may be required to minimize disruption and ensure compliance.
 - 1. Deviation from or modification of these suggested sequences is permitted if techniques and methods known to the CONTRACTOR will result in reducing

disruption to the facility operation and maintaining treatment efficiency, and if deviation is approved in advance by the ENGINEER.

1.3 REQUIRED COMPLETION DATES

- A. **Substantial Completion:** For definition of substantial completion, see Section 01 70 00 – Project Closeout.
- B. **Final Completion:** The date of final completion shall be the date all equipment is installed, successfully tested and operating, punch list items are all 100% complete, and the OWNER certifies that the goods, equipment, materials, structures, and services furnished under this Contract conform to Contract requirements for Final Completion specified in Section 01 70 00 - Project Closeout. The Contract shall allow 30 additional days beyond the Substantial Completion date to allow for the activities necessary to bring the project to Final Completion.
- C. **Liquidated Damages.** In case of failure on the part of the CONTRACTOR to meet the required dates for completion of construction, installation of all equipment, successful start-up and commissioning of the plant, the CONTRACTOR shall pay to the OWNER liquidated damages as described in the Section 00 50 00 AGREEMENT.

1.4 CONTRACT WORK TIMES

- A. Contract work times allowed shall generally be Monday through Saturday, 6 a.m. to 6 p.m., excluding holidays, or as otherwise approved by the OWNER.
- B. The CONTRACTOR shall submit a weekly proposed work plan showing all activities, required inspections for Monday through Saturday of the following week. This work plan shall be submitted via email to the OWNER for approval by 9:00 A.M. every Thursday.
- C. Work not specifically detailed on the weekly work plan as requiring inspection shall not be performed unless approved by the OWNER.
- D. It is possible that other Contractors, loggers or the OWNER will be working in the project area during the time of construction. It shall be the responsibility of this CONTRACTOR to coordinate its work with all other agencies and/or Contractors within the project area.
- E. The CONTRACTOR shall also be responsible to minimize disruptions to the local access roads within the project area.

1.5 OPERATION OF PLANT EQUIPMENT

- A. Operational functions or shutdown of the existing plant required to facilitate CONTRACTOR's operation will be done by the OWNER's personnel only.
- B. The plant operation and maintenance personnel will cooperate in every way that is practical to facilitate CONTRACTOR's operation. However, certain shutdown and connections may only be permissible at times other than normal working hours such as nights or weekends. No additional payment will be made to the CONTRACTOR for any night, weekend, or holiday premium or overtime payments.

- C. It will be necessary to take an outage of the Project for the WORK of the Contract. The CONTRACTOR shall, as soon as possible after the Notice to Proceed (but no later than 30-days), develop a Project Schedule and Outage Plan for submittal to the ENGINEER. The review of this Outage Plan shall be the subject of a Construction coordination meeting with the ENGINEER, OWNER and CONTRACTOR.

1.6 BYPASSING WATER TO CRYSTAL LAKE FISH HATCHERY

- A. During the estimated 4-month construction period when the new turbine-generator and associated equipment is being installed in the project powerhouse, and the lower section of the penstock / bypass system are installed, water flows to the Crystal LFH shall be maintained by the CONTRACTOR by running water down from the dam valve house bypass pipeline to Crystal Creek diversion reach to the hatchery emergency storage pond. The hatchery will be supplying its needs by pumping water from the emergency storage pond during this time.
- B. As soon practical CONTRACTOR shall resume supply of water to Crystal LFH using the penstock and the new powerhouse bypass system.

1.7 COMPLIANCE WITH FERC LICENSE

- A. The Project is operating under the terms of a Federal Energy Regulatory Commission (FERC) License P-201. The FERC license specifies various Project requirements, but a significant requirement involves the supply of water to the Crystal LFH. A copy of the FERC license is included in the Appendix. OWNER has filed for an Amendment to the license and the amendment application is available upon request. OWNER does not anticipate that there will be any changes in the FERC requirements related to the Crystal LFH. In scheduling and performing the WORK, the CONTRACTOR shall not, directly or indirectly, prevent the Project from achieving the FERC license requirements.
- B. The CONTRACTOR shall take necessary precautions to ensure that no damage occurs to the Project facilities, including piping, utilities, roads, and structures, that are to remain in operation and are not to be modified or replaced, in accordance with Section 01 56 10 - Protection of Existing Facilities.
- C. The Project is classified by the FERC as a high hazard project. All provisions of the Dam Safety Surveillance and Monitoring (See DSSMR 2020 report in the Appendix) shall be maintained during the construction project. Requirements as shown in the drawings to maintain dam safety monitoring shall be implemented, verified and maintained at all times.
- D. Any temporary facilities, materials, equipment, and labor required for the Project to continue to meet the terms of the FERC license during construction shall be provided by the CONTRACTOR as part of the WORK. At the completion of work, such temporary facilities, materials, and equipment shall be removed from the Site as part of the WORK.

1.8 OUTAGE REQUESTS TO CRYSTAL LAKE FISH HATCHERY

- A. Modifications to existing facilities, the construction of new facilities, and the connection of new to existing facilities will require a Project outage and bypass of existing water conveyance facilities to the Crystal LFH. In such cases, the CONTRACTOR shall coordinate WORK with the ENGINEER and OWNER as described below. The

CONTRACTOR shall submit a detailed outage plan and time schedule for construction activities which will make it necessary to remove a tank, pipeline, channel, electrical circuit, equipment, structure, road, or other facilities from service.

- B. The outage plans shall be submitted to the ENGINEER for acceptance a minimum of 4-weeks in advance of the time that such outages are required. The outage plans shall be coordinated with the construction schedule and shall meet the restrictions and conditions of this Section. The outage plan shall describe the CONTRACTOR's plans for bypassing water to the Crystal LFH; the length of time required to complete the operation; any necessary temporary power, controls, instrumentation, or alarms required to maintain control, monitoring, and alarms for the treatment plant processes; and the manpower, plant, and equipment which the CONTRACTOR shall provide in order to ensure proper operation of associated treatment units. Costs for preparing and implementing the outage plans shall be the responsibility of the CONTRACTOR as part of the WORK.
- C. The CONTRACTOR shall not begin an alteration affecting existing facilities until specific written approval has been granted by the OWNER or OWNER's Representative in each case.
- D. The OWNER or OWNER's Representative shall be notified in writing at least one week in advance of the required outage if the schedule for performing the WORK has changed or if revisions to the outage plan are required. The CONTRACTOR shall provide written confirmation of the shutdown date and time two (2) Days prior to the actual shutdown.

1.9 TEMPORARY CONNECTIONS

- A. Making connections to existing facilities or other operations that interfere with the operation of the existing equipment shall be thoroughly planned in advance, and required equipment, materials, and labor shall be on hand at the time of undertaking the connections. WORK shall be completed as quickly as possible and with as little delay as possible and shall proceed continuously (24 hours a day and seven days a week) if necessary to complete modifications and/or connections in the minimum time.
- B. The cost of any temporary facilities and night, weekend, or holiday activity and overtime payments required during process interruptions shall be included in the WORK.
- C. Temporary facilities and piping shall be located to minimize interference with CONTRACTOR's construction facilities and OWNER's operation and maintenance of the Project.
- D. When temporary electrical power, controls, instrumentation, or alarms are required for routine continuous operations of existing or new equipment, the CONTRACTOR shall provide the necessary equipment and appurtenances. Prior to installing said equipment and appurtenances, CONTRACTOR shall furnish a submittal on the proposed components and installation for ENGINEER's review and approval.
- E. A plan showing the size and location of the temporary facilities and piping shall be submitted to the ENGINEER at the same time as the outage plan required under this Section. Costs for design, provision, operation, and removal of temporary facilities and piping shall be part of the WORK.

1.10 CONSTRUCTION SEQUENCING

- A. Construction activities shall be scheduled and sequenced to minimize the duration of the Project outage. The CONTRACTOR shall be responsible for development of the construction sequencing. In implementing the construction sequencing, the CONTRACTOR shall maintain the existing facilities in service until new facilities (supply of water to Crystal LFH) are constructed and are operational. When new facilities are operational, the existing facilities may be taken out of service. The following general guidelines shall be used by the CONTRACTOR in planning the sequence of construction.
1. Safe working conditions for personnel shall be maintained during rehabilitation, modification, and demolition WORK. The foregoing includes at least proper trench excavation, the provision of temporary equipment guards, supports, warning signs, walkways, covers over openings, handrailing, and protection of electrical equipment and power supply.
 2. Temporary facilities shall be constructed in accordance with applicable codes and regulations to operate safely and properly.
 3. Valves to be temporarily shut off during the WORK shall be tagged as such and shall be wired shut with a crimped lead seal and padlocked.
 4. Electrical and mechanical equipment shall be similarly shut down.

1.11 PERMITS

- A. The CONTRACTOR shall abide by the conditions of the FERC license and shall obtain proof of satisfaction of conditions from issuers of permits prior to acceptance of the WORK by the OWNER.
- B. Contractor shall obtain the following permits:
1. Building Permit – Petersburg Borough
 2. Electrical Permit – Petersburg Borough

1.12 SCHEDULE CONSTRAINTS

- A. **General:** It is the CONTRACTOR's responsibility to coordinate and plan the construction activities to integrate each schedule constraint into performance of the overall WORK. The CONTRACTOR shall coordinate and schedule the work of all subcontractors, trades, and suppliers to assure the proper and timely prosecution and completion of all items of WORK.
- B. The listing of schedule constraints below does not mean that every constraint or special condition has been identified. The list does not substitute for the CONTRACTOR's coordination and planning for completion of the WORK within the Contract Times.
- C. The following constraints affect the construction schedule.

1. The Project construction cannot start until Crystal LFH water flow requirements are being made from the dam valve house release facility. In accordance with agreements with Crystal LFH flows shall be provided for a minimum of 7-days prior to the Project shutdown.
2. Crystal LFH desires hatchery flows be restored using the powerhouse bypass system as soon as possible. CONTRACTOR shall make all reasonable efforts to restore the hatchery supply using the powerhouse bypass system as quickly as possible.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

- END OF SECTION -

SECTION 01 22 00 - MEASUREMENT AND PAYMENT

PART 1 -- GENERAL

1.1 SCOPE

- A. Payment for the various items of the Bid Schedule, as further specified herein, shall include all compensation to be received by the CONTRACTOR for furnishing all tools, equipment, supplies, and manufactured articles, and for all labor, operations, and incidentals appurtenant to the items of work being described, as necessary to complete the various items of the WORK all in accordance with the requirements of the Contract Documents, including all appurtenances thereto, and including all costs of permits and cost of compliance with the regulations of public agencies having jurisdiction, including Alaska Occupational Safety and Health (AKOSHA), Safety and Health Requirements of the Occupational Safety and Health Administration of the U.S. Department of Labor (OSHA). No separate payment will be made for any item that is not specifically set forth in the Bid Schedule, and all costs therefor shall be included in the prices named in the Bid Schedule for the various appurtenant items of work.
- B. **Prevailing Wages.** In addition to the requirements of the General Conditions, the CONTRACTOR shall be required to post on the job site a copy of the intent form to pay prevailing wages. See Section 01 10 00 – Summary of Work for information regarding requirement to pay prevailing wages.

1.2 APPLICATIONS FOR PROGRESS PAYMENTS

- A. For each Bid item, provide a column for listing each of the following:
 - 1. Bid item Number and description
 - 2. Scheduled value
 - 3. Authorized Change Order(s)
 - 4. Estimate of percentage of completion
- B. CONTRACTOR's foreman and OWNER's Representative shall agree on quantities in advance of application for payment.
- C. Submit each Application for Payment electronically to OWNER'S REPRESENTATIVE (Karl Hagerman) and as directed by the OWNER.
- D. If WORK is suspended, nearly suspended, or in the case where only insignificant progress is being made, the OWNER's Representative may, at their discretion, make progress payments at longer intervals than once per month.

1.3 REQUEST FOR INFORMATION AND MODIFICATION PROCEDURES

- A. The OWNER has developed four (4) forms to facilitate and track communications with the CONTRACTOR. These are the Request for Information (RFI), Engineering Change Directive (ECD), Proposal Request (PR), and Change Order Proposal (COP). Electronic copies of these following forms are available upon request.

1. **The Request for Information (RFI)** shall be used by the CONTRACTOR whenever written direction is desired to clarify perceived conflicts in plans, insufficient detail is shown, or any other issue which should be documented as it arises. The OWNER may also use the form to inquire on CONTRACTOR's methods, schedule or other issues not warranting more formal letter correspondence. The CONTRACTOR shall number each RFI consecutively, and shall number any RFI received from the OWNER at the time of receipt.
2. **The Engineering Change Directive (ECD)** shall be used by the OWNER to transmit new or revised drawings, issue additions or modifications to the contract or furnish any other direction which should be documented. Directives are effective immediately. Should the CONTRACTOR believe that such Directive will result in either a change in the cost of work or the time required to complete the project, CONTRACTOR shall notify the OWNER prior to commencing such work and, if possible, submit a Change Order Proposal (COP) prior to the start of such work, but in no case, less than seven (7) calendar days from receipt of said ECD.

In the event the OWNER does not receive a Change Order Proposal from the CONTRACTOR within seven (7) calendar days of the CONTRACTOR's receipt of an ECD from the OWNER, the CONTRACTOR shall have no claim for extra cost or time or impacts attributable to the work required by the ECD. The OWNER shall number ECDs consecutively. Once the OWNER and the CONTRACTOR have established a price for the changes required by the ECD or any other request by the OWNER for a change in the work, and the OWNER signs a Change Order Proposal reflecting the agreed upon price, it is agreed and understood that the price reflected by the Change Order Proposal shall include all direct costs, indirect costs, and the CONTRACTOR's estimate of impacts to its work, including but not limited to delay impacts, and shall represent a full and final settlement of all issues pertaining to the work required by the ECD, and work performed by the CONTRACTOR up to the date of the Change Order Proposal

3. **The Proposal Request (PR)** shall be used by the OWNER to request pricing on a possible change in plans or additional work. The PR may also be used to request credits for deletion or changes in scope of work. The CONTRACTOR shall respond to such requests with a Change Order Proposal within seven (7) days from receipt of said PR unless the OWNER agrees in writing to extend this deadline. PRs shall be numbered consecutively by the OWNER.
4. **The Change Order Proposal (COP)** shall be used by the CONTRACTOR to respond to OWNER-issued PRs and ECDs, or when the CONTRACTOR believes that changed conditions or omitted, but necessary, work items exist that may materially affect the cost of the work or the schedule for completion of the Project. COPs shall be consecutively numbered by the CONTRACTOR, and, in the case of revision or resubmission of the same COP, the number shall be hyphenated with the letter "B", "C", etc.

1.4 DIFFERING SITE CONDITIONS

- A. Differing site conditions shall be administered in accordance with Article 11, "Changes to the Contract" of the Contract General Conditions. CONTRACTOR shall have no claim for additional costs or work if it fails to submit a written Request for Information (RFI) to the OWNER immediately upon encountering any differing site condition, conflicts in the

plans, specifications, or constructability issues.

- B. The CONTRACTOR shall promptly, and before disturbing any construction site, notify the OWNER of problems with subsurface conditions at the site, problems or conflicts in the plans or specifications or problems on constructability. A written Request for Information (RFI) shall be submitted by the CONTRACTOR when such problems are encountered, or direction is required.
- C. The OWNER shall promptly investigate the conditions reported in the RFI. If the OWNER concludes that adjustment to the plans and specifications of this Contract is appropriate, such adjustments shall be documented in a Change Order Proposal (COP). No claim by the CONTRACTOR relating to any differing site condition shall be allowed unless the OWNER agrees in writing to the change proposed by the CONTRACTOR.
- D. The CONTRACTOR shall submit in advance and in writing, a Change Order Proposal (COP) for changes in the scope of work and/or contract amount. This proposal shall be either accepted or rejected in writing by the OWNER prior to work commencing. When no agreement can be reached, the OWNER may order extra work using the Contingency Allowance in accordance with Section 13 of the General Conditions.
- E. When conditions creating an immediate threat to life, health, safety, or an immediate violation of applicable law, are encountered, the CONTRACTOR shall notify the OWNER as soon as possible that extra work is required, or the OWNER shall notify the CONTRACTOR that extra work is required to address the immediate threat. In such circumstances, the OWNER may issue a verbal or a handwritten Engineering Change Directive, provided that such verbal or handwritten ECD will operate as a change to cost or schedule of work only if, within extra. Within seven (7) calendar days of discovering the emergency condition, the CONTRACTOR submits a written Change Order Proposal and the OWNER formally approves changes necessary to address the emergent condition amount.
- F. Substantiation of Costs from Differing Site Conditions: On request, provide full information required for evaluation, including:
 - 1. Quantities of products, labor, and equipment
 - 2. Taxes, insurance, and bond additional costs
 - 3. Overhead and profit
 - 4. Justification for any change in Contract Time
 - 5. Credit for deletions from Contract, similarly documented
 - 6. For Time and Material work, submit itemized account and supporting data after completion of change, within time limits indicated in the Conditions of the Contract
- G. After execution of Change Order, promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item and adjust the Contract Sum.

1.5 NON-PAYMENT FOR REJECTED OR SURPLUS PRODUCTS OR WORK.

- A. Payment will not be made for work rejected by the OWNER. Products or work not meeting contract requirements shall be replaced by the CONTRACTOR at no expense to the OWNER, regardless of the impact to work, schedule or cost:

1.6 OPTIONAL BID ITEM #1

- A. See spec Section 00 24 13 – Bid Proposal for description of Optional Bid Item #1.

1.7 OPTIONAL BID ITEM #2

- A. See spec Section 00 24 13 – Bid Proposal for description of Optional Bid Item #2.

1.8 APPLICATION FOR FINAL PAYMENT

- A. Application for Final Payment will not be considered until the following have been accomplished.

- 1. All closeout procedures as specified in Section 01 70 00 – Project Closeout.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

- END OF SECTION -

SECTION 01 29 00 - SCHEDULE OF VALUES

PART 1 -- GENERAL

1.1 GENERAL

- A. This Section defines the process whereby the Schedule of Values (lump sum price breakdown) shall be developed and incorporated into the cost loading function of the CPM Schedule per Section 01 32 15 – CPM Construction Schedule. Monthly progress payment amounts shall be determined from the monthly progress updates of the CPM Schedule activities.
- B. The Schedule of Values shall be developed independent but simultaneous with the development of the CPM Schedule activities and logic.

1.2 PRELIMINARY SCHEDULE OF VALUES

- A. The CONTRACTOR shall submit a preliminary Schedule of Values for the major components of the WORK at the Preconstruction Conference in accordance with Section 01 11 00 - Summary of Work and with Part 1.8 of Section 00 24 13 – Bid Proposal. The listing shall include, at a minimum, the proposed value for all of the major Bid Item components listed in Part 1.8 of Section 00 24 13, with each major Bid Item being broken down into either 2 or 3 sub-component items with associated cost values provided for each sub-component item.
 - 1. As an example, the preliminary Schedule of Values shall provide the Contractor's cost values broken down for both "Mobilization" and for "Demobilization" under the Mobilization / Demobilization major Bid Item.
 - 2. As an example, for new penstock and piping installation WORK, the preliminary Schedule of Values shall provide cost values broken down for each principle sub-component of new penstock and piping installation WORK including.
 - a. New 20" OD steel penstock pipeline work near powerhouse
 - b. New 12" / 10" bypass pipeline work, including valves and appurtenances
 - c. Thrust blocks
 - d. Refurbishment work made to all existing sleeve type couplings
 - e. Replacement of some of the existing sleeve type couplings with new couplings or butt-straps (optional work)
- B. The CONTRACTOR and ENGINEER shall meet and jointly review the preliminary Schedule of Values and make any adjustments in value allocations if, in the opinion of the ENGINEER, these are necessary to establish fair and reasonable allocation of values for the major WORK components. Front end loading will not be permitted. The ENGINEER may require reallocation of major WORK components from items in the above listing if in the opinion of the ENGINEER such reallocation is necessary. This review and any necessary revisions shall be completed within 15 Days from the date of Notice-to-Proceed.

1.3 DETAILED SCHEDULE OF VALUES

- A. The CONTRACTOR shall prepare and submit a detailed Schedule of Values to the ENGINEER within 30 Days from the date of Notice to Proceed. The detailed Schedule of Values shall be based on the accepted preliminary Schedule of Values for major WORK components. Because the ultimate requirement is to develop a detailed Schedule of Values sufficient to determine appropriate monthly progress payment amounts through cost loading of the CPM Schedule activities, sufficient detailed breakdown shall be provided to meet this requirement. The ENGINEER shall be the sole judge of acceptable numbers, details and description of values established.
1. If, in the opinion of the ENGINEER, a greater number of Schedule of Values items than proposed by the CONTRACTOR is necessary, the CONTRACTOR shall add the additional items so identified by the ENGINEER.
 2. The minimum detail of breakdown of the major WORK components is indicated in Part 1.2 above. Greater detail shall be provided if requested by either the OWNER or the OWNER's Representative.
 3. The CONTRACTOR and ENGINEER shall meet and jointly review the detailed Schedule of Values within 35 Days from the date of Notice to Proceed. The value allocations and extent of detail shall be reviewed to determine any necessary adjustments to the values and to determine if sufficient detail has been proposed to allow acceptable cost loading of the CPM Schedule activities. Any adjustments deemed necessary to the value allocation or level of detail shall be made by the CONTRACTOR and a revised detailed Schedule of Values shall be submitted within 40 Days from the date of Notice to Proceed.
 4. Following acceptance of the detailed Schedule of Values, the CONTRACTOR shall incorporate the values into the cost loading portion of the CPM Schedule. The CPM activities and logic shall have been developed concurrent with development of the detailed Schedule of Values; however, it shall be necessary to adjust the detailed Schedule of Values to correlate to individual Schedule activities. It is anticipated that instances will occur, due to the independent but simultaneous development of the Schedule of Values and the CPM Schedule activities, where interfacing these 2 documents will require changes to each document. Schedule activities may need to be added to accommodate the detail of the Schedule of Values. Schedule of Value items may need to be added to accommodate the detail of the CPM Schedule activities. Where such instances arise, the CONTRACTOR shall propose changes to the Schedule of Values and to the CPM Schedule activities to satisfy the CPM Schedule cost loading requirements.

1.4 CROSS REFERENCE LISTING

- A. To assist in the correlation of the Schedule of Values and the CPM Schedule, the CONTRACTOR shall provide a Cross Reference Listing which shall be furnished in 2 parts. The first part shall list each Scheduled Activity with the breakdown of the respective valued items making up the total cost of the activity. The second part shall list the valued item with the respective Scheduled Activity or Activities that make up the total cost indicated. In the case where a number of schedule items make up the total cost for a valued item (shown in the Schedule of Values) the total cost for each scheduled item should be indicated.

- B. These listings shall be updated and submitted in conjunction with the CPM monthly submittals as stated in Specification Section 01 32 15.
- C. Approved change orders reflected in the CPM Schedule shall be incorporated into the Schedule of Values as a single unit identified by the change order number.

1.5 CHANGES TO SCHEDULE OF VALUES

- A. Changes to the CPM Schedule which add activities not included in the original schedule but included in the original WORK (schedule omissions) shall have values assigned as approved by the ENGINEER. Other activity values shall be reduced to provide equal value adjustment increases for added activities as approved by the ENGINEER.
- B. In the event that the CONTRACTOR and ENGINEER agree to make adjustments to the original Schedule of Values because of inequities discovered in the original accepted detailed Schedule of Values, increases and equal decreases to values for activities may be made.

1.6 LIQUIDATED DAMAGES

- A. The Schedule of Values information is an integral part of the scheduling and reporting under Section 01 32 16 and the progress payment information. As such, it is critical information to evaluating progress and the proper planning of the OWNER's and ENGINEER's WORK-related effort as well as their financial obligations associated with this project. Accordingly, if any submittal required by this Section is found to be incomplete or is submitted later than required, the OWNER will suffer financial loss and, accordingly, liquidated damages will be assessed against the CONTRACTOR in accordance with Article 4 of the Agreement.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

- END OF SECTION -

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SECTION 01 32 15 - CPM CONSTRUCTION SCHEDULE

PART 1 -- GENERAL

1.1 SUMMARY

- A. The CONTRACTOR shall schedule the WORK in accordance with this Section.
- B. CONTRACTOR's WORK shall include the preparation and submittal of a Construction Schedule to be used by the CONTRACTOR and OWNER to effectively plan and track the course of work and also to be used to establish progress payments for the CONTRACTOR. The CONTRACTOR shall prepare schedules as per the requirements listed herein and shall make every effort for their prompt submittal. Failure to submit the required schedule to accompany the Bid may result in an incomplete Bid and periodic progress schedules which are late will delay the associated progress payment to the CONTRACTOR.
- C. The CPM schedule and related reports should be prepared with the current version of **Primavera Project Planner** or **SureTrak** software.

1.2 DEFINITIONS

- A. **CPM Scheduling:** The term shall be interpreted to be generally as outlined in the Association of General Contractors (AGC) publication, "The Use of CPM in Construction." except that either "i-j" arrow diagrams or precedence diagramming format may be utilized. In the case of conflicts between this Section and the AGC document, this Section shall govern.
- B. **Float:** Unless otherwise indicated herein, float and total float are synonymous. Total float is the period of time measured by the number of Days each non-critical path activity may be delayed before it and its succeeding activities become part of the critical path. If a non-critical path activity is delayed beyond its float period, then that activity becomes part of the critical path and controls the end date of the WORK. Thus, delay of a non-critical path activity beyond its float period will cause delay to the project itself.

1.3 SCHEDULING QUALIFICATION SUBMITTALS

- A. CONTRACTOR shall submit a statement of computerized CPM capability within 10 Days after Notice to Proceed to verify that either: (1) the CONTRACTOR has in-house capability qualified to use CPM techniques and the **Primavera P3** or **SureTrak** software or (2) that the CONTRACTOR will arrange for the services of a CPM consultant so qualified. In either event the statement shall identify the individual who will perform the CPM scheduling and shall describe the construction projects required below. The statement shall also identify the contact persons for the referenced projects with current telephone and address information.
- B. **Criteria:** The individual performing scheduling shall have successfully applied computerized CPM technique to at least two (2) projects of similar nature, scope, and value not less than one half the Total Bid Price of this project.

1.4 INITIAL SCHEDULE SUBMITTALS

- A. Where submittals are required hereunder, the CONTRACTOR shall submit four (4) copies of each submittal item.
- B. **Schedule to Accompany Bid:** A schedule shall be submitted with the Bid and shall to be used by the OWNER to evaluate Bids and to ensure that the CONTRACTOR fully understands the Work required to complete this project.
- C. **Preconstruction Conference Schedules.** The CONTRACTOR shall submit two (2) schedule documents at the Preconstruction Conference which serve as the CONTRACTOR's plan of operation for the initial 60 Day period of the Contract Times and identify the manner in which the CONTRACTOR intends to complete the WORK within the Contract Times.
 - 1. **60-Day Plan of Operation:** During the initial 60 Days of the Contract, the CONTRACTOR shall conduct operations in accordance with a 60 Day bar chart type schedule. The chart so prepared shall show accomplishment of the CONTRACTOR's early activities (mobilization, permit acquisition, submittals necessary for early material and equipment procurement, submittals necessary for long lead equipment procurement, CPM submittals, initial sitework and other submittals and activities required in the first 60 Days).
 - a. OWNER and the CONTRACTOR shall meet to review and discuss the 60-Day plan of operation and project overview bar chart within five (5) Days after submittal to the ENGINEER. The OWNER's review and comment on the schedules will be limited to conformance with the sequencing and milestone requirements in the Contract Documents. The CONTRACTOR shall make corrections to the schedules necessary to comply with the requirements and shall adjust the schedules to incorporate any missing information requested by the ENGINEER.
 - 2. **Project Overview Bar Chart:** The overview bar chart shall indicate the major components of the WORK and the sequence relations between major components and subdivisions of major components. The overview bar chart shall indicate the relationships and time frames in which the various components of the WORK will be made substantially complete and placed into service in order to meet the required milestones. Sufficient detail shall be included to subdivide major components in such activities as (1) excavation, (2) foundation modifications preparation, (3) foundation concrete, (4) completion of structural concrete, (5) major mechanical WORK, (6) major electrical WORK, (7) instrumentation and control WORK, and (8) other important WORK for each major facility within the overall project scope. Planned durations and start dates shall be indicated for each WORK item subdivision. Each major component and subdivision component shall be accurately plotted on time scale sheets not to exceed 22-inches by 34-inches in size. No more than 3 sheets shall be employed to present this overview information.
- D. **Periodic Schedules:** An updated progress schedule shall be submitted with each payment request to assist the OWNER and the OWNER's Project Manager in accurately determining the percentage of work completed to date on the project. These periodic schedules may be in the form of a bar or "Gantt" chart.

1.5 CPM SCHEDULE SUBMITTALS

- A. **Original CPM Schedule Submittal:** Within 45 Days after the commencement date stated in the Notice to Proceed, the CONTRACTOR shall submit for review by the ENGINEER a hard copy of the CPM schedule and the computerized schedule report tabulations. The CONTRACTOR shall also submit a CD that contain the schedule submittal information. The data shall be compatible with **Primavera P3** or **SureTrak** to generate network diagrams and schedule reports identical to the hard copies submitted. This submittal shall have already been reviewed and approved by the CONTRACTOR's Project Manager, superintendent, and estimator prior to submission.
1. The CPM schedule shall be a time-scaled network diagram of the "i-j" activity-on-arrow or precedence type. The network diagram shall describe the activities to be accomplished and their logical relationships and shall show the critical path.
 2. The CONTRACTOR's attention is directed to the requirement that the schedule shall contain sufficient detail and information to cost load the CPM schedule in accordance with the approved schedule of values under Section 01 29 00 - Schedule of Values. Each installation and sitework activity shall be cost loaded as indicated.
- B. The computerized schedule report tabulations shall include the following:
1. Report of activities sorted by activity number: Activity numbers, where practical, shall correlate to the area numbers designated on the Contract Drawings as further defined in Section 01 11 00 - Summary of Work.
 2. Report of activities sorted by early start date.
 3. Report of activities sorted by total float.
 4. Report of activities sorted by responsibility code. Responsibility codes shall be established for the CONTRACTOR, ENGINEER, OWNER, Subcontractors, Suppliers, etc. These codes shall be identified in the Network Diagram.
 5. A successor-predecessor report which shall identify the successor and predecessor activities for each activity and ties between schedule activities.
- C. **Analysis**
1. Early Completion
 - a. The CONTRACTOR may show early completion on the original CPM submittal if that is its plan.
 - b. An original CPM submittal showing early completion shall either be accompanied by:
 - 1) Request for change of Contract Times at zero change of Contract Price, accompanied by documentation demonstrating that the Bid was based on early completion, or

- 2) Demonstration in the submittal that the time difference between early completion and the original Contract Time is total float.
 - c. An early completion schedule unaccompanied by one of these will not be accepted.
 - d. The ENGINEER will analyze a request for Change Order in accordance with the General Conditions.
 2. Float Ownership: Neither the OWNER nor the CONTRACTOR owns the float time. The project owns the float time. Liability for delay to the project completion date rests with the party causing the delay. For example, if Party A is responsible for consuming a portion of the float time and Party B later consumes the remainder of the float time plus additional time beyond the float time, Party B is responsible for the time that is a delay past the completion date. Party A would not be responsible for any delay since it did not consume all the float time, additional float time remained after its delay, and the completion date was unaffected by its tardiness.
 - D. **Original CPM Schedule Submitted for OWNER / ENGINEER Review:** The CONTRACTOR shall submit at least 7 Days prior to the Preconstruction Conference meeting, to both the OWNER and ENGINEER for review the original CPM schedule submittal. The ENGINEER's review will be limited to conformance with the Contract Documents. However, the review may also include:
 1. Clarifications of the design intent.
 2. Directions to include activities and information missing from the submittal.
 3. Requests to the CONTRACTOR to clarify and revise the schedule.
 - E. **Revisions to the Original CPM Schedule:** Within 65 Days after the commencement date stated in the Notice to Proceed, the CONTRACTOR shall revise the original CPM schedule submittal to address review comments from the original CPM schedule review meeting and resubmit the network diagrams and reports for the ENGINEER's review. The ENGINEER, within 14 Days from the date that the CONTRACTOR submitted the revised schedule will either (1) accept the schedule and cost loaded activities as submitted, or (2) advise the CONTRACTOR in writing to review any part or parts of the schedule which either do not meet the requirements or are unsatisfactory for the ENGINEER to monitor the progress and status of WORK or evaluate monthly payment requests by the CONTRACTOR. The ENGINEER may accept the schedule conditional upon the first monthly CPM schedule update correcting deficiencies identified. When the schedule is accepted, it shall be considered as the "Original CPM Construction Schedule" until an updated schedule has been submitted. The ENGINEER reserves the right to require that the CONTRACTOR adjust, add to, or clarify any portion of the schedule which may later be discovered to be insufficient for the monitoring of WORK or approval of partial payment requests. No additional compensation will be provided for such adjustments, additions, or clarifications.
 - F. **Acceptance**
 1. Acceptance of the CONTRACTOR's schedule by the ENGINEER and OWNER will be based solely upon compliance with the requirements. By way of the

CONTRACTOR assigning activity durations and proposing the sequence of the WORK, the CONTRACTOR agrees to utilize sufficient and necessary management and other resources to perform WORK in accordance with the schedule. Upon submittal of a schedule update, the updated schedule shall be considered the "current" project schedule.

2. Submission of the CONTRACTOR's progress schedule to the ENGINEER shall not relieve the CONTRACTOR of total responsibility for scheduling, sequencing, and pursuing the WORK to comply with the requirements of the Contract Documents, including adverse effects such as delays resulting from ill-timed WORK.

G. Monthly Updates and Periodic CPM Schedule Submittals

1. Following acceptance of the CONTRACTOR's original CPM schedule, the CONTRACTOR shall monitor the progress of the WORK and adjust the schedule each month to reflect actual progress and any changes in planned future activities. Each schedule update submittal shall be complete including information requested in the original schedule submittal and be in the schedule report format indicated below. Each update shall continue to show WORK activities including those already completed. Completed activities shall accurately depict "as built" information by indicating when the WORK was actually started and completed.
2. Neither the submission nor the updating of the CONTRACTOR's original schedule submittal nor the submission, updating, change, or revision of any other report, curve, schedule, or narrative submitted by the CONTRACTOR, nor the ENGINEER's review or acceptance of any such report, curve, schedule, or narrative shall have the effect of amending or modifying in any way the Contract Times or milestone dates or of modifying or limiting in any way the CONTRACTOR's obligations under the Contract. Only a signed, fully executed Change Order can modify contractual obligations.
3. The monthly schedule update submittal will be reviewed with the CONTRACTOR during a monthly construction progress meeting held on the 20th Day of each month. The goal of these meetings is to enable the CONTRACTOR and the ENGINEER to initiate appropriate remedial action to minimize any known or foreseen delay in completion of the WORK and to determine the amount of WORK completed since the last schedule update. The status of the WORK will be determined by the percent complete of each activity in the updated CPM schedule. These meetings are considered a critical component of the overall monthly schedule update submittal, and the CONTRACTOR shall have appropriate personnel attend. As a minimum, the CONTRACTOR's Project Manager and superintendent shall attend these meetings. The CONTRACTOR shall plan on the meeting taking no less than 6 hours. Within 7 Days after the monthly progress meeting, the CONTRACTOR shall submit the revised CPM schedule, the revised CPM computerized tabulations, the revised successor/predecessor report, the project status reports as defined below and the CONTRACTOR's Application for Payment. Within 5 Days of receipt of the revised submittals, the ENGINEER will either accept or reject the monthly schedule update submittal. If accepted, the percent complete in the monthly update shall be the basis for the Application for Payment to be submitted by the CONTRACTOR. If rejected, the update shall be corrected and resubmitted by the CONTRACTOR before the Application for Payment for the update period will be processed.

- H. **Schedule Revisions:** The CONTRACTOR shall highlight or otherwise identify changes to the schedule logic or activity durations made from the previous schedule. The CONTRACTOR shall modify any portions of the CPM schedule which become infeasible because activities are behind schedule or for any other valid reason.

1.6 CHANGE ORDERS

- A. Upon approval of a Change Order or upon receipt by the CONTRACTOR of authorization to proceed with additional WORK, the change shall be reflected in the next submittal of the CPM Schedule. The CONTRACTOR shall utilize a sub-network in the schedule depicting the changed WORK and its effect on other activities. This sub-network shall be tied to the main network with appropriate logic so that a true analysis of the critical path can be made. Whenever the CONTRACTOR believes that a Change Order will extend the Contract Times, the sub-network analysis herein shall be submitted with the price proposal for the change. If the CONTRACTOR does not submit the sub-network demonstrating that the change affects the Contract Times, then no subsequent claim for additional time due to the change will be accepted.

1.7 CPM STANDARDS

- A. **Construction Schedules:** Construction schedules shall include a graphic network diagram and computerized schedule reports as required below for status reporting.
- B. **Networks:** The CPM network shall be in a form of a time scaled "i-j" activity-on-arrow or precedence type diagram and may be divided into a number of separate sheets with suitable match lines relating the interface points among the sheets. Individual sheets shall not exceed 36-inches by 60-inches.
- C. Construction and procurement activities shall be presented in a time-scaled format with a calendar time line along the entire sheet length. Each activity arrow or node shall be plotted so that the beginning and completion dates of each activity are accurately represented along the calendar time line. Every activity shall use symbols that clearly distinguish between critical path activities, non-critical activities, and free float for each non-critical activity. Activity items shall be identified by their activity number, responsibility code, duration, and dollar value. Non-critical path activities shall show total float time in scale form by utilizing a dotted line or some other graphical means.
- D. **Duration Estimates:** The duration estimate for each activity shall be computed in Days and shall represent the single best estimate considering the scope of the WORK and resources planned for the activity. Except for certain non-labor activities such as curing of concrete or delivery of materials, activity duration shall not exceed 10 Days nor be less than one Day, unless otherwise accepted by the ENGINEER.

1.8 SCHEDULE REPORT FORMAT

- A. **Schedule Reports:** Schedule reports shall be prepared based on the CPM schedule, shall be submitted on paper and floppy disk or CD, depending on file size, and shall include the following minimum data for each activity:
 - 1. Activity numbers and responsibility codes.
 - 2. Work Order No.

3. CIP No.
4. Estimated activity duration.
5. Activity description.
6. Activity percent completion.
7. Early start date (calendar dated).
8. Early finish date (calendar dated).
9. Late start date (calendar dated).
10. Late finish date (calendar dated).
11. Status (whether critical).
12. Total float for each activity.
13. Free float for each activity.
14. Cost value for each activity.

B. **Project Information:** Each Schedule Report shall be prefaced with the following summary data:

1. Project name.
2. CONTRACTOR name.
3. Type of tabulation.
4. Project duration.
5. Contract Times (as revised by Change Orders).
6. The commencement date stated in the Notice to Proceed.
7. The data date and plot date of the CPM Schedule.
8. If an update, cite the new schedule completion date.

1.9 PROJECT STATUS REPORTING

- A. The CONTRACTOR shall furnish monthly project status reports (overview bar chart and a written narrative report) in conjunction with the revised CPM schedules as indicated above. Status reporting shall be in the form below.
- B. The CONTRACTOR shall prepare and submit monthly an overview bar chart schedule of the major project components. The overview bar chart schedule shall be a summary of the current CPM schedule (original and as updated and adjusted throughout the entire

construction period). The major project components shall be represented as time bars which shall be subdivided into various types of WORK including demolition, excavation and earthwork, yard piping, concrete construction, and mechanical, electrical and instrumentation installations. Major components shall include each new structure by area designation, sitework, modifications to existing structures, tie-ins to existing facilities, and plant startups.

- C. Each major component and subdivision shall be accurately plotted consistent with the project overview bar chart above. It shall represent the same status indicated by early start and finish activity information contained in the latest update of the CPM schedule. In addition, a percent completion shall be indicated for each major component and subdivision. The initial submittal of the overview bar chart schedule shall be made at the time that the revised original CPM schedule is submitted to the ENGINEER. The CONTRACTOR shall amend the overview schedule to include any additional detail required by the ENGINEER. The CONTRACTOR shall include any additional information requested by the ENGINEER at any time during the construction of the WORK.
- D. The CONTRACTOR shall prepare monthly written narrative reports of the status of the project for submission to the ENGINEER. Status reports shall include:
 - 1. The status of major project components (percent complete, amount of time ahead or behind schedule) and an explanation of how the project will be brought back on schedule if delays have occurred.
 - 2. The progress made on critical activities indicated on the CPM schedule.
 - 3. Explanations for any lack of WORK on critical path activities planned for the last month.
 - 4. Explanations for any schedule changes, including changes to the logic and to activity durations.
 - 5. A list of the critical activities scheduled to be performed in the next 2 months.
 - 6. The status of major material and equipment procurement.
 - 7. The value of materials and equipment properly stored at the Site but not yet incorporated into the WORK.
 - 8. Any delays encountered during the reporting period.
 - 9. An assessment of inclement weather delays and impacts to the progress of the WORK.
- E. The CONTRACTOR may include any other information pertinent to the status of the WORK. The CONTRACTOR shall include additional status information requested by the ENGINEER.

1.10 LIQUIDATED DAMAGES

- A. If any submittal required by this Section is determined by the ENGINEER to be incomplete or is submitted later than required, the OWNER will suffer financial loss, and accordingly, the CONTRACTOR shall pay liquidated damages in accordance with Article 4 of the Agreement.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

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SECTION 01 32 23 - SURVEYING

PART 1 -- GENERAL

1.1 OVERVIEW

- A. All Surveying establishing property boundaries or clearing limits shall be done by or under the direct supervision of an Alaska State Registered Professional Land Surveyor (PLS) and shall comply with the survey standards, Alaska Administrative Code (AAC) 53.110.
- B. Survey control for the project shall be based upon survey control points, electronic drawing files, and recorded descriptions of property boundaries as provided by the OWNER. Existing information included for reference is identified below:
 - 1. Project Legal Description
 - 2. R&M Survey-Ketchikan completed a survey of the project in 2019 and this data is available for CONTRACTOR'S use. All data is delivered in the Wrangell-Petersburg State Plane coordinate system, with horizontal units in survey feet using the NAD83, and vertical units in feet on the NAVD88 vertical datum using Geoid09. This survey data-set is available from the OWNER as electronic drawing files.
 - 3. David Thynes, PLS, completed additional survey work in 2022 around the powerhouse area and this data is also available for CONTRACTOR'S use. All data is delivered in the Wrangell-Petersburg State Plane coordinate system, with horizontal units in survey feet using the NAD83, and vertical units in feet on the NAVD88 vertical datum using Geoid09. This survey data-set is available from the OWNER as electronic drawing files.
 - 4. CAD-compatible project drawings files of the project drawings will provided to the CONTRACTOR.
 - 5. Reference drawing C121 for survey control points adjacent to the powerhouse.
- C. Prior to bid, the CONTRACTOR shall satisfy themselves to the quantity of excavation and other work by examining the electronic survey, plans and the CONTRACTOR's planned means and methods. Errors, inconsistencies or omissions discovered shall be reported to the OWNER immediately.
- D. The CONTRACTOR shall be responsible for locating and preserving all existing monuments and property corners within the project area that may be disturbed during the work. The CONTRACTOR shall re-establish any existing survey control that is accidentally or otherwise disturbed during the work.
- E. Detailed survey records shall be maintained by the CONTRACTOR's surveyor, including a description of the work performed on each shift, the methods utilized, and the control points used. The record shall be adequate to allow the survey to be reproduced. A copy of each day's record shall be provided to the OWNER within ten working days after the end of the shift.

- F. The meaning of words and terms used in this section shall be as listed in "Definitions of Surveying and Associated Terms" current edition, published by the American Congress on Surveying and Mapping and the American Society of Civil Engineers.

1.2 REFERENCE STANDARDS

- A. US Army Corps of Engineers Manual No. 1110-1-1003 – NAVSTAR GLOBAL POSITIONING SYSTEM SURVEYING

1.3 CONTROL POINTS ESTABLISHED PRIOR TO WORK

A. Survey Reference Points

1. The CONTRACTOR shall:

- a. Protect survey control points prior to starting site work and preserve permanent reference points during construction;
- b. Promptly report to the OWNER the loss or destruction of any reference point or relocation required because of changes in grades or any other reason; and,
- c. Replace survey control points damaged by the CONTRACTOR and compensate the OWNER for survey control points replaced by the OWNER.

B. Established By OWNER.

- 1. The OWNER has survey control points at the dam and powerhouse site for the CONTRACTOR's use. CONTRACTOR shall locate baselines, clearing limits, and all other improvements by reference to the survey control points established by the OWNER. CONTRACTOR's work shall conform to the horizontal and vertical controls.
- 2. Establishment of these points is to be by a Professional Licensed Surveyor familiar with the previously collected topographic information, and property boundary.

C. To Be Established and Maintained By CONTRACTOR.

- 1. Based upon the information provided by the OWNER, all other lines, grades, and detail surveys necessary for the execution and completion of the work, including slope stakes and other working points, lines and elevations, shall be established and maintained by the CONTRACTOR.
- 2. After lines and grades for any part of the work have been given by the OWNER on the drawings, the CONTRACTOR shall be held responsible for the proper execution of the work to such lines and grades, and all benchmarks, reference points and stakes given shall be carefully preserved by the CONTRACTOR until the OWNER authorizes their removal. The CONTRACTOR shall be responsible for any mistakes that may be caused by the unnecessary loss or disturbance of such benchmarks, reference points and stakes.
- 3. The OWNER reserves the right to check all work, shall have free access to all work, and shall have the full cooperation of the CONTRACTOR in conducting such

inspections of the work.

PART 2 -- PRODUCTS

2.1 EQUIPMENT REQUIREMENTS

A. GPS Receivers.

1. **Satellite Coverage.** For establishment of clearing limits, a minimum of five (5) visible satellites must be tracked at all times-preferably five or more satellites will have continuous tracking throughout the session. GPS mission planning software should be used to maximize the number of continuously tracked satellites in each session.
2. Only precise carrier phase relative positioning techniques will yield accuracies sufficient for GPS structural deformation surveys. Commercial off-the-shelf (COTS) geodetic type receiver/antenna equipment has the operational capabilities necessary for collecting high- quality carrier phase data. An inventory of required components for such a system are as follows:
 - a. **Receiver.** A geodetic quality GPS receiver must have: L1/L2 phase measurement capability, with at least a one second data logging rate; up-to-date receiver firmware version, and hardware boards that include any features available for high fidelity carrier tracking, and RF suppression in static surveying mode; minimum 3-10 megabyte internal raw data storage with a port connection enabled for logging to a laptop computer, data collector, or data communications system; and other accessories for protection and transport, such as carrying cases.
 - b. **Antenna.** At minimum, the antenna must be a dual frequency GPS L1/L2 microstrip antenna with flat ground plane or choke ring, and type-matched to GPS receiver. Both L1/L2 antenna phase center offsets must be published within 1 mm as measured along the mechanical axis to the antenna reference base-plate. Standard antenna base attachment rod/bolt, with 5/8-inch-diameter, 11NC tooling, or other precision forced centered attachment system is required. Standard antenna-to- tribrach mounting adapters and Wild-type tribrachs may be used as a forced centering assembly.
 - c. **Transmission cables.** Antenna-receiver, and data communications (RS-232 serial port interface, or special), connector cables with maximum length of 35 ft. (or suitable number of line amplifiers to prevent degradation of signal and noise amplifying losses) are required.
3. For multiple equipment systems deployed on a project, efforts should be made to replicate each unit as closely as possible. This includes specifications for hardware manufacturer, model, and physical specifications (e.g., cable lengths), firmware version, and software. Variations in measurement performance between different receiver-antenna system are reduced because equipment related biases are common to each system.

B. Electronic Total Station.

1. Force-centered, standard target set/prism combination used with a particular total

station. Target set/prism combinations not matched to a particular total station will not be used. Target set/prism combinations for total stations which are non-coaxial, will be tilting target set/prism combinations that allow for alignment with the line of observation.

2. EDM prisms. EDM targets will be the reflectors included with the EDM unit. Prisms not matched to a particular EDM will not be used.
3. Instrument calibrations.
 - a. Calibrations of surveying instruments are highly standardized and are essential for valid results when coordinate differencing is used to compute displacements. CONTRACTOR will provide only survey equipment which has been recently calibrated in accordance with manufacturer requirements

PART 3 EXECUTION

3.1 STAKING

- A. All surveyed points shall be established by placing hubs and tacks with marked stakes in unpaved areas or P. K. nails with painted markings in concrete areas. All surveying stakes shall be marked in accordance with Alaska DOT Construction Surveying Requirements including the additional information specified herein and/or as ordered by the OWNER. When stakes are needed that are not described in the Standard Plans, then those stakes shall be marked as ordered by the OWNER. The CONTRACTOR's PLS shall maintain and replace survey hubs, stakes, nails, and markings immediately if destroyed, removed, or the OWNER determines the stake or markings are illegible.
- B. The CONTRACTOR shall provide the OWNER copies of any calculations and staking data when requested by the OWNER. Regardless of any copies provided to the OWNER during the construction period, the CONTRACTOR shall provide a complete copy, paper and/or electronic, of all surveying records created by the CONTRACTOR's PLS.

3.2 POST CONSTRUCTION TOPOGRAPHIC SURVEY

- A. CONTRACTOR shall provide the following post-construction topographic survey information upon completion of all earthwork activities:
 1. An as-built topographic survey depicting the ground profile along the horizontal penstock centerline alignment shown on the Drawings. The profile shall show significant grade breaks. The profile shall be established by measuring ground elevations at least every 50 feet along the alignments. All manholes and above-ground penstock appurtenances shall be located.
 2. An as-built topographic survey of the deep-cut penstock excavation with all hinge points, top and toe of slope points at 50 foot stations.
 3. An as-built topographic survey of all stockpile locations so that the OWNER can determine the volume of stockpiled material.

4. An as-built topographic survey of the intake and powerhouse locations providing vertical elevations for the corners and angle points of each site.

3.3 POST CONSTRUCTION RECORD OF SURVEY

- A. CONTRACTOR shall perform the following post-construction survey activities upon completion of all major construction and earthwork-related activities:
 1. Prepare and submit for approval to the ENGINEER a Record of Survey of the project boundary. The map shall be prepared in accordance with Petersburg Borough requirements and shall depict all monumentation used for control.

3.4 ACCURACY

- A. The CONTRACTOR shall ensure a surveying accuracy within the following tolerances for structures based on initial reference points provided by OWNER.
 1. Stationing on structures ± 0.02 feet (Horizontal)
 2. Alignment on structures ± 0.02 feet (Horizontal)
 3. Elevations ± 0.01 feet (Vertical)
 4. Substructure ± 0.02 feet (Vertical)

3.5 RECORD DRAWINGS

- A. The CONTRACTOR shall maintain Record Drawings as detailed in Section 01 78 39 – Record Documents.

- END OF SECTION -

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SECTION 01 33 00 - CONTRACTOR SUBMITTALS

PART 1 -- GENERAL

1.1 SUMMARY

- A. Wherever submittals are required in the Contract Documents, submit them to the OWNER or OWNER's Resident Representative as directed.
- B. Within seven (7) Days after the date of commencement as stated in the Notice to Proceed, the CONTRACTOR shall submit the following items for review:
 - 1. A preliminary schedule of Shop Drawings, Samples, and proposed Substitutes ("Or-Equal") submittals listed in the Bid. The schedule of submittals shall be based on CONTRACTOR's priority, planned construction sequence and schedule, long lead items, and size of submittal package. Allow time for resubmittals.
 - 2. A list of permits and licenses the CONTRACTOR shall obtain, indicating the agency required to grant the permit and the expected date of submittal for the permit and required date for receipt of the permit.

1.2 EXPERIENCE AND QUALIFICATIONS SUBMITTALS REQUIRED WITH BID

- A. In addition to the items listed in the Bidders Checklist, the CONTRACTOR shall submit with their bid package the following information. This information will be used for bid-evaluation purposes.
 - 1. Experience and success of both company and superintendent completing at least three (3) projects of similar scope, complexity, and overall cost. A detailed list of comparable projects with current list of contacts shall be submitted with the bids
 - 2. A minimum of five (5) documented years' experience in major construction supervision by superintendent. Bidders shall submit a resume of named superintendent with their bid.

1.3 PRECONSTRUCTION CONFERENCE SUBMITTALS

- A. At the preconstruction conference of Section 01 11 00 - Summary of Work, the CONTRACTOR shall submit the following items to the OWNER for review:
 - 1. A revised schedule of Shop Drawings, Samples, and proposed Substitute ("Or-Equal") submittals listed in the Bid.
 - 2. List of Subcontractors, including each Subcontractor's address, telephone number, and contact person to be used on this project
 - 3. A list of permits and licenses the CONTRACTOR shall obtain, indicating the agency required to grant the permit, the expected date of submittal for the permit, and required date for receipt of the permit.
 - 4. A preliminary schedule of values in accordance with Section 01 29 00 - Schedule of Values.

5. A 60-Day plan of operation in accordance with Section 01 32 15 - CPM Construction Schedule.
6. A detailed layout of the field office required under Section 01 52 00 - Field Office, Equipment, and Services. The office shall not be shipped to the Site until the layout is approved.

1.4 SUBMITTALS AND SHOP DRAWINGS DURING CONSTRUCTION

- A. **General.** Submittals and shop drawings submitted to the OWNER as specified herein are intended to show compliance with the Contract Documents. Signatures, corrections or comments made on submittals do not relieve the CONTRACTOR from compliance with requirements of the drawings and specifications. Neither does acceptance or approval of submittals by signature add to or delete from any contract requirements resulting from these specifications regardless of the wording of the submittals.
1. Submittals will not be reviewed or approved when the term "By Others" is used
 2. Submittals are reviewed or approved for general conformance with the design concept of the project and general compliance with the information given in the Contract Documents.
 3. The CONTRACTOR is responsible for confirming and correlating all quantities and dimensions, selecting fabrication processes and techniques of construction, coordinating their work with that of other CONTRACTORS and agencies, and performing their work in a safe and satisfactory manner.
 4. Unnecessary "piece-mealing" or subdividing of submittals shall not be accepted.
- B. **Electronic .pdf Format.** All shop drawing submittals along with the shop drawing transmittal form, shall be made electronically in ".pdf" format and distributed by email from the CONTRACTOR to the OWNER's Resident Project Representative (RPR). The OWNER'S RPR shall be responsible to distribute each shop drawing to all reviewers and to receive and compile all review comments generated.
- C. Wherever called for in the Contract Documents or where required by the ENGINEER, the CONTRACTOR shall furnish a clear (non-scanned) electronic version, of each Shop Drawing and submittal. Shop Drawings may include detail design calculations, shop-prepared drawings, fabrication and installation drawings, erection drawings, lists, graphs, catalog sheets, data sheets, and similar items. Whenever the CONTRACTOR is required to submit design calculations as part of a submittal, such calculations shall bear the signature and seal of an engineer registered in the appropriate branch and in the state wherein the project is located, unless otherwise indicated.
- D. Shop Drawing submittals shall be accompanied by the OWNER's standard submittal transmittal form, an electronic copy of which is available from the OWNER. A submittal without the form or where applicable items on the form are not completed will be returned for resubmittal.
- E. **Organization**

1. The OWNER's RPR shall provide to the CONTRACTOR the numbering convention to be used for all submittals, at the Preconstruction Conference.
2. A single submittal transmittal form shall be used for each technical specification section or item or class of material or equipment for which a submittal is required. A single submittal covering multiple specification sections will not be acceptable, unless the primary specification references other sections for components.
3. On the transmittal form, index the components of the submittal and insert tabs in the submittal to match the components. Relate the submittal components to specification paragraph and subparagraph, Drawing number, detail number, schedule title, room number, or building name, as applicable.
4. Unless indicated otherwise, terminology and equipment names and numbers used in submittals shall match those used in the Contract Documents.

F. Format

1. Minimum sheet size shall be 8-1/2 inches by 11-inches. Maximum sheet size shall be 11-inches by 17-inches. Every page in a submittal shall be numbered in sequence. All sheets shall be submitted on one (1) pdf file and arranged.
 2. Where product data from a manufacturer is submitted, clearly mark which model is proposed, with complete pertinent data capacities, dimensions, clearances, diagrams, controls, connections, anchorage, and supports. Sufficient level of detail shall be presented for assessment of compliance with the Contract Documents.
 3. Each submittal shall be assigned a unique number. Submittals shall be numbered sequentially, and the submittal numbers shall be clearly noted on the transmittal. Original submittals shall be assigned a numeric submittal number followed by a decimal point and a "1" to indicate it is an original (first) submittal. (For example, if submittal number 16.1 requires a resubmittal, that resubmittal will bear the designation "16.2". A further resubmittal would bear the designation "16.3", etc.
- G. Disorganized submittals that do not meet the requirements of the Contract Documents will be returned without review.
- H. Except as may otherwise be indicated, the ENGINEER will return email comments (in pdf format) of each submittal to the OWNER's RPR with comments noted thereon, within 14 calendar Days following receipt by the ENGINEER. The OWNER's RPR will compile all comments and return the complete submittal (in pdf format), within 21 calendar days following original receipt by the OWNER's RPR. It is considered reasonable that the CONTRACTOR will make a complete and acceptable submittal to the OWNER's RPR by the first resubmittal on an item. The OWNER reserves the right to withhold monies due to the CONTRACTOR to cover additional costs of the ENGINEER's review beyond the first resubmittal. The ENGINEER's and OWNER RPR's combined maximum review period for each submittal or resubmittal will be 21 calendar Days. Thus, for a submittal that requires 2 resubmittals before it is complete, the maximum review period could be 63 calendar Days.

I. Submittal Review Marking

1. **NO EXCEPTIONS TAKEN.** If a submittal is returned to the CONTRACTOR marked "NO EXCEPTIONS TAKEN," formal revision and resubmission will not be required.
 2. **MAKE CORRECTIONS NOTED.** If a submittal is returned marked "MAKE CORRECTIONS NOTED," CONTRACTOR shall make the corrections on the submittal, but formal revision and resubmission will not be required.
 3. **REVISE-RESUBMIT.** If a submittal is returned marked "REVISE-RESUBMIT," the CONTRACTOR shall revise it and shall resubmit the required number of copies. Resubmittal of portions of multi-page or multi-drawing submittals will not be allowed. For example, if a Shop Drawing submittal consisting of 10 drawings contains one drawing noted as "REVISE - RESUBMIT," the submittal as a whole is deemed "REVISE - RESUBMIT," and all 10 drawings are required to be resubmitted.
 4. **REJECTED-RESUBMIT.** If a submittal is returned marked "REJECTED-RESUBMIT," it shall mean either that the proposed material or product does not satisfy the specification, the submittal is so incomplete that it cannot be reviewed, or is a substitution request not submitted in accordance with Section 01 60 00 - Products, Materials, Equipment, and Substitutions. In the first 2 cases, the CONTRACTOR shall prepare a new submittal and shall resubmit. In the latter case, the CONTRACTOR shall submit the substitution request according to Section 01 60 00.
- J. Resubmittal of rejected portions of a previous submittal will not be allowed. Every change from a submittal to a resubmittal or from a resubmittal to a subsequent resubmittal shall be identified and flagged on the resubmittal.
- K. Fabrication of an item may commence only after the ENGINEER has reviewed the pertinent submittals and returned copies to the CONTRACTOR marked either "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED." Corrections indicated on submittals shall be considered as changes necessary to meet the requirements of the Contract Documents and shall not be taken as changes to the contract requirements.
- L. Submittals shall be carefully reviewed by an authorized representative of the CONTRACTOR prior to submission to the ENGINEER. Each submittal shall be dated and signed by the CONTRACTOR as being correct and in strict conformance with the Contract Documents. In the case of Shop Drawings, each sheet shall be so dated and signed. Any deviations from the Contract Documents shall be noted on the transmittal sheet. The ENGINEER will only review submittals that have been so verified by the CONTRACTOR. Non-verified submittals will be returned to the CONTRACTOR without action taken by the ENGINEER, and any delays caused thereby shall be the total responsibility of the CONTRACTOR.
- M. Corrections or comments made on the CONTRACTOR's Shop Drawings during review do not relieve the CONTRACTOR from compliance with Contract Drawings and Specifications. Review is for conformance to the design concept and general compliance with the Contract Documents only. The CONTRACTOR is responsible for confirming and correlating quantities and dimensions, fabrication processes and techniques, coordinating WORK with the trades, and satisfactory and safe performance of the WORK.

1.5 SAMPLES

- A. The CONTRACTOR shall submit the number of samples indicated by the Specifications. If the number is not indicated, submit not less than three (3) samples. Where the amount of each sample is not indicated, submit such amount as necessary for proper examination and testing by the methods indicated.
- B. Samples shall be individually and indelibly labeled or tagged, indicating the salient physical characteristics and manufacturer's name. Upon acceptance by the ENGINEER, one set of the samples will be stamped and dated by the ENGINEER and returned to the CONTRACTOR, one set of samples will be retained by the OWNER, and one set shall remain at the Site in the OWNER RPR's field office until completion of the WORK.
- C. Unless indicated otherwise, the OWNER will select colors and textures from the manufacturer's standard colors and standard materials, products, or equipment lines. If certain samples represent non-standard colors, materials, products, or equipment lines that will require an increase in Contract Times or Price, the CONTRACTOR shall clearly state so on the transmittal page of the submittal.

1.6 TECHNICAL MANUAL

- A. The CONTRACTOR shall submit technical operation and maintenance information for each item of mechanical, electrical, and instrumentation equipment in an organized manner in the Technical Manual. It shall be written so that it can be used and understood by the OWNER's operation and maintenance staff.
- B. **Organization.** The Technical Manual shall be subdivided first by specification section number; second, by equipment item; and last, by "Category." The following "Categories" shall be addressed (as applicable):

1. **Category 1 - Equipment Summary**

- a. Summary: A table shall indicate the equipment name, equipment number, and process area in which the equipment is installed.
- b. Form: The ENGINEER will supply an Equipment Summary Form for each item of mechanical, electrical, and instrumentation equipment in the WORK. The CONTRACTOR shall fill in the relevant information on the form and include it in Part 1.

2. **Category 2 - Operational Procedures**

- a. Operational and Maintenance procedures shall be written in Microsoft TM Word document format for the startup, operation, maintenance, emergency situations and shutdown for all facility systems. The procedures shall be written in a step by step method for proper operation or maintenance of each individual system.
- b. Manufacturer-recommended procedures on the following shall be included in Part 2:
 - 1) Installation

- 2) Adjustment
- 3) Startup
- 4) Location of controls, special tools, equipment required, or related instrumentation needed for operation
- 5) Operation procedures
- 6) Load changes
- 7) Calibration
- 8) Shutdown
- 9) Troubleshooting
- 10) Disassembly
- 11) Reassembly
- 12) Realignment
- 13) Testing to determine performance efficiency
- 14) Tabulation of proper settings for air and vacuum relief valves, pressure relief valves, low and high pressure switches, and other protection devices
- 15) List of all electrical relay settings including alarm and contact settings

3. Category 3 - Preventive Maintenance Procedures

- a. Procedures: Preventive maintenance procedures shall include manufacturer-recommended procedures to be performed on a periodic basis, both by removing and replacing the equipment or component, and by maintaining the equipment in place.
- b. Schedules: Recommended frequency of preventive maintenance procedures shall be included. Lubrication schedules, including lubricant SAE grade, type, and temperature ranges, shall be covered.

4. Category 4 - Wiring and Loop Diagrams

- a. Diagrams: This category includes complete internal and connection wiring diagrams for electrical and instrumentation equipment items.

5. Category 5 - Shop Drawings

- a. Drawings: This category includes approved shop or fabrication drawings with ENGINEER comments and corrections incorporated, complete with dimensions.

6. **Category 6 - Parts List**

- a. **Parts List:** A complete parts list shall be furnished, including a generic description and manufacturer's identification number for each part. Addresses and telephone numbers of the nearest supplier and parts warehouse shall be included.
- b. **Drawings:** Cross-sectional or exploded view drawings shall accompany the parts list. Part numbers shall appear on the drawings with arrows to the corresponding part.

7. **Category 7 - Safety**

- a. **Procedures:** This category describes the safety precautions to be taken when operating and maintaining the equipment or working near it.

8. **Category 8 – Documentation & Warrantees**

- a. Equipment warranties, affidavits, certifications, calibrations, laboratory test results, etc. required by the Technical Specifications shall be placed in this category.

C. **Format**

1. Each Technical Manual shall be bound in standard size 3 ring hardcover binders labeled on the spine and cover with project name, OWNER's project number, specification section number, equipment name, and equipment identification number
2. Each Binder shall contain its own detailed table of contents at the front, plus a summary level table of contents information for the other binders in a multi-binder set.
3. Documents in binders shall be 3-hole punched, no text shall be punched out, and pages larger than 8-1/2 inches by 11-inches shall be folded to 8-1/2 inches by 11-inches. Binder ring size shall not exceed 2.5-inches in diameter.
4. Each final set of Technical Manuals shall include a CD or flash-stick drive with electronic files:
 - a. Project specific files shall be created in Microsoft Office 2010, AutoCAD version 2018 or later], Adobe Acrobat portable document format, or other software required by the specifications.
 - b. Manufacturer literature in Adobe Acrobat portable document format (pdf).

D. **Technical Manual Review Process**

1. The CONTRACTOR shall furnish three (3) draft Technical Manuals for each Specification Section that requires a Manual. The OWNER's RPR will retain one (1) copy, will forward one (1) copy to the OWNER, and will return one (1) copy to the CONTRACTOR with review comments.

2. The CONTRACTOR shall incorporate all comments into the draft and shall submit five (5) identical hard copies of the final Manual, bound in 3-ring binders, for acceptance.

E. **Schedule**

1. Except where indicated otherwise, Technical Manuals shall be submitted in final form to the OWNER's RPR not later than the 80 percent of construction completion date. Discrepancies found by the OWNER or ENGINEER shall be corrected within 30 Days from the date of written notification by the OWNER's RPR.

1.7 SPARE PARTS LIST

- A. The CONTRACTOR shall furnish to the OWNER spare parts information for mechanical, electrical, and instrumentation equipment. The spare parts list shall include those spare parts that each manufacturer recommends be maintained by the OWNER in inventory.
 1. **Sources and Pricing:** The spare parts list shall include a current list price of each spare part. Each manufacturer or supplier shall indicate the name, address, and telephone number of its nearest outlet of spare parts to assist the OWNER in ordering.
 2. **Format:** The CONTRACTOR shall cross-reference spare parts lists to the equipment numbers designated in the Contract Documents. The spare parts lists shall be bound in standard size, 3 ring, loose-leaf, vinyl plastic hard cover binders suitable for bookshelf storage. Binder ring size shall not exceed 2.5 inches.

1.8 RECORD DRAWINGS

- A. The CONTRACTOR shall maintain one set of Drawings at the Site for the preparation of record drawings. On these, it shall mark every project condition, location, configuration, and any other change or deviation which may differ from the Contract Drawings at the time of award, including buried or concealed construction and utility features that are revealed during the course of construction. Special attention shall be given to recording the horizontal and vertical location of buried utilities that differ from the locations indicated, or that were not indicated on the Contract Drawings.
- B. The record drawings shall be supplemented by any detailed sketches as necessary or as CONTRACTOR is directed, to fully indicate the WORK as actually constructed. These record drawings are the CONTRACTOR's representation of as-built conditions, shall include revisions made by addenda and change orders, and shall be maintained up-to-date during the progress of the WORK. Red ink shall be used for alterations and notes. Notes shall identify relevant Change Orders by number and date.
- C. 11-inch x 17-inch size paper copies of the record drawings shall be submitted to the OWNER's RRP at 120 day intervals, starting after the date of the Notice to Proceed, and also at completion of WORK. Failure to submit complete record drawings on or before these dates will enact the liquidated damages clause for interim record drawing submittals described in Division 00 Contract Specifications.
- D. In the case of those drawings that depict the detail requirement for equipment to be assembled and fabricated in the factory, the record drawings shall be updated by

indicating those portions which are superseded by change order drawings or final Shop Drawings, and by including appropriate reference information describing the change orders by number and the Shop Drawings by manufacturer, drawing, and revision numbers.

- E. Disorganized or incomplete record drawings will not be accepted. The CONTRACTOR shall revise them and resubmit the drawings for review.
- F. Record drawings shall be accessible to the OWNER's RPR during the construction period.
- G. Final payment will not be acted upon until the record drawings have been completed and delivered to the OWNER's RPR. Said up-to-date record drawings shall be in the form of a set of prints with carefully plotted information overlaid on the Contract Drawings.
- H. Information submitted by the CONTRACTOR will be assumed to be correct, and the CONTRACTOR shall be responsible for the accuracy of such information

1.9 QUALITY CONTROL (QC) SUBMITTALS

- A. Quality control submittals are defined as those required by the Specifications to present documentary evidence to the OWNER and ENGINEER that the CONTRACTOR has satisfied certain requirements of the Contract Documents.
- B. Unless otherwise indicated, QC submittals shall be submitted:
 - 1. Before delivery and unloading, for the following types of submittals:
 - a. Manufacturers' installation instructions
 - b. Manufacturers' and Installers' experience qualifications
 - c. Affidavits and manufacturers' certification of compliance with indicated product requirements
 - d. Laboratory analysis results
 - e. Factory test reports
 - f. Ready mix concrete delivery tickets
 - g. Design calculations
 - 2. Within 30 Days of the event documented for the following types of submittals:
 - a. Manufacturers' field representative certification of proper installation
 - b. Field measurement
 - c. Field test reports
 - d. Receipt of permit

e. Receipt of regulatory approval

C. The OWNER's RPR and ENGINEER will record the date that a QC submittal was received and review it for compliance with submittal requirements, but the review procedures above for Shop Drawings and samples will not apply.

1.10 INFORMATIONAL SUBMITTALS

A. Informational submittals, such as Requests for Information (RFI), Deviation Request (DR), Change Order Proposals (COR), etc. formalize the flow of information between the CONTRACTOR and the OWNER's RPR and ENGINEER. The OWNER's standard forms will be employed for such purpose. Electronic copies of all standard Construction Management forms shall be provided by the OWNER to the CONTRACTOR.

1.11 CONSTRUCTION PHOTOGRAPHS

A. The CONTRACTOR shall be responsible to take digital construction photographs, no less than once per week, showing the progress of the WORK, including documentation of all buried utilities encountered during construction as well as installation of new buried utilities and buried WORK required by the Contract.

B. Upon completion of the WORK and before final payment, the CONTRACTOR shall electronically submit all photographs to the OWNER on a CD or other electronic media with each photograph's file name identified by location and date it was taken.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

- END OF SECTION -

SECTION 01 35 00 – SITE SECURITY

PART 1 -- GENERAL

1.1 SECURITY PROGRAM

- A. The CONTRACTOR shall:
 - 1. Protect WORK, existing premises, and OWNER'S operations from theft, vandalism, and unauthorized entry.
 - 2. Maintain program throughout construction period until OWNER'S acceptance precludes the need for CONTRACTOR security.

1.2 ENTRY CONTROL

- A. The CONTRACTOR shall:
 - 1. Provide temporary security fence and gate to control access to the site.
 - 2. Restrict entry of persons and vehicles into Site and existing facilities.
 - 3. Allow entry only to authorized persons with proper identification.
 - 4. Maintain log of workmen and visitors and make log available to OWNER on request.
 - 5. Coordinate access of OWNER'S personnel to Site in coordination with OWNER'S security measures.
- B. CONTRACTOR shall control entrance of persons and vehicles onto the project site at all times during normal working business hours. During after hours the access gate shall be locked.
- C. CONTRACTOR shall take adequate precaution to protect OWNER's property and employees.

1.3 RESTRICTIONS

- A. The CONTRACTOR shall not allow cameras on site or photographs taken except by written approval of OWNER.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

- END OF SECTION -

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SECTION 01 35 20 - ESCROW BID DOCUMENTS

PART 1 -- GENERAL

1.1 SUMMARY

- A. This specification requires that the Bidders submit, at the time of receipt of Bids, one copy of all documentary information generated in preparation of Bid prices for this project, as described in paragraph 1.4 "Format and Contents". This material is hereinafter referred to as "Escrow Bid Documents". The Escrow Bid Documents of the successful Bidder will be held in escrow for the duration of the Contract.
- B. The successful Bidder agrees, as a condition of award of the Contract, that the Escrow Bid Documents constitute all the information used in the preparation of its Bid, and that no other bid preparation information shall be considered in resolving disputes or claims. The successful Bidder also agrees that nothing in the Escrow Bid Documents shall change or modify the terms or conditions of the Contract Documents.

1.2 OWNERSHIP

- A. The Escrow Bid Documents are and shall always remain the property of the CONTRACTOR, subject to joint review by the OWNER and the CONTRACTOR, as provided herein.
- B. The OWNER stipulates and expressly acknowledges that the Escrow Bid Documents, as defined herein, constitute trade secrets. This acknowledgement is based on the OWNER's express understanding that the information contained in the Escrow Bid Documents is not known outside Bidder's business, is known only to a limited extent and only by a limited number of employees of the Bidder, is safeguarded while in Bidder's possession, is extremely valuable to Bidder and could be extremely valuable to Bidder's competitors by virtue of it reflecting Bidder's contemplated techniques of construction. OWNER further acknowledges that Bidder expended substantial sums of money in developing the information included in the Escrow Bid Documents and further acknowledges that it would be difficult for a competitor to replicate the information contained therein. OWNER further acknowledges that the Escrow Bid Documents and the information contained therein are made available to OWNER only because such action is an express prerequisite to award of the Contract. OWNER further acknowledges that the Escrow Bid Documents include a compilation of information used in Bidder's business, intended to give Bidder an opportunity to obtain an advantage over competitors who do not know of or use the contents of the documentation. OWNER further agrees to safeguard the Escrow Bid Documents, and all information contained therein against disclosure to the fullest extent permitted by law.

1.3 PURPOSE

- A. Escrow Bid Documents will be used to assist in the negotiation of price adjustments and change orders and in the settlement of disputes and claims. They will not be used for pre-award evaluation of the CONTRACTOR's anticipated methods of construction or to assess the CONTRACTOR's qualifications for performing the WORK.

1.4 FORMAT AND CONTENTS

- A. Bidders may submit Escrow Bid Documents in their usual cost estimating format; a standard format is not required. It is not the intention of this specification to cause the Bidder extra work during the preparation of the Bid, but to ensure that the Escrow Bid Documents will be adequate to enable complete understanding and proper interpretation for their intended use. The Escrow Bid Documents shall be submitted in the language (e.g., English) of the specifications.
- B. It is required that the Escrow Bid Documents clearly itemize the estimated costs of performing the WORK of each Bid item contained in the Bid schedule. Bid items should be separated into sub-items as required to present a detailed cost estimate and allow a detailed cost review. The Escrow Bid Documents shall include all quantity takeoffs, crews, equipment, calculations of rates of production and progress, copies of quotes from Subcontractors and Suppliers, and memoranda, narratives, add/deduct sheets, and all other information used by the Bidder to arrive at the prices contained in the Bid. Estimated costs should be broken down into the Bidder's usual estimate categories such as direct labor, repair labor, equipment ownership and operation, expendable materials, permanent materials and subcontract costs as appropriate. Plant and equipment and indirect costs should be detailed in the Bidder's usual format. The CONTRACTOR's allocation of indirect costs, contingencies, markup and other items to each Bid item shall be identified.
- C. All costs shall be identified. For Bid items amounting to less than \$10,000, estimated unit costs are acceptable without a detailed cost estimate, provided that labor, equipment, materials and subcontracts, as applicable, are included and provided that indirect costs, contingencies and markup, as applicable, are allocated.
- D. Bid documents provided by the OWNER should not be included in the Escrow Bid Documents unless needed to comply with the following requirements.

1.5 SUBMITTAL

- A. The Escrow Bid Documents shall be submitted by the Bidders in a sealed container at the time for receipt of Bids. The container shall be clearly marked on the outside with the Bidder's name, date of submittal, project name and the words "Escrow Bid Documents".
- B. The Escrow Bid Documents shall be accompanied with the certification (sample included in paragraph 1.9), signed by an individual authorized by the Bidder to submit the Bid, stating that the material in the Escrow Bid Documents constitutes all the documentary information used in preparation of the Bid and that the Bidder has personally examined the contents of the Escrow Bid Documents container and has found that the documents in the container are complete.
- C. Escrow Bid Documents of the apparent successful Bidder will be examined, organized and inventoried by representatives of the OWNER, together with members of the CONTRACTOR's staff who are knowledgeable in how the Bid was prepared.
- D. This examination is to ensure that the Escrow Bid Documents are legible and complete. It will not include review of, and will not constitute approval of proposed construction

methods, estimating assumptions, or interpretations of Contract Documents. Examination will not alter any condition or term of the contract.

- E. If all the documentation required in paragraph 1.4, "Format and Contents", has not been included in the original submittal, additional documentation may be submitted, at the OWNER's discretion, prior to award of Contract. The detailed breakdown of estimated costs shall be reconciled and revised, if appropriate, by agreement between the CONTRACTOR and the OWNER before making the award.
- F. If the Contract is not awarded to the apparent successful bidder, the Escrow Bid Documents of the Bidder next to be considered for the award shall be processed as described above.
- G. Timely submission of complete Escrow Bid Documents is an essential element of the Bidder's responsibility and a prerequisite to a Contract award. Failure to provide the necessary Escrow Bid Documents will be sufficient cause for the OWNER to reject the Bid.
- H. Escrow Bid Documents of the unsuccessful Bidders will be returned following award of the Contract.
- I. If any Bid is based upon subcontracting any part of the WORK, each Subcontractor, whose total subcontract price exceeds 5 percent of the total Contract Price proposed by the Bidder, shall provide separate Escrow Bid Documents to be included with those of the Bidder. Such documents shall be opened and examined in the same manner and at the same time as the examination described above for the apparent successful Bidder.
- J. If the CONTRACTOR wishes to subcontract any portion of the WORK after award, the OWNER retains the right to require the CONTRACTOR to submit Escrow Bid Documents from the Subcontractor before the subcontract is approved.

1.6 STORAGE

- A. The Escrow Bid Documents will be placed in escrow, for the life of the Contract, in a mutually agreeable institution. The cost of storage will be paid by the AUTHORITY.

1.7 EXAMINATION

- A. The Escrow Bid Documents shall be examined by both the OWNER and the CONTRACTOR at any time deemed necessary by both of them to assist in the negotiation of price adjustments and change orders or the settlement of disputes and claims.
- B. Examination of the Escrow Bid Documents is subject to the following conditions:
 - 1. As trade secrets, the Escrow Bid Documents are proprietary and confidential as described in Part 1.
 - 2. The OWNER and the CONTRACTOR shall each designate in writing to the other party and within 10 Days after execution of the Contract, representatives who are authorized to examine the Escrow Bid Documents. Members of the Disputes

Review Board may examine the Escrow Bid Documents. No other person shall have access to the Escrow Bid Documents.

3. Access to the documents may take place only in the presence of duly designated representatives of both the OWNER and CONTRACTOR.

1.8 FINAL DISPOSITION

- A. The Escrow Bid Documents will be returned to the CONTRACTOR at such time as the Contract has been completed and final settlement has been achieved.

1.9 SAMPLE CERTIFICATION

BID DOCUMENTATION

Certification

THE UNDERSIGNED HEREBY CERTIFIES THAT THE BID DOCUMENTATION CONTAINED HEREIN CONSTITUTES ALL THE INFORMATION USED IN PREPARATION OF THE BID AND THAT I HAVE PERSONALLY EXAMINED THESE CONTENTS AND HAVE FOUND THAT THIS BID DOCUMENTATION IS COMPLETE.

BY: _____

TITLE: _____

FIRM: _____

DATE: _____

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

- END OF SECTION -

SECTION 01 40 00 – QUALITY REQUIREMENTS

PART 1 -- GENERAL

1.1 QUALITY CONTROL

- A. The CONTRACTOR shall provide tests and reports described in this section with any tests, reports, and other information that may be additionally required in any section of the specifications.
- B. The OWNER will submit a Quality Control and Inspection Plan (QCIP) to the FERC. The QCIP will be made available upon request to the CONTRACTOR. The CONTRACTOR will be responsible for compliance with quality assurance, however OWNER will carry out all quality control testing to independently verify compliance with the specifications.

1.2 TESTS BY INDEPENDENT TESTING LABORATORY

A. **Inspection, General**

1. Construction inspection and testing for the OWNER will be performed by a material testing firm to be selected by the OWNER, or others as the OWNER may designate and as the construction situation may dictate. The OWNER Inspector will be responsible for verifying that the CONTRACTOR is complying with the Contract Documents.
2. The OWNER will prepare a Construction Inspection Checklist to be presented to the CONTRACTOR at the Pre-construction Meeting. The Checklist will include all inspections typically required by local, city and county officials as well as other items as deemed important by the PROJECT LEAD.
3. The CONTRACTOR shall be required to contact the OWNER Inspector 24 hours in advance of all of the construction activities listed on the Checklist, have the indicated activity inspected, and the OWNER's Inspector initial that the work was performed in accordance with the appropriate technical provision.
4. The CONTRACTOR shall be required to schedule all local inspections with the permitting agencies in accordance with the permit conditions and requirements found in the Appendices of the Contract Documents. Appropriate notice as required by the local agencies shall be provided.
5. The Checklist shall be posted near each project office and be available for review by the OWNER at all times. These inspections shall be in addition to any required inspections by state or local jurisdictions. The OWNER will prepare a suitable checklist for each building to be constructed and present same to the CONTRACTOR at the Pre- construction Meeting.
6. Laboratory Services
 - a. Testing for Quality Control Certification or Special Inspections as required by the permitting authority will be conducted by OWNER and/or an independent laboratory which will be furnished and paid for by the OWNER. The OWNER

will select and direct an independent construction inspector and testing laboratory (Testing Lab) to perform inspection and testing services as described in this Section.

- 1) The construction inspector and testing laboratory will work solely at the direction of the OWNER's own Quality Assurance program.
 - 2) The CONTRACTOR shall include the cost in the price proposal to provide their own testing services program.
- b. Failure of the material to achieve the specified density or standards will be just cause for rejecting any portion of, and/or all of the material represented by the test. All costs associated with replacement materials or any delays caused by such failure shall be borne by the CONTRACTOR.

It shall be the CONTRACTOR's responsibility to prepare test specimens as required for special inspection as required by the permitting authority or the PROJECT LEAD and the cost shall be incidental to the Contract

B. Permit Inspections

1. The CONTRACTOR shall comply with the requirements of all permits. It shall be the CONTRACTOR's responsibility to contact the permitting authority and schedule all required inspections. The CONTRACTOR shall notify the OWNER's RPR of all scheduled inspections.

C. Taking Test Samples and Delivery to Testing Lab:

1. Make available and deliver to Testing Lab, at the CONTRACTOR's expense, all materials to be tested. The CONTRACTOR shall be responsible for coordinating all testing.
2. Provide labor necessary to supply samples and assist in making tests.
3. Advise Testing Lab of the identity of material sources and instruct suppliers to allow inspections by the laboratory if so desired by the OWNER.

D. The testing lab is not authorized to:

1. Release, revoke, alter or enlarge on, contract requirements.
2. Approve or accept any portion of the work.
3. Perform any duties required of the CONTRACTOR, including any testing work requested by the CONTRACTOR for verification.

E. Tests shall be conducted in accordance with the requirements of the specifications as designated or, where not specified, as requested by the OWNER. All testing will be in accordance with the latest standards of the American Society for Testing and Materials, and other relevant standards to the WORK.

1.3 INDEPENDENT TESTING LABORATORY SERVICES, TESTS AND RELATED

CONTRACTOR RESPONSIBILITIES

A. Testing Lab Services will be performed for, though are not limited to, the following items:

1. **Compacted Soils**

- a. The Testing Lab will secure samples of onsite fills proposed for use or being used in construction and test for proper gradation (sieve analysis) in accordance with the applicable sections of these specifications. This will also be done on CONTRACTOR provided samples from offsite borrow sources.
- b. The Testing Lab will establish optimum moisture – density relationship in accordance with ASTM D698 (Standard Proctor).
- c. The OWNER reserves the right to make or request in-situ tests of fills and backfills at any time, above those require by the CONTRACTOR, in order to determine compliance with the specifications.

2. **Concrete**

- a. The Testing Lab will test samples of aggregates CONTRACTOR proposes to use for compliance with specifications.
- b. The OWNER will verify compliance with the specifications for cement proposed for use by the CONTRACTOR based on data submitted by the CONTRACTOR.
- c. The Testing Lab will review the CONTRACTOR's proposed design concrete mix, as well as perform appropriate laboratory tests during construction, including compression tests of cylinders and slump test, if required, to substantiate mix designs.
- d. When requested by the OWNER, the Testing Lab will inspect and collect test materials during concrete work to substantiate compliance with specifications and mix requirements.
- e. Slump Test
 - 1) The right to perform or request a slump test by the CONTRACTOR at any time, which may be in addition to the CONTRACTOR's testing, is reserved for the OWNER.
 - 2) Test cylinders shall be prepared and supplied by the CONTRACTOR as required by SECTION 03 30 00 as follows:
 - a) Each set of test cylinders shall consist of three cylinders prepared by the Contractor.
 - b) Test cylinders shall be made and cured by the Contractor in conformity with ASTM C31. No sooner than 24 hours, but no more than 48 hours, after taking cylinders, the Contractor shall carefully transport the cylinders to the Testing Laboratory for moisture curing.

- f. The Testing Lab will perform the required number of compression tests as follows:
 - 1) Test one cylinder to failure at 7 days.
 - 2) Test two (2) cylinders at 28 days in accordance with ASTM C39 and SECTION 03 30 00 of these specifications.
 - g. The CONTRACTOR shall identify all test cylinders with symbols to indicate location on the job where concrete test was made. Symbols will be used to record placement locations on record drawings.
3. **Roadway Subgrades.** The Testing Lab will verify roadway aggregate gradation and compaction in accordance with applicable specifications.

1.4 CONTRACTOR'S RESPONSIBILITIES

- A. Furnish product data meeting or exceeding contract requirements in accordance with the applicable specifications.
- B. Cooperate with any of OWNER and Testing Lab personnel, in providing access to work and to manufacturer's or suppliers operations.
 - 1. Direct CONTRACTOR's representative, if desired, to monitor each inspection, sampling and test.
 - 2. The CONTRACTOR shall, within 24 hours, notify the OWNER in writing of reasons for not acknowledging field testing and sampling procedures.
- C. Provide to the Testing Lab, initial representative samples of materials to be tested, in specified quantities.
- D. Furnish copies of mill test reports.
- E. Furnish verification of compliance with contract requirements for materials and equipment.
- F. Furnish labor and facilities:
 - 1. To provide access to work to be tested.
 - 2. To obtain, handle and transport samples at site.
 - 3. To facilitate inspections and tests.
 - 4. For the Testing Lab's exclusive use for storage and pouring of concrete test samples.
- G. Notify the OWNER, Construction Inspector, and the Testing Lab sufficiently in advance of operations to allow for assignment of personnel and scheduling of tests. A minimum of two (2) days advance notice will be provided. CONTRACTOR shall notify the OWNER, Construction Inspector and the Testing Lab when work is ready for testing. The

CONTRACTOR shall provide a schedule for the Testing Lab for acceptance by the Construction Inspector and OWNER. The CONTRACTOR shall pay for any testing he or any of his representatives or employees schedule as defined in these specifications.

- H. Work which is defective or which fails to conform to the contract documents shall be corrected by the CONTRACTOR at the CONTRACTOR's sole expense. Corrective work shall not be cause for delay in the project schedule or the work of other CONTRACTOR.
- I. Pay all costs of retesting when test results indicate non-compliance with contract requirements.
- J. Restore all surfaces and areas disturbed by testing operations to conditions existing before testing.

1.5 BUILDING ELECTRICAL PERMIT AND INSPECTION

- A. The CONTRACTOR shall obtain an Electrical Building Permit from the Petersburg Borough, Community & Economic Development Department.
- B. The CONTRACTOR shall be responsible to obtain any required electrical inspection services during or after completion of Electrical Work by the State of Alaska electrical inspector.

1.6 QUALIFICATIONS FOR WELDING WORK

- A. Welders employed in executing work under this project shall possess qualification papers given by an independent testing laboratory under AWS Code, Standard Qualifications Procedure.
- B. The qualification papers shall be dated no earlier than six months prior to the NTP date provided for the project. Welders not engaged in welding for a period of three or more months within the 6 months preceding construction must be re-qualified.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION (Not Used)

- END OF SECTION -

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SECTION 01 42 10 - REFERENCE STANDARDS

PART 1 -- GENERAL

1.1 GENERAL

- A. **Titles of Sections and Paragraphs:** Titles and subtitles accompanying specification sections and paragraphs are for convenience and reference only and do not form a part of the Specifications.
- B. **Applicable Publications:** Whenever in these Specifications references are made to published specifications, codes, standards, or other requirements, it shall be understood that wherever no date is indicated, only the latest specifications, standards, or requirements of the respective issuing agencies which have been published as of the date that the Contract is advertised for Bids shall apply; except to the extent that said standards or requirements may be in conflict with applicable laws, ordinances, or governing codes. No requirements set forth in the Specifications or shown on the Drawings will be waived because of any provision of or omission from said standards or requirements.
- C. **Specialists, Assignments:** In certain instances, specification text requires (or implies) that specific WORK is to be assigned to specialists or expert entities who must be engaged to perform that WORK. Such assignments shall be recognized as special requirements over which the CONTRACTOR has no choice or option. These requirements shall not be interpreted so as to conflict with the enforcement of building codes and similar regulations governing the WORK; also they are not intended to interfere with local union jurisdiction settlements and similar conventions. Such assignments are intended to establish which party or entity involved in a specific unit of WORK is recognized as "expert" for the indicated construction processes or operations. Nevertheless, the final responsibility for fulfillment of the entire set of Contract requirements remains with the CONTRACTOR.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. The CONTRACTOR shall construct the WORK in accordance with the Contract Documents and the referenced portions of those referenced codes, standards, and specifications.
 - 1. References to "Building Code" or "International Building Code" shall mean International Building Code of the International Code Council (ICC) as adopted and amended by the local jurisdiction.
 - 2. Similarly, references to "Mechanical Code" or "Uniform Mechanical Code," "Plumbing Code" or "Uniform Plumbing Code," "Fire Code" or "Uniform Fire Code," shall mean Uniform Mechanical Code, Uniform Plumbing Code and Uniform Fire Code of the International Association of Plumbing and Mechanical Officials (IAPMO) as adopted and amended by the local jurisdiction.
 - 3. References to the "Electric Code" or "National Electric Code (NEC)" shall mean the National Electric Code of the National Fire Protection Association (NFPA).

The latest edition of the codes as approved by the Municipal Code and used by the local agency as of the date that the WORK is advertised for Bids shall apply to the WORK herein, including all addenda, modifications, amendments, or other lawful changes thereto.

- B. In case of conflict between codes, reference standards, drawings, and the other Contract Documents, the most stringent requirements shall govern. All conflicts shall be brought to the attention of the ENGINEER for clarification and direction prior to ordering or providing any materials or furnishing labor. The CONTRACTOR shall bid for the most stringent requirements.
- C. References to "OSHA Regulations for Construction" shall mean **Title 29, Part 1926, Construction Safety and Health Regulations**, Code of Federal Regulations (OSHA), including all changes and amendments thereto.
- D. References to "OSHA Standards" shall mean **Title 29, Part 1910, Occupational Safety and Health Standards**, Code of Federal Regulations (OSHA), including all changes and amendments thereto.

1.3 REGULATIONS RELATED TO HAZARDOUS MATERIALS

- A. The CONTRACTOR shall be responsible that all WORK included in the Contract Documents, regardless if indicated or not, shall comply with all EPA, OSHA, RCRA, NFPA, and any other federal, state, and local regulations governing the storage and conveyance of hazardous materials, including petroleum products.
- B. Where no specific regulations exist and the OWNER has not waived the requirement in writing, chemical, hazardous, and petroleum product piping and storage in underground locations shall be double containment piping and tanks or be installed in separate concrete trenches and vaults with an approved lining that cannot be penetrated by the chemicals.

PART 2 -- PRODUCTS (CONSTRUCTION INDUSTRY STANDARD DOCUMENTS)

2.1 AASHTO -- AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS

- A. AASHTO M 36 - Standard Specification for Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains; 2003.
- B. AASHTO M 147 - Standard Specification for Materials for Aggregate and Soil-Aggregate Subbase, Base and Surface Courses; 1965 (2004).
- C. AASHTO M 252 - Standard Specification for Corrugated Polyethylene Drainage Pipe; 2009.
- D. AASHTO M 288 - Standard Specification for Geotextiles; 2006.
- E. AASHTO M 294 - Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500 MM (12- to 60-in.) Diameter; 2013.

- F. AASHTO T 238 - Standard Specification for Density of Soil and Soil-Aggregate In-Place by Nuclear Methods (Shallow Depth); 1997.
- G. AASHTO T 239 - Standard Specification for Moisture Content of Soil and Soil-Aggregate In-Place by Nuclear Methods (Shallow Depth); 1997.

2.2 **ACA -- AMERICAN COATINGS ASSOCIATION**

2.3 **ACI -- AMERICAN CONCRETE INSTITUTE INTERNATIONAL**

- A. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials; 2010.
- B. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; 1991 (Reapproved 2009).
- C. ACI 211.2 - Standard Practice for Selecting Proportions for Structural Lightweight Concrete; 1998 (Reapproved 2004).
- D. ACI 301 - Specifications for Structural Concrete; 2010 (Errata 2012).
- E. ACI 302.1R - Guide for Concrete Floor and Slab Construction; 2004 (Errata 2007).
- F. ACI 304 - Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete;.
- G. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000.
- H. ACI 305R - Hot Weather Concreting; 2010.
- I. ACI 306R - Cold Weather Concreting; 2010.
- J. ACI 308R - Guide to Curing Concrete; 2001 (Reapproved 2008).
- K. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; 2011.
- L. ACI 347 - Recommended Practice For Concrete Formwork;
- M. ACI 347 - Guide to Formwork for Concrete; 2004.
- N. ACI 530/530.1/ERTA - Building Code Requirements and Specification for Masonry Structures and Related Commentaries; 2011.
- O. ACI 530.1/ASCE 6/TMS 602 - Specification for Masonry Structures; 2008.
- P. ACI 531.1 - Specification for Concrete Masonry Construction; 1976 (Reapproved 1983).
- Q. ACI SP-66 - ACI Detailing Manual; 2004.

2.4 **ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC):**

- A. AEIC CS 5, Crosslinked Polyethylene Insulated Shielded Power Cables Rated 5

Through 35 kV.

- B. AEIC CS 6, Ethylene-Propylene-Rubber-Insulated Shielded Power Cables Rated 5 Through 69 kV.

2.5 **AHRI -- AIR-CONDITIONING, HEATING, AND REFRIGERATION INSTITUTE**

- A. AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI); current edition at www.ahrinet.org.

2.6 **AMCA -- AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL, INC.**

- A. AMCA 99 - Standards Handbook; 2010.

2.7 **ANSI -- AMERICAN NATIONAL STANDARDS INSTITUTE**

- A. ANSI A13.1 - Scheme for the Identification of Piping Systems; 1981 (R1993).
- B. ANSI A14.3 - American National Standard for Ladders -- Fixed -- Safety Requirements; 2008.
- C. ANSI A112.21.1M - Floor Drains; 1991.
- D. ANSI C2 - National Electrical Safety Code.
- E. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2005.
- F. ANSI C80.3 - American National Standard for Steel Electrical Metallic Tubing (EMT); 2005.
- G. ANSI C80.5 - American National Standard for Electrical Rigid Aluminum Conduit (ERAC); 2005.
- H. ANSI S1.8 - American National Standard Reference Quantities for Acoustical Levels; 1989 (R2011).
- I. ANSI S1.13 - American National Standard Measurement of Sound Pressure Levels in Air; 2005 (R2010).
- J. ANSI S12.1 - American National Standard Guidelines for the Preparation of Standard Procedures to Determine the Noise Emission from Sources; 1983 (R2011).
- K. ANSI Z358.1 - American National Standard for Emergency Eyewash and Shower Equipment; 2009.
- L. ANSI Z535.2 - American National Standard for Environmental and Facility Safety Signs; 2011.

2.8 **ASA -- ACOUSTICAL SOCIETY OF AMERICA**

- A. ASA 16 - Survey Methods for Determination of Sound Power Levels of Noise Sources; current edition.
- B. ASA 47 - Specification for Sound Level Meters.
- C. ASA 49 - Preparation of Standard Procedures to Determine the Noise Emission from Sources.

2.9 ASHRAE -- AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS, INC.

- A. ASHRAE (FUND) - ASHRAE Handbook - Fundamentals; 2013.
- B. ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications; 2011.
- C. ASHRAE (HVACS) - ASHRAE Handbook - HVAC Systems and Equipment; 2012.
- D. ASHRAE Guideline 1.1 - The HVAC Commissioning Process; 2012
- E. ASHRAE Std 62.1 - Ventilation For Acceptable Indoor Air Quality; 2013.
- F. ASHRAE Std 68 - Laboratory Method of Testing to Determine the Sound Power in a Duct; 1997.
- G. ASHRAE Std 70 - Method of Testing the Performance of Air Outlets and Inlets; 2006 (R2011).
- H. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems; 2008.

2.10 ASME -- THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2007 (ANSI/ASME A13.1).
- B. ASME A112.6.1M - Supports for Off-the-Floor Plumbing Fixtures for Public Use; 1997 (Reaffirmed 2002).
- C. ASME A112.6.3 - Floor and Trench Drains; 2001 (R2007).
- D. ASME A112.18.1 - Plumbing Supply Fittings; 2012.
- E. ASME A112.19.1 - Enamelled Cast Iron and Enamelled Steel Plumbing Fixtures; 2013.
- F. ASME A112.19.1M - Enameled Cast Iron Plumbing Fixtures; 2008 (R2011).
- G. ASME A112.19.2 - Ceramic Plumbing Fixtures; 2013.
- H. ASME A112.19.4M - Porcelain Enameled Formed Steel Plumbing Fixtures; 1994 (R2004).
- I. ASME A112.19.5 - Flush Valves and Spuds for Water Closets, Urinals, and Tanks; 2011.

- J. ASME A112.21.1 - Floor and Trench Drains; 2001.
- K. ASME A112.26.1M - Water Hammer Arrestors; 1984.
- L. ASME B1.1 - Unified Inch Screw Threads; 2003 (Reaffirmed 2008).
- M. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2010.
- N. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2011.
- O. ASME B16.4 - Gray Iron Threaded Fittings: Classes 125 and 250; 2011.
- P. ASME B16.5 - Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard; 2013 (ANSI/ASME B16.5).
- Q. ASME B16.9 - Factory-Made Wrought Buttwelding Fittings; 2012.
- R. ASME B16.11 - Forged Fittings, Socket-Welding and Threaded; 2011.
- S. ASME B16.12 - Cast Iron Threaded Drainage Fittings; 2009.
- T. ASME B16.21 - Nonmetallic Flat Gaskets for Pipe Flanges; 2011.
- U. ASME B16.25 - Buttwelding Ends; 2012.
- V. ASME B18.2.1 - Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series); 2010.
- W. ASME B18.2.2 - Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series); 2010.
- X. ASME B31.1 - Power Piping; 2014 (ANSI/ASME B31.1).
- Y. ASME B31.2 - Fuel Gas Piping; 1968.
- Z. ASME B31.8 - Gas Transmission and Distribution Piping Systems; 2014.
- AA. ASME B40.100 - Pressure Gauges and Gauge Attachments; 2013.
- AB. ASME BPVC - Boiler and Pressure Vessel Code; 2013.

2.11 **ASTM A SERIES -- ASTM INTERNATIONAL**

- A. ASTM A6/A6M - Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling; 2014.
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
- C. ASTM A48/A48M - Standard Specification for Gray Iron Castings; 2003 (Reapproved 2012).

- D. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.
- E. ASTM A82/A82M - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement; 2007.
- F. ASTM A105/A105M - Standard Specification for Carbon Steel Forgings for Piping Applications; 2013.
- G. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2013.
- H. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings; 2004 (Reapproved 2014).
- I. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- J. ASTM A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip; 1999 (Reapproved 2009).
- K. ASTM A185/A185M - Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete; 2007.
- L. ASTM A193/A193M - Standard Specification for Alloy - Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications; 2014.
- M. ASTM A194/A194M - Standard Specification for Carbon and Alloy Nuts for Bolts for High Pressure or High Temperature Service, or Both; 2014.
- N. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2015.
- O. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes; 2015.
- P. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2014.
- Q. ASTM A312/A312M - Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes; 2015.
- R. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength; 2014.
- S. ASTM A490 - Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength; 2012.
- T. ASTM A490M - Standard Specification for High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints (Metric); 2012.

- U. ASTM A491 - Standard Specification for Aluminum-Coated Steel Chain-Link Fence Fabric; 2011.
- V. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2014.
- W. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement; 2015.
- X. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc- Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- Y. ASTM A884/A884M - Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement; 2014.
- Z. ASTM A951/A951M - Standard Specification for Steel Wire for Masonry Joint Reinforcement; 2011.
- AA. ASTM A992/A992M - Standard Specification for Structural Steel Shapes; 2011 (Reapproved 2015).
- AB. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2015.

2.12 **ASTM B SERIES -- ASTM INTERNATIONAL**

- A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire; 2013.
- B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft; 2011.
- C. ASTM B263, Standard Test Method for Determination of Cross-Sectional Area of Stranded Conductors.

2.13 **ASTM C SERIES -- ASTM INTERNATIONAL**

- A. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units; 2014.
- B. ASTM C91/C91M - Standard Specification for Masonry Cement; 2012.
- C. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2015.
- D. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates; 2006.
- E. ASTM C140/C140M - Standard Test Methods of Sampling and Testing Concrete Masonry Units and Related Units; 2014.
- F. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2011.
- G. ASTM C150/C150M - Standard Specification for Portland Cement; 2012.

- H. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2014a.
- I. ASTM C476 - Standard Specification for Grout for Masonry; 2010.
- J. ASTM C891 - Standard Practice for Installation of Underground Precast Concrete Utility Structures; 2011.
- K. ASTM C1019 - Standard Test Method for Sampling and Testing Grout; 2013.
- L. ASTM C1314 - Standard Test Method for Compressive Strength of Masonry Prisms; 2012.

2.14 AWS -- AMERICAN WELDING SOCIETY

- A. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2012.
- B. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2014.
- C. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2011 w/Errata.
- D. AWS D10.9 - Specification for Qualification of Welding Procedures and Welders for Piping and Tubing; 1980.

2.15 CBMA -- CERTIFIED BALLAST MANUFACTURERS ASSOCIATION

2.16 CISPI -- CAST IRON SOIL PIPE INSTITUTE

- A. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; 2011.

2.17 EIA -- ELECTRONIC INDUSTRIES ALLIANCE

- A. EIA/TIA-455-170 (1989) FOTP-170 Cable Cutoff Wavelength of Single-Mode Fiber by Transmitted Power.

2.18 IAPMO -- INTERNATIONAL ASSOCIATION OF PLUMBING AND MECHANICAL OFFICIALS

- A. IAPMO (UPC) - Uniform Plumbing Code; 2012.

2.19 ICC -- INTERNATIONAL CODE COUNCIL, INC.

- A. ICC (IBC) - International Building Code; 2015.
- B. ICC (IECC) - International Energy Conservation Code; 2012.
- C. ICC (IMC) - International Mechanical Code; 2012.
- D. ICC (IPSDC) - International Private Sewage Disposal Code; 2012.

2.20 **ICEA -- INSULATED CABLE ENGINEERS ASSOCIATION**

- A. ICEA T 29 520, Procedure for Conducting Vertical Cable Tray Flame Test With a Theoretical Heat Input of 210,000 Btu/hour

2.21 **IEEE -- INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS**

- A. IEEE 80 Guide for Safety in AC Substation Grounding.
- B. IEEE Standard 81 Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potential of a Ground System.
- C. IEEE Standard 665-1995 Guide for Generating Station Grounding.
- D. IEEE 48 - IEEE Standard Test Procedures and Requirements for Alternating-Current Cable Terminations 2.5 kV through 765 kV; 1996 (R2009).
- E. IEEE 386 - IEEE Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600 V; 2011.
- F. IEEE 404 - Standard for Cable Joints for Use with Extruded Dielectric Cable Rated 5,000V through 138,000V and Cable Joints for Use with Laminated Dielectric Cable Rated 2,500V through 500,000V.
- G. IEEE 1222 - Standard for All-Dielectric Self-Supporting Fiber Optic Cable.
- H. IEEE C2 - National Electrical Safety Code; 2012.

2.22 **NECA -- NATIONAL ELECTRICAL CONTRACTORS ASSOCIATION**

- A. NECA 5055, Standard of Installation.

2.23 **NEMA -- NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION**

- A. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.
- B. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches; 1993.
- C. NEMA CC 1 - Electric Power Connectors for Substations.
- D. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2000 (R2005), with errata, 2008.
- E. NEMA PB 1 - Panelboards; 2011.
- F. NEMA RN 1 - Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit; 2005.
- G. NEMA ST 20 - Dry-Type Transformers for General Applications; 2014.
- H. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit; 2013.

- I. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing; 2015.
- J. NEMA TC 6 - PVC and ABS Plastic Utilities Duct for Underground Installation; 1990.
- K. NEMA VE 1 - Metal Cable Tray Systems; 2009.
- L. NEMA WC 3 - Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy; 1992 (Rev 1, 1994).
- M. NEMA WC 5 - Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy; 1992.
- N. NEMA WC 7 - Cross-Linked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy; 1988.
- O. NEMA WC 8 - Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy; 1988.
- P. 6. WC 55, Instrumentation Cables and Thermocouple Wire.
- Q. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (R 2010).

2.24 **NETA -- INTERNATIONAL ELECTRICAL TESTING ASSOCIATION**

- A. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013. (ANSI/NETA ATS)

2.25 **NFPA -- NATIONAL FIRE PROTECTION ASSOCIATION**

- A. NFPA 1 - Fire Code; 2015.
- B. NFPA 10 - Standard for Portable Fire Extinguishers; 2013.
- C. NFPA 14 - Standard for the Installation of Standpipe and Hose Systems; 2013.
- D. NFPA 25 - Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems; 2011.
- E. NFPA 54 - National Fuel Gas Code; 2012.
- F. NFPA 55 - Standard for the Storage, Use, and Handling of Compressed Gases and Cryogenic Fluids in Portable and Stationary Containers, Cylinders, and Tanks; 2013.
- G. NFPA 58 - Liquefied Petroleum Gas Code; 2014.
- H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. NFPA 70E - Standard for Electrical Safety in the Workplace; 2015.

- J. NFPA 72E - Automatic Fire Detectors;
- K. NFPA 72G - Notification Appliances for Protective Signaling Systems;
- 2.26 **NSF INTERNATIONAL (THE PUBLIC HEALTH AND SAFETY ORGANIZATION)**
 - A. NSF 61 - Drinking Water System Components - Health Effects; 2014.
- 2.27 **SMA -- SCREEN MANUFACTURERS ASSOCIATION**
 - A. SMA 6001 - Specifications for Metal Protection Screens; 2002.
- 2.28 **SMACNA -- SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION, INC.**
 - A. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005.
 - B. SMACNA (LEAK) - HVAC Air Duct Leakage Test Manual; 2012, 2nd Edition.
 - C. SMACNA (TAB) - HVAC Systems Testing, Adjusting and Balancing; 2002.
- 2.29 **SSPC -- THE SOCIETY FOR PROTECTIVE COATINGS**
 - A. SSPC V1 (PM1) - Good Painting Practice: Painting Manual, Volume 1; Fourth Edition.
 - B. SSPC-SP 1 - Solvent Cleaning; 2015.
 - C. SSPC-SP 6 - Commercial Blast Cleaning; 2007.
 - D. SSPC-SP 10 - Near-White Blast Cleaning; 2007.
- 2.30 **STI -- STEEL TANK INSTITUTE**
- 2.31 **UL -- UNDERWRITERS LABORATORIES INC.**
 - A. UL 1 - Flexible Metal Conduit; Current Edition, Including All Revisions.
 - B. UL 6 - Electrical Rigid Metal Conduit-Steel; Current Edition, Including All Revisions.
 - C. UL 13 - Standard for Safety Power-Limited Circuit Cables.
 - D. UL 44 - Thermoset-Insulated Wires and Cables; Current Edition, Including All Revisions.
 - E. UL 67 - Panelboards; Current Edition, Including All Revisions.
 - F. UL 98 - Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.
 - G. UL 360 - Liquid-Tight Flexible Steel Conduit; Current Edition, Including All Revisions.
 - H. UL 486A-486B - Wire Connectors; Current Edition, Including All Revisions.
 - I. UL 486E - Standard for Safety for Equipment Wiring Terminals for use with Aluminum

and/or Copper Conductors.

- J. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.
- K. UL 508 - Industrial Control Equipment; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.
- L. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape; Current Edition, Including All Revisions.
- M. UL 514B - Conduit, Tubing, and Cable Fittings; Current Edition, Including All Revisions.
- N. UL 514C - Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers; Current Edition, Including All Revisions.
- O. UL 595 - Standard for Safety Marine Type Electric Lighting Fixtures.
- P. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings; Current Edition, Including All Revisions.
- Q. UL 651A - Schedule 40 and 80 High Density Polyethylene (HDPE) Conduit; Current Edition, Including All Revisions.
- R. UL 797 - Electrical Metallic Tubing-Steel; Current Edition, Including All Revisions.
- S. UL 870 - Wireways, Auxiliary Gutters, and Associated Fittings; Current Edition, Including All Revisions.
- T. UL 910 - Standard for Safety Test Method for Flame Propagation and Smoke Density Values for Electrical and Optical-Fiber Cables Used in Spaces Transporting Environmental Air.
- U. UL 924 - Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.
- V. UL 1072 - Standard for Safety Medium-Voltage Power Cables.
- W. UL 1277 - Standard for Safety Electrical Power and Control Tray Cables with Optional Optical- Fiber Members.
- X. UL 1581 - Reference Standard for Electrical Wires, Cables, and Flexible Cords; Current Edition, Including All Revisions.
- Y. UL 1660 - Liquid-Tight Flexible Nonmetallic Conduit; Current Edition, Including All Revisions.

PART 3 -- EXECUTION (NOT USED)

3.1 CFR -- CODE OF FEDERAL REGULATIONS

- A. 29 CFR 1910 - Occupational Safety and Health Standards; current edition.

- B. 29 CFR 1910.132-138 - Personal Protective Equipment; current edition.
- C. 29 CFR 1910.134 - Respiratory protection; current edition.
- D. 29 CFR 1910.145 - Accident Prevention Signs and Tags; current edition.
- E. 29 CFR 1926 - U.S. Occupational Safety and Health Standards; current edition. (for construction work)

3.2 EPA -- ENVIRONMENTAL PROTECTION AGENCY

- A. EPA (NPDES) - National Pollutant Discharge Elimination System (NPDES), Construction General Permit; Current Edition.

3.3 FHWA -- FEDERAL HIGHWAY ADMINISTRATION

- A. FHWA FLP-94-005 - Best Management Practices for Erosion and Sediment Control; 1995.

3.4 USDA -- UNITED STATES DEPARTMENT OF AGRICULTURE

- A. USDA TR-55 - Urban Hydrology for Small Watersheds; USDA Natural Resources Conservation Service; 2009.

- END OF SECTION -

SECTION 01 42 13 - ABBREVIATIONS OF INSTITUTIONS

PART 1 -- GENERAL

1.1 GENERAL

- A. Wherever in these Specifications references are made to the standards, specifications, or other published data of the various international, national, regional, or local organizations, such organizations may be referred to by their acronym or abbreviation only. As a guide to the user of the Specifications, the following acronyms or abbreviations which may appear shall have the meanings indicated herein.

1.2 ABBREVIATIONS

AA	Aluminum Association
AAMA	American Architectural Manufacturers Association
AASHTO	American Association of State Highway and Transportation Officials
AATCC	American Association of Textile Chemists and Colorists
ABMA	American Bearing Manufacturer's Association – ABMA
ACGIH	American Conference of Governmental Industrial Hygienists
ACI	American Concrete Institute
AF&PA	American Forest and Paper Association
AGA	American Gas Association
AGMA	American Gear Manufacturers Association
AHA	American Hardboard Association
AHAM	Association of Home Appliance Manufacturers
AI	The Asphalt Institute
AIA	American Institute of Architects
AIHA	American Industrial Hygiene Association
AIIM	Association for Information and Image Management
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
AMA	Acoustical Material Association
AMCA	Air Movement and Control Association International, Inc
ANS	American Nuclear Society
ANSI	American National Standards Institute, Inc.
APA	The Engineered Wood Association
API	American Petroleum Institute
APWA	American Public Works Association
ARI	Air-Conditioning and Refrigeration Institute
ASA	Acoustical Society of America
ASAE	American Society of Agricultural Engineers
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASNT	American Society of Nondestructive Testing
ASQ	American Society for Quality
ASSE	American Society of Sanitary Engineers
ASTM	American Society for Testing and Materials
AWCI	American Wire Cloth Institute

AWI	Architectural Woodwork Institute
AWPA	American Wood Preservers Association
AWPI	American Wood Preservers Institute
AWS	American Welding Society
AWWA	American Water Works Association
BBC	Basic Building Code, Building Officials and Code Administrators International
BHMA	Builders Hardware Manufacturer's Association
CABO	Council of American Building Officials
CDA	Copper Development Association
CEMA	Conveyors Equipment Manufacturer's Association
CGA	Compressed Gas Association
CLFMI	Chain Link Fence Manufacturer's Institute
CLPCA	California Lathing and Plastering Contractors Association
CMAA	A division/section of the Material Handling Industry of America
CRSI	Concrete Reinforcing Steel Institute
DCDMA	Diamond Core Drilling Manufacturer's Association
DHI	Door and Hardware Institute
DIPRA	Ductile Iron Pipe Research Association
EI	Energy Institute
EIA	Electronic Industries Alliance
EPA	Environmental Protection Agency
ETL	Electrical Test Laboratories
FCC	Federal Communications Commission
FCI	Fluid Controls Institute
FEMA	Federal Emergency Management Association
FHWA	Federal Highway Administration
FM	Factory Mutual System
FPL	Forest Products Laboratory
HI	Hydronics Institute, Hydraulic Institute
HSWA	Federal Hazardous and Solid Waste Amendments
IAPMO	International Association of Plumbing and Mechanical Officials
ICBO	International Conference of Building Officials
IBC	International Building Code
ICC	International Code Council
ICEA	Insulated Cable Engineers Association
ICCEC	Electrical Code
ICC-ES	International Code Council Evaluation Service
IEEE	Institute of Electrical and Electronics Engineers
IESNA	Illuminating Engineering Society of North America
IFC	International Fire Code
IFGC	International Fuel Gas Code
IMC	International Mechanical Code
IME	Institute of Makers of Explosives
IPC	International Plumbing Code, Association Connecting Electronic Industries
IRC	International Residential Code
ISA	Instrument Society of America
ISDI	Insulated Steel Door Institute
ISEA	Industrial Safety Equipment Association
ISO	International Organization for Standardization
ITE	Institute of Traffic Engineers

ITU-T	Telecommunications Standardization Sector of the International Telecommunications Union
LPI	Lightning Protection Institute
LRQA	Lloyd's Register Quality Assurance
MBMA	Metal Building Manufacturer's Association
MIL	Military Standards (DoD)
MPTA	Mechanical Power Transmission Association
MSS	Manufacturers Standardization Society
NAAMM	National Association of Architectural Metal Manufacturer's
NACE	National Association of Corrosion Engineers
DASMA	Door and Access Systems Manufacturers Association International
NAPF	National Association of Pipe Fabricators
NBBPVI	National Board of Boiler and Pressure Vessel Inspectors
NCCLS	National Committee for Clinical Laboratory Standards
NCMA	National Concrete Masonry Association
NEC	National Electrical Code
NEMA	National Electrical Manufacturer's Association
NETA	International Electrical Testing Association
NFPA	National Fire Protection Association or National Fluid Power Association
NISO	National Information Standards Organization
NIST	National Institute of Standards and Technology
NLGI	National Lubricating Grease Institute
NRCA	National Roofing Contractors Association
NSF	National Sanitation Foundation
NWWDA	National Wood Window and Door Association
OSHA	Occupational Safety and Health Administration
PCA	Portland Cement Association
PCI	Precast/Prestressed Concrete Institute
PMPL	Petersburg Municipal Power and Light
PPI	Plastic Pipe Institute
RCRA	Resource Conservation and Recovery Act
RIS	Redwood Inspection Service, a division of the California Redwood Association, CRA
RMA	Rubber Manufacturers Association
RVIA	Recreational Vehicle Industry Association
RWMA	Resistance Welder Manufacturer's Association
SAE	Society of Automotive Engineers
SDI	Steel Door Institute, Steel Deck Institute
SMA	Screen Manufacturers Association
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
SPFA	Steel Plate Fabricator's Association
SPIB	Southern Pine Inspection Bureau
SSBC	Southern Standard Building Code, Southern Building Code Congress
SSPC	Society for Protective Coating
SSPWC	Standard Specifications for Public Works Construction
STLE	Society of Tribologists and Lubricating Engineers
TAPPI	Technical Association of the Worldwide Pulp, Paper, and Converting Industry
TFI	The Fertilizer Institute
TIA	Telecommunications Industries Association
TPI	Truss Plate Institute

UBC	Uniform Building Code
UL	Underwriters Laboratories, Inc.
WCLIB	West Coast Lumber Inspection Bureau
WDMA	National Window and Door Manufacturers Association
WEF	Water Environment Federation
WI	Woodwork Institute
WRI	Wire Reinforcement Institute, Inc.
WWPA	Western Wood Products Association

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

- END OF SECTION -

SECTION 01 50 00 - MOBILIZATION

PART 1 -- GENERAL

1.1 GENERAL

- A. CONTRACTOR shall mobilize as required for the proper performance and completion of the WORK and in accordance with the Contract Documents.
- B. Mobilization shall include at least the following items:
 - 1. Moving onto the Site of CONTRACTOR's plant and equipment necessary for the first month of operations.
 - 2. Installing temporary construction power, wiring, and lighting facilities.
 - 3. Developing construction water supply, as needed.
 - 4. Providing field offices for the CONTRACTOR and the OWNER's RPR, complete with furnishings, equipment, and utility services.
 - 5. Providing on-site communication facilities, including telephones, internet access, and radio handsets.
 - 6. Providing on-Site sanitary facilities and potable water facilities or drinking water dispensers.
 - 7. Arranging for and erection of CONTRACTOR's work and storage yards.
 - 8. Constructing and implementing security features and requirements complying with Section 01 35 00 – Site Security.
 - 9. Obtaining required permits.
 - 10. Having State of Alaska and OSHA required notices and establishing safety programs.
 - 11. Having the CONTRACTOR's superintendent at the Site full time.
 - 12. Submitting Preconstruction conference submittals in accordance with 01 33 00 – Contractor Submittals.
 - 13. All other items required for completion of the mobilization WORK not otherwise called out in specific bid items

1.2 MOBILIZATION SUBMITTALS

- A. A layout of the construction sites including laydown, staging and stockpile areas within 30 days of the Notice to Proceed date.

1.3 DELIVERY

- A. Delivery to the jobsite of construction tools, equipment, materials and supplies shall be accomplished in conformance with local governing ordinances and regulations.

1.4 TOOLS AND SUPPLIES

- A. Provide construction tools, equipment, materials and supplies of the types and quantities that will facilitate timely execution of the work.
- B. Provide personnel, products, construction materials, equipment, tools and supplies at the jobsite at the time they are scheduled to be installed or utilized

1.5 DEMOBILIZATION

- A. Upon completion of the Work, remove construction tools, apparatus, equipment, unused materials and supplies, plant, temporary facilities, and personnel from the jobsite.

1.6 PAYMENT FOR MOBILIZATION

- A. The CONTRACTOR's attention is directed to the condition that no payment for mobilization, or any part thereof, will be recommended for payment under the Contract until mobilization items listed above have been completed.
- B. Payment shall be made on a lump sum basis, as described in Section 01 22 00 – Measurement and Payment.
- C. Payment for Mobilization will be a one-time payment only. Payment will not be made for multiple Mobilizations/Demobilizations.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

- END OF SECTION -

SECTION 01 52 00 - FIELD OFFICE, EQUIPMENT, AND SERVICES

PART 1 -- GENERAL

1.1 SUMMARY

- A. The CONTRACTOR shall provide a field office and equipment and furnish related services at the Site.
- B. The field office shall be located as indicated on Contract Drawing G-008.
- C. OWNER to provide 120/240VAC, 50kVA single-phase electrical service for CONTRACTOR use. CONTRACTOR to provide meter base and termination point for OWNER provided electrical service and revenue meter. Meter to provide OWNER with power consumption information only.

1.2 FIELD OFFICE SCHEDULE

- A. Field offices, equipped as indicated herein, shall be provided at the Site, ready for exclusive use by the ENGINEER and the OWNER's representative and staff within 14 Days after the commencement date stated in the Notice to Proceed. The CONTRACTOR'S attention is directed to the condition that no payment for that portion of the Contract Price designated for mobilization, or any part thereof, will be approved for payment until the field office facilities indicated herein have been provided. The provisions for such payment are included in Section 01 50 00 - Mobilization.
- B. Unless released earlier by the ENGINEER in writing, field office(s) shall be maintained in full operation at the Site with all utilities connected and operable until the Notice of Completion has been executed or recorded. Upon execution or recordation of the Notice of Completion, or upon early release of the field office by the OWNER's resident project representative (RPR), the CONTRACTOR shall remove the field office within 14 Days from said date and shall restore the Site occupied by the field office to the condition indicated.

PART 2 -- PRODUCTS

2.1 OFFICE FACILITIES

- A. **General:** The CONTRACTOR shall provide necessary electrical wiring, plumbing, toilet and lavatory fixtures, air conditioning and heating equipment, and shelving, and shall furnish light, heat, water, and daily janitorial services in connection with the field office.
- B. **Field Office:** The primary office shall be located at the project site and be of one separate, well lighted, electrically-heated field office with outside toilet room containing a water closet and lavatory partitioned off from the working area. The water closet may be of the chemical type provided that it is a flush type with an approved holding tank. The toilet room door shall be provided with a latch set. The office shall have an outside door lock. Area of the field office shall not be less than 350 square feet. Office shall be of the portable trailer type unless otherwise specifically authorized by the ENGINEER in writing and shall be a separate unit, not attached or connected to any other structures. The office shall have as minimum 2 private offices, one conference room, and one common

area that can accommodate at least 2 desks, 4 filing cabinets, 1 plan table, and 2 bookcases.

2.2 FIELD OFFICE FURNISHINGS

- A. The CONTRACTOR shall furnish the following items, at a minimum, in good condition in the primary field office:

3 each	Standard 30- by 60-inch desks with not less than 3 drawers each
1 each	Plan table 36- by 72-inch top; 36-inches tall
1 each	Plan rack (all metal plan-hold type) capable of holding 6 sets of plans, complete with 6 standard all metal plan-hold clamps
2 each	File cabinet, legal size, 4 or 5 drawer with lock and 3 keys, double suspension, complete with Pendaflex suspension racks for each drawer
3 each	Office chairs, standard armrest type, adjustable, swivel, tilt-back with casters
4 each	Metal office chairs, collapsible stiff-leg type, no armrest
2 each	Drafting stools
3 each	Waste baskets
2 each	White Marker board, 36- by 42-inches
2 each	4 shelf bookshelves
1 each	Bottled water dispenser unit (supplying both hot and cold water) and bottled water service and supply of paper cups

2.3 FIELD OFFICE SERVICES

- A. Each field office shall be provided with sufficient lighting to produce not less than 50 foot-candles at desktop height at each desk location. Exterior lighting shall be provided over the entrance door.
- B. A minimum of four 110 VAC duplex grounded electric convenience outlets shall be provided in each office and in the conference room and common area. At least one such outlet shall be located on each wall. The electric distribution panel shall service not less than two 110 VAC circuits.
- C. Where inside toilet facilities are not connected to outside plumbing, a flush-type chemical toilet with a holding tank shall be provided. Sanitary waste material shall be regularly

pumped out and the chemicals recharged. Toilet paper and paper towels shall be furnished for each toilet facility.

- D. Regular daily janitorial services shall be furnished during working hours each Day. Offices shall be swept, dusted, and waste receptacles emptied. Toilet facilities shall be sanitized and cleaned daily, and paper supplies shall be replenished.

2.4 TELEPHONE AND INTERNET SERVICE

- A. Within 14 Days after the commencement date stated in the Notice to Proceed, the CONTRACTOR shall coordinate with local phone company to provide either cellular phone service or a minimum of two (2) hard-wire phone land-lines into the primary trailer for its main Superintendent and Foreman at the site.
 - 1. In addition, local internet service shall be provided to the Primary Construction Trailer for effective email and project communications.
 - 2. 2-way radio communications across the project site shall also be provided by the CONTRACTOR to help insure the safety of the employees on the site.

2.5 OFFICE COPY MACHINE

- A. The CONTRACTOR shall provide at least one new office copy machine for use by all project team members including the OWNER's RPR. The copy machine shall be designed to produce 20,000 copies per month and shall be dust resistant.
- B. Copy machine shall employ a dry, electrostatic process and be capable of automatically feeding 8.5-inch by 11-inch and 11-inch by 17-inch originals and copying onto plain bond paper sheets at variable magnification from 50 percent to 200 percent. The machine shall have an automatic copy sorter. The paper tray for each size paper shall hold at least 200 sheets.
- C. The CONTRACTOR shall obtain and pay for a service and repair contract with a local representative of the copy machine dealer or manufacturer for on-call daily on-Site service. The CONTRACTOR shall furnish powders, cartridges, chemicals, or other materials required for proper operation of the copy machine, including paper.
- D. **Manufacturers, or Equal:** The copy machine shall be of latest model, no more than 1-year old from:
 - 1. **Brothers**
 - 2. **Gestetner**
 - 3. **Sharp**
 - 4. **Xerox**

2.6 PRINTER / SCANNER

- A. **General:** The CONTRACTOR shall provide for the use of all team member staff, including the OWNER'S RPR and the ENGINEER, at least one printer / scanner in the primary field office.
- B. **Printer:** The printer shall be a laser jet automatic feed type, compatible with the computer and shall be complete with connecting cables to at least two office computers, or shall be of wireless type to allow for printing from multiple local computers. The printer shall operate off the parallel port, and shall be capable of printing both 8-1/2 by 11-inch and 11- by 17-inch sheets. Printer shall also have scanner capabilities to provide high resolution scanning of up to 11 x17-inch sheets in color, for use by all project team members.
- C. **Service Contract:** The CONTRACTOR shall obtain and pay for a service and repair contract with a local representative of the dealer or manufacturer for on-call, daily, on-Site service. The service contract shall cover both the printer / scanner equipment.

PART 3 -- EXECUTION (NOT USED)

3.1 GENERAL

- A. Field office and storage trailers or buildings shall be sited in approved locations and properly set up for all potential weather conditions.
- B. Sanitary conveniences, in sufficient numbers, for the use of all persons employed on the work including the OWNER, and properly screened from public observation, shall be maintained at suitable locations, in accordance with state and local ordinances. The CONTRACTOR shall rigorously enforce the use of the approved sanitary facilities provided. When no longer required, they shall be removed from the site and the contents disposed of in a satisfactory manner consistent with all applicable environmental laws and regulations. CONTRACTOR shall also provide trash bins and arrange for the proper disposal of the contents and for the removal of the bins upon project completion.
- C. The CONTRACTOR shall provide sufficient drinking water for all its employees, and the employees of the OWNER and all subcontractors, from approved sources. CONTRACTOR shall also obey and enforce other local sanitary regulations and orders, taking such precautions against infectious diseases as may be deemed necessary.
- D. The CONTRACTOR shall conduct its operations in a manner that, with the use of proper equipment will provide maximum safety for workmen and the traveling public.
- E. All compressed air hose couplings must be affixed with a safety device to prevent uncoupling.

- END OF SECTION -

SECTION 01 55 00 - SITE ACCESS AND STORAGE

PART 1 -- GENERAL

1.1 HIGHWAY LIMITATIONS

- A. The CONTRACTOR shall make its own investigation of the condition of available public and private roads and of clearances, restrictions, bridge load limits, and other limitations affecting transportation and ingress and egress to the site of the WORK.
- B. New access or haul roads will be not be required for the WORK.

1.2 TEMPORARY CROSSINGS

- A. **General:** Continuous, unobstructed, safe, and adequate pedestrian and vehicular access shall be provided to fire hydrants, commercial and industrial establishments, churches, schools, parking lots, service stations, motels, fire and police stations, and hospitals. Safe and adequate public transportation stops and pedestrian crossings at intervals not exceeding 300-feet shall be provided. The CONTRACTOR shall cooperate with parties involved in the delivery of mail and removal of trash and garbage so as to maintain existing schedules for such services. Vehicular access to residential driveways shall be maintained to the property line except when necessary construction precludes such access for reasonable periods of time.
- B. **Temporary Crossings and Bridges:** Wherever necessary, to maintain vehicular crossings, the CONTRACTOR shall provide suitable temporary bridges or steel plates over unfilled excavations, except in such cases as the CONTRACTOR shall secure the written consent of the responsible individuals or authorities to omit such temporary bridges or steel plates, which written consent shall be delivered to the ENGINEER prior to excavation. Such bridges or steel plates shall be maintained in service until access is provided across the backfilled excavation.
- C. **Street Use:** Nothing herein shall be construed to entitle the CONTRACTOR to the exclusive use of any public street, alleyway, or parking area during the performance of the WORK hereunder, and it shall conduct its operations to not interfere unnecessarily with the authorized work of utility companies or other agencies in such streets, alleyways, or parking areas. No street shall be closed to the public without first obtaining permission of the OWNER and proper governmental authority.
- D. **Traffic Control:** For the protection of traffic in public or private streets and ways, the CONTRACTOR shall provide, place, and maintain necessary barricades, traffic cones, warning signs, lights, and other safety devices in accordance with the requirements of the "Manual of Uniform Traffic Control Devices, Part VI - Traffic Controls for Street and Highway Construction and Maintenance Operations," published by U.S. Department of Transportation, Federal Highway Administration (ANSI D6.1)
 - 1. The CONTRACTOR shall take necessary precautions for the protection of the WORK and the safety of the public, as well as those living and working at the Crystal Lake Fish Hatchery. Barricades and obstructions shall be illuminated at night. Signs, signals, and barricades shall conform to the requirements of Subpart G, Part 1926, of the OSHA Safety and Health Standards for Construction.

2. The CONTRACTOR shall remove traffic control devices when no longer needed, repair damage caused by installation of the devices, and shall remove post settings and backfill the resulting holes to match grade.
- E. **Temporary Street Closure:** If closure of any street is required during construction, the CONTRACTOR shall apply in writing to the OWNER and any other jurisdictional agency at least 30 Days in advance of the required closure. A Detour and Traffic Control Plan shall accompany the application.
- F. **Temporary Driveway Closure:** The CONTRACTOR shall notify the owner or occupant (if not owner-occupied) of the closure of the driveways to be closed more than one 8 hour work day at least three (3) working days prior to the closure. The CONTRACTOR shall minimize the inconvenience and minimize the time period that the driveways will be closed. The CONTRACTOR shall fully explain to the OWNER and driveway occupant how long the closure will take and when closure will start.

1.3 CONTRACTOR'S WORK AND STORAGE AREA

- A. The OWNER has designated and arranged for the CONTRACTOR's use, a portion of the property adjacent to the WORK for its exclusive use during the term of the Contract as a storage and administration area for its construction operations on the WORK. At completion of WORK, the CONTRACTOR shall return this area to its original condition, including grading and landscaping.
- B. The CONTRACTOR shall make its own arrangements for any necessary off-Site storage or shop areas necessary for the proper execution of the WORK.
- C. The CONTRACTOR shall construct and use a separate storage area for hazardous materials storage used in performing the WORK.
1. For the purpose of this paragraph, hazardous materials to be stored in the separate area are products labeled with any of the following terms: Warning, Caution, Poisonous, Toxic, Flammable, Corrosive, Reactive, or Explosive. In addition, whether or not so labeled, the following materials shall be stored in the separate area: diesel fuel, gasoline, new and used motor oil, hydraulic fluid, cement, paints and paint thinners, 2-part epoxy coatings, sealants, asphaltic products, glues, solvents, wood preservatives, sand blast materials, and spill absorbent.
 2. Hazardous materials shall be stored in groupings according to the Material Safety Data Sheets.
 3. The CONTRACTOR shall develop and submit to the ENGINEER a plan for storing and disposing of the materials above.
 4. The CONTRACTOR shall obtain and submit to the ENGINEER a single EPA number for wastes generated at the Site.
 5. The separate storage area shall meet the requirements of authorities having jurisdiction over the storage of hazardous materials.

6. The separate storage area shall be inspected by the OWNER prior to construction of the area, upon completion of construction of the area, and upon cleanup and removal of the area.
7. Hazardous materials that are delivered in containers shall be stored in the original containers until use. Hazardous materials delivered in bulk shall be stored in containers which meet the requirements of authorities having jurisdiction.

1.4 PARKING

- A. The CONTRACTOR shall provide at least two parking spaces for the OWNER's RPR and OWNER's staff at all times:
 1. When space on the Site is not available, the CONTRACTOR shall make additional spaces available for the OWNER's use.
 2. The CONTRACTOR shall direct its employees to park in areas requested by the OWNER.
 3. Traffic and parking areas shall be maintained in a sound condition, free of excavated material, construction equipment, mud, and construction materials. The CONTRACTOR shall repair breaks, potholes, low areas which collect standing water, and other deficiencies.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

- END OF SECTION -

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SECTION 01 56 00 - PROTECTION OF EXISTING FACILITIES

PART 1 -- GENERAL

1.1 GENERAL

- A. The CONTRACTOR shall protect all existing structures, utilities and improvements not designated for removal and shall restore damaged structures, utilities or temporarily relocated utilities and improvements to a condition equal to or better than prior to such damage or temporary relocation, all in accordance with the Contract Documents.

1.2 RIGHTS-OF-WAY

- A. The CONTRACTOR shall not do any WORK that would affect any oil, gas, sewer, or water pipeline; any telephone, telegraph, or electric transmission line; any fence; or any other structure, nor shall the CONTRACTOR enter upon the rights-of-way involved until notified that the OWNER has secured authority therefor from the proper party.
- B. After authority has been obtained, the CONTRACTOR shall give said party due notice of its intention to begin work, if required by said party, and shall remove, shore, support, or otherwise protect such pipeline, transmission line, ditch, fence, or structure, or replace the same.

1.3 PROTECTION OF STREET OR ROADWAY MARKERS

- A. The CONTRACTOR shall not destroy, remove, or otherwise disturb any existing survey markers or other existing street or roadway markers without proper authorization. No pavement breaking or excavation shall be started until all survey or other permanent marker points that will be disturbed by the construction operations have been properly referenced. Survey markers or points disturbed by the CONTRACTOR shall be accurately restored after street or roadway resurfacing has been completed.

1.4 RESTORATION OF PAVEMENT

- A. **General:** All paved areas including asphaltic concrete berms cut or damaged during construction shall be replaced with similar materials of equal thickness to match the existing adjacent undisturbed areas, except where specific resurfacing requirements have been called for in the Contract Documents or in the requirements of the agency issuing the permit. The pavement restoration requirement to match existing sections shall apply to all components of existing sections, including sub-base, base, and pavement. Temporary and permanent pavement shall conform to the requirements of the affected pavement owner. Pavements which are subject to partial removal shall be neatly saw cut in straight lines.
- B. **Temporary Resurfacing:** Wherever required by the public authorities having jurisdiction, the CONTRACTOR shall place temporary surfacing promptly after backfilling and shall maintain such surfacing for the period of time fixed by said authorities before proceeding with the final restoration of improvements.
- C. **Permanent Resurfacing:** In order to obtain a satisfactory junction with adjacent surfaces, the CONTRACTOR shall saw cut back and trim the edge so as to provide a

clean, sound, vertical joint before permanent replacement of an excavated or damaged portion of pavement. Damaged edges of pavement along excavations and elsewhere shall be trimmed back by saw cutting in straight lines. All pavement restoration and other facilities restoration shall be constructed to finish grades compatible with adjacent undisturbed pavement.

- D. **Restoration of Sidewalks or Private Driveways / Roads:** Wherever sidewalks or private roads have been removed or impacted for purposes of construction, the CONTRACTOR shall place suitable temporary sidewalks or roadways promptly after backfilling and shall maintain them in satisfactory condition for the period of time fixed by the authorities having jurisdiction over the affected portions. If no such period of time is so fixed, the CONTRACTOR shall maintain said temporary sidewalks or roadways until the final restoration thereof has been made.

1.5 EXISTING UTILITIES AND IMPROVEMENTS

- A. **General:** The CONTRACTOR shall protect underground Utilities and other improvements which may be impaired during construction operations, regardless of whether or not the Utilities are indicated on the Drawings. The CONTRACTOR shall take all possible precautions for the protection of unforeseen Utility lines to provide for uninterrupted service and to provide such special protection as may be necessary.
- B. The term "Utilities" shall also include all exposed penstock pipe to remain in-service including all buried penstock pipe, buried tailrace pipe, and other water piping systems that are not delineated for demolition by the CONTRACTOR.
- C. Except where the Drawings indicate Utilities have been field located during design or certain Utility locations shall be exposed as part of the WORK, the CONTRACTOR shall be responsible for exploratory excavations as it deems necessary to determine the exact locations and depths of Utilities which may interfere with its work. All such exploratory excavations shall be performed as soon as practicable after Notice to Proceed and, in any event, a sufficient time in advance of construction to avoid possible delays to the CONTRACTOR's progress. When such exploratory excavations show the Utility location as shown on the Drawings to be in error, the CONTRACTOR shall so notify the ENGINEER.
- D. The number of exploratory excavations required shall be that number which is sufficient to determine the alignment and grade of the Utility.
- E. **Utilities to be Moved:** In case it shall be necessary to move the property of any public utility or franchise holder, such utility company or franchise holder will, upon request of the CONTRACTOR, be notified by the OWNER to move such property within a specified reasonable time. When utility lines that are to be removed are encountered within the area of operations, the CONTRACTOR shall notify the ENGINEER a sufficient time in advance for the necessary measures to be taken to prevent interruption of service.
- F. **Utilities to be Removed:** Where the proper completion of the WORK requires the temporary or permanent removal and/or relocation of an existing Utility or other improvement which is indicated, the CONTRACTOR shall remove and, without unnecessary delay, temporarily replace or relocate such Utility or improvement in a manner satisfactory to the ENGINEER and the owner of the facility. In all cases of such temporary removal or relocation, restoration to the former location shall be accomplished

by the CONTRACTOR in a manner that will restore or replace the Utility or improvement as nearly as possible to its former locations and to as good or better condition than found prior to removal.

- G. **OWNER's Right of Access:** The right is reserved to the OWNER and to the owners of public utilities and franchises to enter at any time upon any public street, alley, right-of-way, or easement for the purpose of making changes in their property made necessary by the WORK of this Contract.
- H. **Underground Utilities Indicated:** Existing Utility lines that are indicated or the locations of which are made known to the CONTRACTOR prior to excavation and that are to be retained, and all Utility lines that are constructed during excavation operations shall be protected from damage during excavation and backfilling and, if damaged, shall be immediately repaired or replaced by the CONTRACTOR, unless otherwise repaired by the owner of the damaged Utility. If the owner of the damaged facility performs its own repairs, the CONTRACTOR shall reimburse said owner for the costs of repair.
- I. **Underground Utilities Not Indicated:** In the event that the CONTRACTOR damages existing Utility lines that are not indicated or the locations of which are not made known to the CONTRACTOR prior to excavation, a verbal report of such damage shall be made immediately to the ENGINEER and a written report thereof shall be made promptly thereafter. The ENGINEER will immediately notify the owner of the damaged Utility. If the ENGINEER is not immediately available, the CONTRACTOR shall notify the Utility owner of the damage. If directed by the ENGINEER, repairs shall be made by the CONTRACTOR under the provisions for changes and extra work contained in Articles 10, 11, and 12 of the General Conditions.
- J. Costs of locating and repairing damage not due to failure of the CONTRACTOR to exercise reasonable care, and removing or relocating such Utility facilities not indicated in the Contract Documents with reasonable accuracy, and for equipment on the project which was actually working on that portion of the WORK which was interrupted or idled by removal or relocation of such Utility facilities, and which was necessarily idled during such work will be paid for as extra work in accordance with the provisions of Articles 10, 11, and 12 of the General Conditions.
- K. **Approval of Repairs:** All repairs to a damaged Utility or improvement are subject to inspection and approval by an authorized representative of the Utility or improvement owner before being concealed by backfill or other work.
- L. **Maintaining in Service:** Unless indicated otherwise, oil and gasoline pipelines, power, and telephone or the communication cable ducts, gas and water mains, irrigation lines, sewer lines, storm drain lines, poles, and overhead power and communication wires and cables encountered along the line of the WORK shall remain continuously in service during all the operations under the Contract, unless other arrangements satisfactory to the ENGINEER are made with the owner of said pipelines, duct, main, irrigation line, sewer, storm drain, pole, or wire or cable. The CONTRACTOR shall be responsible for and shall repair all damage due to its operations, and the provisions of this Section shall not be abated even in the event such damage occurs after backfilling or is not discovered until after completion of the backfilling.

1.6 TREES OR SHRUBS WITHIN STREET RIGHTS-OF-WAY AND PROJECT LIMITS

- A. **General:** Except where trees or shrubs are indicated to be removed, the CONTRACTOR shall exercise all necessary precautions so as not to damage or destroy any trees or shrubs, including those lying within street rights-of-way and project limits, and shall not trim or remove any trees unless such trees have been approved for trimming or removal by the jurisdictional agency or OWNER. Existing trees and shrubs which are damaged during construction shall be trimmed or replaced by the CONTRACTOR or a certified tree company under permit from the jurisdictional agency and/or the OWNER.

1.7 NOTIFICATION BY THE CONTRACTOR

- A. Prior to any excavation in the vicinity of any existing underground facilities, including all water, other pipelines; all buried electric power, communications, or television cables; the CONTRACTOR shall notify the respective authorities representing the owners or agencies responsible for such facilities not less than 3-Days nor more than 7-Days prior to excavation so that a representative of said owners or agencies can be present during such work if they so desire.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

- END OF SECTION -

SECTION 01 57 20 - TEMPORARY ENVIRONMENTAL CONTROLS

PART 1 -- GENERAL

1.1 SUMMARY

- A. WORK includes furnishing all labor, materials and equipment required for the installation and maintenance of temporary environmental controls, including erosion and sediment controls.

1.2 REFERENCE STANDARDS

- A. ASTM D4355 - Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture, and Heat in a Xenon Arc Type Apparatus; 2007.
- B. ASTM D4491 - Standard Test Methods for Water Permeability of Geotextiles by Permittivity; 1999a (Reapproved 2009).
- C. ASTM D4533 - Standard Test Method for Trapezoid Tearing Strength of Geotextiles; 2011.
- D. ASTM D4632 - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles; 2008.
- E. ASTM D4751 - Standard Test Method for Determining Apparent Opening Size of a Geotextile; 2012.
- F. ASTM D4873 - Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples; 2002 (Reapproved 2009).
- G. EPA (NPDES) - National Pollutant Discharge Elimination System (NPDES), Construction General Permit; current edition.
- H. FHWA FLP-94-005 - Best Management Practices for Erosion and Sediment Control; Federal Highway Administration; 1995.

1.3 SUBMITTALS

- A. **Storm Water Pollution Prevention Plan (SWPPP):** Submit a SWPPP indicating storm water pollution prevention measures.
- B. **Erosion and Sediment Control Plan (ESC Plan):** Submit an ESC Plan indicating erosion and sediment control measures and products, as well as installation, maintenance, repair, and removal procedures. The basis or beginning assumptions of the ESC Plan shall be the Erosion and Sediment Control Drawings provided in the Contract Documents.

1.4 TEMPORARY DRAINAGE PROVISIONS

- A. CONTRACTOR shall provide for the drainage of storm water and such water as may be applied or discharged on the site in performance of the work. Drainage facilities shall be adequate to prevent damage to the work, the site, and adjacent property. All temporary

drainage and storm water handling features must fully comply with the Storm Water Pollution Prevention Plan (SWPPP).

1.5 DUST ABATEMENT

- A. The CONTRACTOR shall prevent its operation from producing dust in amounts damaging to property, cultivated vegetation, or domestic animals, or causing a nuisance to persons living in or occupying buildings in the vicinity of the Site. The CONTRACTOR shall be responsible for any damage resulting from dust originating from its operations. Dust abatement measures shall be continued until the CONTRACTOR is relieved of further responsibility by the ENGINEER.
- B. **Storage Piles:** Enclose, cover, water (as needed), or apply non-toxic soil binders according to manufacturer's specifications on material piles (i.e. gravel, sand, dirt) with a silt content of 5 percent or greater.
- C. **Active Areas of Site:** Water active construction areas and unpaved roads as needed and as requested by ENGINEER.
- D. **Inactive Areas of Site:** Apply non-toxic soil stabilizers according to manufacturer's specifications to inactive construction areas, or water as needed to maintain adequate dust control.
- E. **Vehicle Loads:** Cover or maintain at least 2-feet of freeboard vertical distance between the top of the load and the top of the trailer sides on trucks hauling dirt, sand, soil, or other loose materials off of the Site.
- F. **Roads:** When there is visible track-out onto a paved public road, install approved Best Management Practices where the vehicles exit and enter onto the paved roads. Sweep the paved street at the end of each shift with a water spray pick-up broom-type street sweeper as necessary or as directed.
- G. **Vehicle Speeds:** If watering of unpaved roads is not sufficient to control dust, reduce vehicle speeds as necessary to control dust.

1.6 STORMWATER POLLUTION PREVENTION PLAN (SWPPP)

- A. **General.** CONTRACTOR shall minimize stormwater pollution from the Site in accordance with this Section, Codes, Laws and Regulations.
- B. **Provisions.** Items to be considered and addressed in the CONTRACTOR'S SWPPP shall include, but not be limited to the following:
 - 1. Collecting, storing, hauling, and disposing of spoil, silt, and waste materials in compliance with applicable Federal, State, and Local rules and regulations and the Contract Documents.
 - 2. Install and maintain erosion and sediment control measures, such as swales, grade stabilization structures, berms, dikes, waterways, filter fabric fences, and sediment basins.
 - 3. Filter fabric barrier systems, if used, shall be installed in such a manner that surface

runoff will percolate through the system in sheet flow fashion and allow sediment to be retained and accumulated

4. Remove and dispose of sediment deposits at the designated spoil area. If a spoil area is not indicated, dispose of sediment off-Site at a location not in or adjacent to a stream or floodplain. Sediment to be placed at the spoil area should be spread evenly, compacted, and stabilized. Sediment shall not be allowed to flush into a stream or drainage way.
5. Maintain erosion and sediment control measures in accordance with Contract requirements (see drawings) and Federal, State, and Local requirements until final acceptance.
 - a. Should the erosion and sedimentation control measures initially installed prove to be inadequate, the CONTRACTOR shall immediately install additional facilities as necessary to protect adjacent properties, sensitive areas, natural water sources and/or storm drainage systems, as a part of the Temporary Erosion and Sediment Control Maintenance bid item.

- C. **Other Permits.** The CONTRACTOR shall review and follow all requirements of the various permits and licenses received by the OWNER included in the Appendices

1.7 WATER RUNOFF POLLUTION CONTROL

- A. CONTRACTOR shall prevent the pollution of drains and watercourses by sanitary wastes, sediment, debris, and other substances resulting from construction activities. No sanitary wastes will be permitted to enter any drain or watercourse. No sediment, debris, or other substances will be permitted to enter any drain or watercourse.
- B. The CONTRACTOR shall maintain oil absorption pads on the actual job site whenever any equipment is present to immediately catch and contain any oil and/or fuel leaks.
- C. The OWNER is not required to obtain a construction stormwater permit for the WORK. The CONTRACTOR will develop and submit a construction Storm Water Pollution Protection Plan (SWPPP) and Erosion and Sedimentation Control Plan (ESCP) and maintain a copy of the Plan on site whenever construction is in progress. Should the erosion and sedimentation control measures initially installed prove to be inadequate, the CONTRACTOR shall immediately install additional facilities as necessary to protect adjacent properties, sensitive areas, natural water sources and/or storm drainage systems. In addition, the CONTRACTOR shall review and follow all requirements of the various permits received by the OWNER included in the Appendix.

1.8 RUBBISH CONTROL

- A. During the progress of the WORK, the CONTRACTOR shall keep the Site and other areas for which it is responsible in a neat and clean condition and free from any accumulation of rubbish (garbage). The CONTRACTOR shall dispose of rubbish and waste materials of any nature and shall establish regular intervals of collection and disposal of such materials and waste. The CONTRACTOR shall also keep its haul roads free from dirt, rubbish, and unnecessary obstructions resulting from its operations. Disposal of rubbish and surplus materials shall be off the Site in accordance with local codes and ordinances governing locations and methods of disposal and in conformance

with applicable safety laws and the particular requirements of Part 1926 of the OSHA Safety and Health Standards for Construction.

1.9 SANITATION

- A. **Toilet Facilities:** Fixed or portable chemical toilets shall be provided wherever needed for the use of employees. Toilets shall conform to the requirements of Part 1926 of the OSHA Safety and Health Regulations for Construction.
- B. **Sanitary and Other Organic Wastes:** The CONTRACTOR shall establish a regular daily collection of sanitary and organic wastes. Wastes and refuse from sanitary facilities provided by the CONTRACTOR or organic material wastes from any other source related to the CONTRACTOR's operations shall be disposed of away from the Site in a manner satisfactory to the ENGINEER and in accordance with Laws and Regulations pertaining thereto.

1.10 VEHICULAR ACCESS AND PARKING (See Section 01 55 00 – Site Access and Storage)

1.11 CHEMICALS

- A. Chemicals used on the WORK or furnished for facility operation, whether defoliant, soil sterilant, herbicide, pesticide, or of other classification, shall show approval of either the U.S. Environmental Protection Agency or the U.S. Department of Agriculture. Use of such chemicals and disposal of residues shall be in strict accordance with the printed instructions of the manufacturer.

1.12 CULTURAL RESOURCES

- A. The CONTRACTOR's attention is directed to the National Historic Preservation Act of 1966 (16 U.S.C. 470) and 36 CFR 800 which provides for the preservation of potential historical architectural, archaeological, or cultural resources (hereinafter called "cultural resources").
- B. In the event potential cultural resources are discovered during subsurface excavations at the Site, the following procedures shall be instituted:
 - 1. The OWNER will issue a temporary Notice to Suspend Work directing the CONTRACTOR to cease construction operations at the location of such potential cultural resources find.
 - 2. The suspension Notice will contain the following:
 - a. A clear description of the WORK to be suspended
 - b. Instructions regarding issuance of further orders by the CONTRACTOR for material services
 - c. Guidance as to the action to be taken on subcontracts
 - d. Suggestions to the CONTRACTOR to minimize incurred costs

- e. Estimated duration of the temporary suspension.
 3. Such suspension shall be effective until such time as a qualified archeologist can assess the value of the potential cultural resources and make recommendations to the Department of Natural Resources, Division of Parks and Outdoor Recreation, Office of History and Archaeology (907) 269-8721.
 4. The OWNER will implement appropriate actions as directed by the Office of History and Archaeology. The CONTRACTOR shall cease WORK in the area of a discovery until appropriate actions have been determined in accordance with this paragraph.
 5. If human remains are discovered, WORK in the immediate vicinity of the find shall stop. The Local Law Enforcement Agency shall be notified.
- C. If the archeologist determines that the potential find is a bonafide cultural resource, at the direction of the Office of History and Archaeology, the OWNER will extend the duration of the suspension.
- D. Changes to the Contract Price and Contract Times for suspension due to discovery of a potential cultural resource will be made in the following manner:
1. Contract Times
 - a. If the WORK temporarily suspended is on the “critical path”, the total number of Days for which the suspension is in effect will be added to the Contract Times.
 - b. If a portion of WORK at the time of such suspension is not on the “critical path”, but subsequently becomes WORK on the critical path, the Contract Times will be computed from the date such WORK is classified as on the critical path.
 2. Contract Price
 - a. If, as a result of a cultural resources suspension, the CONTRACTOR sustains a loss that could not have been avoided by judicious handling of forces and equipment or redirection of forces or equipment to perform other WORK on the contract, there will be paid an amount based on time and materials for the loss in accordance with the following:
 - 1) Idle Time of Equipment: Compensation for equipment idle time will be determined in accordance with the General Conditions for equipment time and equipment rental time.
 - 2) Idle Time of Labor: Compensation for idle time of workers will be determined in accordance with the General Conditions for labor.
 - b. Costs of labor will be compensated only to the extent such cost was in fact caused by the suspension.
 - c. Compensation for loss due to idle time of either equipment or labor will not include markup for profit.

- d. The hours for which compensation will be paid will be the actual normal working time during which such suspension lasts, but will in no case exceed eight hours in any single Day.
- e. The days for which compensation will be paid exclude Saturdays, Sundays, and legal holidays during the suspension.

PART 2 -- PRODUCTS

2.1 SUMMARY

- A. **Mulch:** Use one of the following approved mulch materials:
 - 1. Straw or hay (certified weed-free).
 - 2. Wood waste, chips, or bark.
 - 3. Erosion control matting or netting.
- B. Grass Seed for Temporary Cover: Utilize a seed mix selected from Section 32 92 19.
- C. Bales: Air dry, rectangular straw bales (certified weed-free).
- D. Bale Stakes shall be one of the following, minimum 3 feet long:
 - 1. Wood, 2 by 2 inches in cross section.
- E. **Silt Fence Stakes.** Materials for silt fences shall meet minimum requirements of the Washington State Department of Transportation Standard Specifications. Stakes shall be 2 inch x 2 inch by 4 ft fir or metal, and spaced not more than 6 feet on center.
- F. **Silt Fence Fabric.** Polypropylene geotextile resistant to common soil chemicals, mildew, and insects; non-biodegradable; in longest lengths possible; fabric including seams with the following minimum average roll lengths:
 - 1. Average Opening Size: 30 U.S. Std. Sieve, maximum, when tested in accordance with ASTM D4751.
 - 2. Permittivity: 0.05 sec^{-1} , minimum, when tested in accordance with ASTM D4491.
 - 3. Ultraviolet Resistance: Retaining at least 70 percent of tensile strength, when tested in accordance with ASTM D4355 after 500 hours exposure.
 - 4. Tensile Strength: 100 lb-f, minimum, in cross-machine direction; 124 lb-f, minimum, in machine direction; when tested in accordance with ASTM D4632.
 - 5. Elongation: 15 to 30 percent, when tested in accordance with ASTM D4632.
 - 6. Tear Strength: 55 lb-f, minimum, when tested in accordance with ASTM D4533.
 - 7. Color: Manufacturer's standard, with embedment and fastener lines preprinted.

PART 3 -- EXECUTION

3.1 SUMMARY

- A. Examine site and identify existing features that contribute to erosion resistance; maintain such existing features to greatest extent possible.

3.2 PREPARATION

- A. Schedule work so that soil surfaces are left exposed for the minimum amount of time.

3.3 SCOPE OF PREVENTIVE MEASURES

- A. In all cases, if permanent erosion resistant measures have been installed, temporary preventive measures are not required.

- B. Construction Entrances:** Traffic-bearing aggregate surface.

- 1. Width: As required; 15 feet, minimum.
- 2. Length: 50 feet, minimum.
- 3. Provide at each construction entrance from each entrance from access roads as shown in the Contract Documents.

- C. Linear Sediment Barriers:** Made of silt fences.

- 1. Provide linear sediment barriers:
 - a. Along downhill perimeter edge of disturbed areas, including soil stockpiles.
 - b. Along the top of the slope or top bank of drainage channels and swales that traverse disturbed areas.
 - c. Along the toe of cut slopes and fill slopes.
- 2. Space sediment barriers with the following maximum slope length upslope from barrier:
 - a. Slope of Less Than 2 Percent: 100 feet..
 - b. Slope Between 2 and 5 Percent: 75 feet.
 - c. Slope Between 5 and 10 Percent: 50 feet.
 - d. Slope Between 10 and 20 Percent: 25 feet.
 - e. Slope Over 20 Percent: 15 feet.

- D. Soil Stockpiles:** Protect using one of the following measures:

- 1. Cover with polyethylene film, secured by placing soil on outer edges.

2. Cover with mulch at least 4 inches thickness of pine needles, sawdust, bark, wood chips, or shredded leaves, or 6 inches of straw or hay.
- E. Mulching: Use only for areas that may be subjected to erosion for less than 6 months.
1. Wood Waste: Use only on slopes 3:1 or flatter; no anchoring required.
- F. Temporary Seeding: Use where temporary vegetated cover is required.

3.4 INSTALLATION OF EROSION AND SEDIMENT CONTROL MEASURES

A. Traffic-Bearing Aggregate Surface:

1. Excavate minimum of 6 inches.
2. Place geotextile fabric full width and length, with minimum 12 inch overlap at joints.
3. Place and compact at least 6 inches of 1.5 to 3.5 inch diameter stone.

B. Silt Fences:

1. Store and handle fabric in accordance with ASTM D4873.
2. CONTRACTOR shall install silt fences as shown on the Drawings and as specified at the downhill edge of earthwork. The CONTRACTOR shall minimize disturbance of native soils and vegetation when installing the silt fence. Side casting spoils on the downhill side will not be allowed. The CONTRACTOR shall maintain the silt fences, remove accumulated sediments, and keep the silt fences in good condition.
3. Do not splice fabric width; minimize splices in fabric length; splice at post only, overlapping at least 18 inches, with extra post.

C. Straw Bale Rows:

1. Install bales in continuous rows with ends butting tightly, with one bale at each end of row turned uphill.
2. Install bales so that bindings are not in contact with the ground.
3. Embed bales at least 4 inches in the ground.
4. Anchor bales with at least two stakes per bale, driven at least 18 inches into the ground; drive first stake in each bale toward the previously placed bale to force bales together.
5. Fill gaps between ends of bales with loose straw wedged tightly.
6. Place soil excavated for trench against bales on the upslope side of the row, compacted.

D. Temporary Seeding:

1. When hydraulic seeder is used, seedbed preparation is not required.
2. When surface soil has been sealed by rainfall or consists of smooth undisturbed cut slopes, and conventional or manual seeding is to be used, prepare seedbed by scarifying sufficiently to allow seed to lodge and germinate.
3. If temporary mulching was used on planting area but not removed, apply nitrogen fertilizer at 1 pound per 1000 sq ft.
4. On soils of very low fertility, apply 10-10-10 fertilizer at rate of 12 to 16 pounds per 1000 sq ft.
5. Incorporate fertilizer into soil before seeding.
6. Apply seed uniformly; if using drill or cultipacker seeders place seed 1/2 to 1 inch deep.
7. Irrigate as required to thoroughly wet soil to depth that will ensure germination, without causing runoff or erosion.
8. Repeat irrigation as required until grass is established.

3.5 MAINTENANCE

3.6 CLEARING

- A. Clearing shall be limited to areas where construction will be completed in one season. Disturbed areas shall be revegetated as quickly as possible after construction is completed.
- B. Install silt fences or straw bale sediment barriers prior to general earthwork, stripping of topsoil and excavation.
- C. All areas that are to remain undisturbed during site clearing and grading shall be delineated and fenced with highly visible material prior to construction. Where clearing limits are near streams, or their buffers, normal flagging shall be supplemented with either an orange barrier fence or, where terrain slopes toward the water, a silt fence.

3.7 GENERAL SLOPE PROTECTION DURING CONSTRUCTION

- A. The CONTRACTOR shall protect slopes from erosion during construction until permanent erosion control measures are established. Slope protection shall be in the form of plastic sheeting, organic or inorganic erosion control matting, shot rock, or temporary seeding or straw mulch. Shot rock shall be placed in ditches on temporary construction access roads as required to reduce erosion and scour in ditches. The CONTRACTOR shall install erosion control matting and hydroseed to protect vulnerable slopes until permanent measures are in place. Temporary seeding shall be done using fast growing grass seed mixes suitable for the climate of the Project area. Erosion control matting shall be applied according to the manufacturer's

recommendation. Temporary erosion control shall be removed prior to installing permanent erosion control facilities only if the temporary facilities interfere with proper installation of permanent facilities (i.e., plastic or slopes to be hydroseeded). Sediment control structures must be inspected periodically. Sediment control measures shall be in working condition at the end of each working day. After any significant rainfall, sediment control structures must be inspected for integrity.

3.10 ACCESS ROAD CONSTRUCTION / REHABILITATION (If required)

- A. Construct permanent and temporary access roads in a manner that will not cause sedimentation. Do not side cast any soil downhill.
- B. Install sediment barriers on the downhill side of fills and excavations prior to construction.
- C. Provide erosion control barriers at inlets to all culverts and drainage structures. Install riprap at culvert outlets as shown on Drawings.
- D. Provide suitable sediment barriers to protect all stream crossings and designated wetland areas.
- E. Provide temporary check dams in roadside ditches until stabilized.
- F. Where practical, cover excavated or filled side slopes with mulch, polyethylene sheets or erosion control blankets until slopes can be permanently protected or stabilized.

3.11 PIPELINE INSTALLATION

- A. Install sediment barriers as needed to capture sediments and to protect any downhill areas from receiving sediments from pipeline installation earthwork, including temporary stockpiles.
- B. Excess material excavated for pipeline shall be transported to spoil stockpiles. Stockpiles shall be covered to prevent erosion or silt fences shall be installed around stockpiles to capture sediments
- C. Material to be reused in trench shall not be placed in drainage courses. Material shall be temporarily protected against erosion as needed.
- D. If standing water needs to be removed from excavations then it shall be pumped to an upland area where it can be filtered and dispersed without causing erosion or sedimentation. Filtered sediments shall be collected and disposed of in soil piles.
- E. Protect all stream crossings from sediments deriving from excavated soils.
- F. Install culverts in locations shown on the Drawings and protect inlets and outlets against erosion as required.

3.12 CONSTRUCTION AROUND POWERHOUSE

- A. Install sediment barriers between the construction site and any water bodies/creek to contain and capture sediments.

- B. Install drainage ditches and provide temporary check dams as needed.
- C. Cover excavated side slopes to protect them from erosion until permanent measures are established.
- D. Use sediment barriers to protect all drainage courses and new drainage structures.
- E. Excavation for the tailrace channel shall be done carefully to avoid getting any soils into the creek or adjacent waterway. No construction equipment shall be operated in flowing water. Place riprap protection immediately after excavating any water channels.

3.13 MAINTENANCE OF TEMP. ENVIRONMENTAL CONTROLS

- A. Inspect preventive measures weekly, within 24 hours after the end of any storm that produces 0.5 inches or more rainfall at the project site, and daily during prolonged rainfall.
- B. Repair deficiencies immediately.
- C. Silt Fences:
 - 1. Promptly replace fabric that deteriorates unless need for fence has passed.
 - 2. Remove silt deposits that exceed one-third of the height of the fence.
 - 3. Repair fences that are undercut by runoff or otherwise damaged, whether by runoff or other causes.
- D. Straw Bale Rows:
 - 1. Promptly replace bales that fall apart or otherwise deteriorate unless need has passed.
 - 2. Remove silt deposits that exceed one-half of the height of the bales.
 - 3. Repair bale rows that are undercut by runoff or otherwise damaged, whether by runoff or other causes.
- E. Place sediment in appropriate locations on site; do not remove from site.

3.14 COMPLETION OF CONSTRUCTION

- A. Upon completion of the Project, all temporary erosion control measures shall be removed and all captured sediments shall be disposed of at designated spoil areas or in an appropriate manner approved by the OWNER.
- B. Upon completion of work install final erosion control measures as shown on the DRAWINGS.

- C. All excavated and fill slopes shall be revegetated.
- D. Temporary laydown areas and soil stockpiles areas shall be graded to conform to the adjacent topography and shall be revegetated.
- E. The penstock right-of-way shall be replanted with native vegetation consistent with FERC approved Revegetation Plan and per the current commercial forest management requirements. Margins of the project access road right-of-way will be hydroseeded within the first growing season following road construction.
- F. Revegetate using hydroseeding where access allows, using OWNER approved erosion control seed mix. Use tackifiers at 45 lbs/ac for slopes < 2.5H:1V and 90 lbs/ac for steeper slopes. Some areas require hand seeding. Use 10-20-20 slow release fertilizer at 220 lbs/ac; apply wood fiber or straw mulch – 2,000 lbs/ac.
- G. The OWNER will accept responsibility for maintenance of the erosion control facilities remaining on site upon final acceptance of the Project.

3.15 CLEAN UP

- A. Remove temporary measures after permanent measures have been installed, unless permitted to remain by OWNER.
- B. Clean out temporary sediment control structures that are to remain as permanent measures.
- C. Where removal of temporary measures would leave exposed soil, shape surface to an acceptable grade and finish to match adjacent ground surfaces.

3.16 NONCOMPLIANCE WITH REQUIREMENTS

- A. After due notification by the OWNER, in writing, of the lack of compliance with the requirements of this Section, failure to rectify such lack of compliance will result in a stop work order issued by the OWNER that will not entitle the CONTRACTOR to an extension of time for delay. The CONTRACTOR shall incur liquidated damages as described in the proposal.

- END OF SECTION -

SECTION 01 60 00 - PRODUCTS, MATERIALS, EQUIPMENT AND SUBSTITUTIONS

PART 1 -- GENERAL

1.1 DEFINITIONS

- A. The word "Products," as used in the Contract Documents is defined to include purchased items for incorporation into the WORK, regardless of whether specifically purchased for the project or taken from CONTRACTOR's stock of previously purchased products. The word "Materials," is defined as products which must be substantially cut, shaped, worked, mixed, finished, refined, or otherwise fabricated, processed, installed, or applied to form WORK. The word "Equipment" is defined as products with operational parts, regardless of whether motorized or manually operated, and particularly including products with service connections (wiring, piping, and other like items). Definitions in this paragraph are not intended to negate the meaning of other terms used in the Contract Documents, including "specialties," "systems," "structure," "finishes," "accessories," "furnishings," special construction," and similar terms, which are self-explanatory and have recognized meanings in the construction industry.
- B. Neither "Products" nor "Materials" nor "Equipment" includes machinery and equipment used for preparation, fabrication, conveying, and erection of the WORK.

1.2 QUALITY CONTROL

- A. **Source Limitations:** To the greatest extent possible for each unit of WORK, the CONTRACTOR shall provide products, materials, and equipment of a singular generic kind from a single source.
- B. **Compatibility of Options:** Where more than one choice is available as options for CONTRACTOR's selection of a product, material, or equipment, the CONTRACTOR shall select an option which is compatible with other products, materials, or equipment. Compatibility is a basic general requirement of product, material and equipment selections.

1.3 PRODUCT DELIVERY AND STORAGE

- A. The CONTRACTOR shall deliver and store the WORK in accordance with manufacturer's written recommendations and by methods and means which will prevent damage, deterioration, and loss including theft. Delivery schedules shall be controlled to minimize long-term storage of products at the Site and overcrowding of construction spaces. In particular, the CONTRACTOR shall ensure coordination to ensure minimum holding or storage times for flammable, hazardous, easily damaged, or sensitive materials to deterioration, theft, and other sources of loss.

1.4 TRANSPORTATION AND HANDLING

- A. Products shall be transported by methods to avoid damage and shall be delivered in undamaged condition in manufacturer's unopened containers and packaging.
- B. Equipment shall be adequately supported for shipment. All loose parts shall be crated or boxed for shipment and appropriately identified.

1. Where shipment is braced internally, it shall be marked conspicuously, "Remove internal braces before testing and operation."
- C. All large and heavy shipping units shall have suitable skids for moving. Crating shall also be adequate for lifting with slings. If location of slings is critical, these locations shall be marked accordingly. Lifting lugs, if required, shall be provided and installed by CONTRACTOR.
- D. The CONTRACTOR shall provide equipment and personnel to handle products, materials, and equipment including those furnished by OWNER, by methods to prevent soiling and damage.
- E. The CONTRACTOR shall provide additional protection during handling to prevent marring and otherwise damaging products, packaging, and surrounding surfaces.

1.5 STORAGE AND PROTECTION

- A. CONTRACTOR shall be responsible for delivery of all of CONTRACTOR-supplied materials to the Project site or a location nearby designated by the OWNER, for unloading by the CONTRACTOR.
 1. CONTRACTOR shall be responsible for acceptance, unloading and safe storage of all OWNER-supplied materials to the Project site
- B. Maintenance of storage locations at the jobsite will be the responsibility of the CONTRACTOR. Where electrical equipment is required to be protected against condensation and humidity, sufficient desiccant and humidity controlled indoor environment for the prescribed storage conditions shall be provided by the CONTRACTOR, noting the need of periodic removal, dry-out or replacement, shall be conspicuously so marked.
 1. When electric space heaters are provided for that purpose, these shall be wired by the CONTRACTOR such that the space heaters can be energized immediately upon receipt without disassembly of crates, etc.
 2. CONTRACTOR must also insure that no combustible material be left in the inside of the equipment or crates during such storage.
- C. **OWNER Supplied Equipment and Products.** All OWNER supplied products and equipment shall be inspected at the time of delivery for damage and compliance with the Contract Documents by both the OWNER and CONTRACTOR. Any damage and/or non-compliance will be documented and signed by both the OWNER and CONTRACTOR. The OWNER will be responsible for notifying the supplier of the damage and/or non-compliance of the product or equipment with the procurement documents.
- D. **Steel Pipe Handling and Storage.** Particular care shall be exercised by the CONTRACTOR in coordinating the delivery, offloading and storage of all pipe segments and accessories. Time shall be allowed by the CONTRACTOR and OWNER to inspect and repair any damage to interior or exterior pipe coatings prior to installation.
- E. All material and equipment shall be protected against loss, damage by corrosion,

weather, overstressed components, or contamination by foreign materials. CONTRACTOR shall repair or replace any material or equipment damaged during delivery, at no cost to the OWNER, and without impact to the Commissioning schedule.

- F. Products shall be stored in accordance with manufacturer's written instructions and with seals and labels intact and legible. Sensitive products shall be stored in weather-tight climate-controlled enclosures and temperature and humidity ranges shall be maintained within tolerances required by manufacturer's recommendations.
- G. For exterior storage of fabricated products, products shall be placed on sloped supports above ground. Products subject to deterioration shall be covered with impervious sheet covering and ventilation shall be provided to fully protect against condensation and corrosion.
- H. Loose granular materials shall be stored on solid flat surfaces in a well-drained area and shall be prevented from mixing with foreign matter.
- I. Storage shall be arranged to provide access for inspection. The CONTRACTOR shall periodically inspect to assure products are undamaged and are maintained under required conditions.
- J. Storage shall be arranged in a manner to provide access for maintenance of stored items and for inspection.

1.6 MAINTENANCE OF PRODUCTS IN STORAGE

- A. Stored products shall be periodically inspected on a scheduled basis. The CONTRACTOR shall maintain a log of inspections and shall make the log available on request.
- B. The CONTRACTOR shall comply with manufacturer's product storage requirements and recommendations.
- C. The CONTRACTOR shall maintain manufacturer-required environmental conditions continuously.
- D. The CONTRACTOR shall ensure that surfaces of products exposed to the elements are not adversely affected and that weathering of finishes does not occur.
- E. For mechanical and electrical equipment, the CONTRACTOR shall provide a copy of the manufacturer's service instructions with each item and the exterior of the package shall contain notice that instructions are included.
- F. Products shall be serviced on a regularly scheduled basis, and a log of services shall be maintained and submitted as a record document prior to final acceptance by the OWNER in accordance with the Contract Documents.

1.7 PROPOSED SUBSTITUTIONS OR "OR-EQUAL" ITEM

- A. Whenever materials or equipment are indicated in the Contract Documents by using the name of a proprietary item or the name of a particular manufacturer, the naming of the item is intended to establish the type, function, and quality required. If the name is

followed by the words "or equal" indicating that a substitution is permitted, materials or equipment of other manufacturers may be accepted if sufficient information is submitted by the CONTRACTOR to allow the ENGINEER to determine that the material or equipment proposed is equivalent or equal to that named, subject to the following requirements:

1. The burden of proof as to the type, function, and quality of any such substitution product, material or equipment shall be upon the CONTRACTOR.
 2. The ENGINEER will be the sole judge as to the type, function, and quality of any such substitution and the ENGINEER's decision shall be final.
 3. The ENGINEER may require the CONTRACTOR to furnish additional data about the proposed substitution.
 4. The OWNER may require the CONTRACTOR to furnish a special performance guarantee or other surety with respect to any substitution.
 5. Acceptance by the ENGINEER of a substitution item proposed by the CONTRACTOR shall not relieve the CONTRACTOR of the responsibility for full compliance with the Contract Documents and for adequacy of the substitution.
 6. The CONTRACTOR shall pay all costs of implementing accepted substitutions, including redesign and changes to WORK necessary to accommodate the substitution.
- B. The procedure for review by the ENGINEER will include the following:
1. If the CONTRACTOR wishes to provide a substitution item, the CONTRACTOR shall make written application to the ENGINEER on the "Substitution Request Form."
 2. Unless otherwise provided by law or authorized in writing by the ENGINEER, the "Substitution Request Form(s)" shall be submitted within the 35 Day period after award of the Contract.
 3. Wherever a proposed substitution item has not been submitted within said 35 Day period, or wherever the submission of a proposed substitution material or equipment has been judged to be unacceptable by the ENGINEER, the CONTRACTOR shall provide the material or equipment indicated in the Contract Documents.
 4. The CONTRACTOR shall certify by signing the form that the list of paragraphs on the form are correct for the proposed substitution.
 5. The ENGINEER will evaluate each proposed substitution within a reasonable period of time.
 6. As applicable, no shop drawing submittals shall be made for a substitution item nor shall any substitution item be ordered, installed, or utilized without the ENGINEER'S prior written acceptance of the CONTRACTOR'S "Substitution Request Form."
 7. The ENGINEER will record the time required by the ENGINEER in evaluating

substitutions proposed by the CONTRACTOR and in making changes by the CONTRACTOR in the Contract Documents occasioned thereby.

- C. The CONTRACTOR's application shall address the following factors which will be considered by the ENGINEER in evaluating the proposed substitution:
1. Whether the evaluation and acceptance of the proposed substitution will prejudice the CONTRACTOR's achievement of Substantial Completion on time.
 2. Whether acceptance of the substitution for use in the WORK will require a change in any of the Contract Documents to adapt the design to the proposed substitution.
 3. Whether incorporation or use of the substitution in connection with the WORK is subject to payment of any license fee or royalty.
 4. Whether all variations of the proposed substitution from the items originally specified are identified.
 5. Whether available maintenance, repair, and replacement service are indicated. The manufacturer shall have a local service agency (within 50 miles of the site) which maintains properly trained personnel and adequate spare parts and is able to respond and complete repairs within 24 hours.
 6. Whether an itemized estimate is included of all costs that will result directly or indirectly from acceptance of such substitution, including cost of redesign and claims of other contractors affected by the resulting change.
 7. Whether the proposed substitute item meets or exceeds the experience and/or equivalency requirements listed in the appropriate technical specifications.
- D. Without any increase in cost to the OWNER, the CONTRACTOR shall be responsible for and pay all costs in connection with proposed substitutions and of inspections and testing of equipment or materials submitted for review prior to the CONTRACTOR's purchase thereof for incorporation in the WORK, whether or not the ENGINEER accepts the proposed substitution or proposed equipment or material. The CONTRACTOR shall reimburse the OWNER for the charges of the ENGINEER for evaluating each proposed substitution.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION

3.1 DELIVERY

- A. All products and materials shall be delivered to:
1. Petersburg Municipal Power & Light
Attn: Blind Slough Hydroelectric Project
18 Mile Mitkof Highway,
Petersburg, Alaska 99833

2. and clearly marked "***For Blind Slough Construction Contract***"
- B. Transportation to the Project site:
1. CONTRACTOR shall be responsible for shipping his materials and equipment to the site and shall make all necessary investigations of highway clearance, bridge load limits, etc. The Project is about 18 miles south of Petersburg, Alaska.
- C. Unloading of Turbine and Generator Heavy Parts
1. CONTRACTOR is responsible to accept delivery and unload OWNER-supplied equipment, including but not limited to the turbine casing, turbine runner, generator stator, and generator rotor. This equipment is scheduled to be delivered at a time to be coordinated with the OWNER and the water-to-wire supplier, but between the dates shown in Section 01 10 00 - Summary of Work.

- END OF SECTION -

SECTION 01 74 30 - PENSTOCK CLEANING & PRESSURE TESTING

PART 1 -- GENERAL

1.1 SUMMARY

- A. After completion of all penstock replacement and modification WORK, the CONTRACTOR shall clean and pressure test the new penstock water pipeline, including new bypass pipeline, and appurtenant piping, in accordance with the Contract Documents.
- B. The CONTRACTOR shall be responsible for safely discharging excess testing water without causing scouring or erosion or increasing turbidity to the natural receiving streams or channels.
- C. Penstock cleaning and pressure testing shall generally require the following three steps.
 - 1. **Penstock Flushing and Cleaning Exercise.** The CONTRACTOR shall clean and flush the new penstock pipe work according to the requirements specified in Part 3.2 of this Section.
 - a. The OWNER shall witness this flushing and cleaning WORK and provide written approval to the CONTRACTOR prior to the CONTRACTOR being able to advance to the Stage 1 Hydrostatic Pressure Testing Work.
 - 2. **Penstock Stage 1 Hydrostatic Pressure Testing** (up to 220 psig). The CONTRACTOR shall work with the OWNER to essentially fill the entire penstock pipe up to about the 40-percent full point such that the hydrostatic pressure at the new penstock thrust block is 220 psig +/- 10 psig. The new 20-inch penstock work shall be left in an unburied state for visual inspection of all welded joints during this Stage 1 pressure test.
 - a. The CONTRACTOR shall conduct this Stage 1 hydrostatic pressure testing of the new penstock pipe work according to the requirements specified in Part 3.3.B of this Section.
 - 3. **Penstock Stage 2 Hydrostatic Pressure Testing** (full hydrostatic pressure up to 540 – 545 psig). The CONTRACTOR shall work with the OWNER's staff to fill the entire penstock pipe up all the way to the dam / intake valve house, such that the hydrostatic pressure at the new penstock thrust block is the full Project 540 psig +/- pressure. Prior to this pressure testing occurring, all essential Work at the powerhouse and all penstock and bypass piping work just outside the powerhouse shall be fully complete, QC checked and inspected, and granted substantial completion by the OWNER.
 - a. The CONTRACTOR shall conduct this Stage 2 hydrostatic pressure testing of the new penstock pipe work according to the requirements specified in Part 3.3.C of this Section.

1.2 CONTRACTOR SUBMITTALS

- A. Furnish submittals in accordance with Section 01 33 00 – Contractor Submittals.
- B. CONTRACTOR shall submit the following for review and approval:
 - 1. A flushing / cleaning and testing plan and schedule, including at a minimum the method for water conveyance, control, testing procedures and apparatus, and disposal of test water.

PART 2 -- PRODUCTS

2.1 MATERIAL REQUIREMENTS

- A. All temporary test equipment including equipment to fill the penstock pipeline for the Hydrostatic Pressure Testing including temporary valves, bulkheads, gas powered water transfer pumps, water hoses and temporary piping, and other water control equipment shall be as determined by the CONTRACTOR. No materials shall be used which would be injurious to the Work for future conveyance of water.

PART 3 -- EXECUTION

3.1 GENERAL

- A. Water for hydrostatic testing of the new penstock and associated pipelines shall be taken from the following sources:
 - 1. Stage 1 Hydrostatic Pressure Testing water shall be sourced from the project dam main water supply Crystal Lake, as provided by OWNER.
 - 2. Stage 2 Hydrostatic Pressure Testing water shall be sourced from the project dam main water supply Crystal Lake, as provided by OWNER.
 - 3. The CONTRACTOR in cooperation with the OWNER shall convey the water from the project dam and intake area to the refurbished penstock pipeline.
- B. All newly constructed pressure pipelines shall be tested. All testing operations shall be performed in the presence of the OWNER or OWNER's RPR.
- C. Disposal of flushing / cleaning water shall be by methods acceptable to the OWNER.

3.2 MANUAL CLEANING AND FLUSHING OF EXISTING PENSTOCK

- A. Prior to initiating a water flush of the penstock pipeline, the CONTRACTOR shall manually inspect and clean / sweep, the inside of the penstock, to the extent possible without entering the penstock, to remove all debris of 0.5-inch in size or larger.
- B. One complete volume of the 4425 ft long by 20-inch outside diameter penstock represents a volume of 9,080 cubic feet (68,000 gallons) of water.
- C. After the interior cleaning is complete, the CONTRACTOR shall flush the penstock

system thoroughly by allowing water to flow thru the new powerhouse bypass pipeline at a flow rate of 8 to 10 cfs for a time period of 15 minutes. All flushing water thru the bypass pipeline shall discharge into the existing tailrace pipe and into the existing emergency storage pond.

D. This penstock flushing shall include the following:

1. Prior to performing the water flush, CONTRACTOR shall remove any pressure reducing type valve on the new bypass pipelines (i.e the Bailey fixed sleeve valves or other pressure reducing style valves) to prevent damage to such equipment, and replace such with a temporary steel filler plate, flange, or short pipe spool to occupy the same laying length as occupied by the permanent pressure reducing valve. The flush water shall be piped to convey the water to the tailrace channel.
2. Prior to performing the water flush, CONTRACTOR shall coordinate with OWNER and insure that the existing inlet turbine isolation valve is closed and is properly working. Penstock flushing shall occur by using the new bypass valves installed on the new penstock bypass pipeline. Penstock flushing shall occur by opening and throttling the bypass pipeline valves, with instruction provided by ENGINEER, and allowing water to scour and flush any small residual debris (less than 0.5-inch in size) remaining in the refurbished pipeline into the existing tailrace pipeline, located just outside the powerhouse building.
3. The CONTRACTOR shall open and adjust the bypass line metal seated isolation valve to maintain the desired flushing flow.
4. The CONTRACTOR shall monitor the flushing water flow rate thru the penstock to insure that the flushing flow rate does not exceed 10 cfs at any time, by proper throttling of the new bypass pipeline isolation valve with metal seats.
5. The minimum time duration of the entire penstock flushing process shall be no less than 15 minutes and the maximum duration of the flushing process shall be no more than 30 minutes. The CONTRACTOR and OWNER's RPR shall monitor the clarity and sediment discharges of the discharge water to determine the appropriate time duration of the flush process.

E. After the manual clean and flush procedure is completed, The CONTRACTOR shall replace any orifice plate devices or other pressure reducing devices in the existing bypass / drain line system(s) and remove any temporary pipe spools or flanges

F. After the manual clean and flush procedure is completed, the penstock may be refilled with water for the required hydrostatic pressure test of the penstock, per the requirements of Part 3.3.B of this Section.

3.3 HYDROSTATIC PRESSURE TEST OF PIPELINES

A. **Preparations for Hydrotest.** Prior to hydrostatic testing, pipelines shall be flushed as described above. The CONTRACTOR shall plan to hydrostatic test the entire penstock as one entire unit, at the CONTRACTOR's option.

1. No section of the pipeline shall be tested until field-placed concrete or mortar has attained an age of at least 10-Days, and until any polyurethane or epoxy lining

product has fully cured for at least 3-Days, or longer as required by the manufacturer.

2. The CONTRACTOR shall be responsible for ascertaining that any test bulkheads are suitably restrained to resist the thrust of the test pressure without damage to or movement of the adjacent pipe. Any new unharnessed sleeve-type couplings, expansion joints, or other sliding joints shall be restrained or suitably anchored prior to the test to avoid movement and damage to piping and equipment.
3. Remove or protect any pipeline-mounted devices that may be damaged by the test pressure. The CONTRACTOR shall provide sufficient temporary tappings in the pipelines to allow for trapped air to exit. After completion of the tests, such taps shall be permanently plugged.
4. Care shall be taken that any pipeline air relief and vacuum relief valves are open during penstock filling.

B. Penstock Stage 1 Hydrostatic Pressure Testing (up to 220 psig). The CONTRACTOR shall work with the OWNER to essentially fill the entire penstock pipe up to about the 40-percent full point such that the hydrostatic pressure at the new penstock thrust block is 220 psig +/- 10 psig. The new 20-inch penstock work shall be left in an unburied state for visual inspection of all welded joints during this Stage 1 pressure test.

1. This pressure test shall last a minimum of 24 hours and the CONTRACTOR shall provide a temporary pressure gauge for monitoring pressures on the new 12-inch bypass pipeline.
2. Any visual leaks thru any of the new piping systems, fittings, accessories, valves, etc provided by the CONTRACTOR shall constitute a failed test and require fixes / repairs be made to the system by the CONTRACTOR.
3. Once repairs have been made and quality checked by the OWNER or OWNER's Representative, the Stage 1 Hydrostatic Pressure Test shall be repeated. The CONTRACTOR and OWNER shall work together to develop the new testing date, but not more than five (5) Working Days after the piping / fitting repairs have been made and approved, unless agreed to by both parties.
4. The OWNER shall witness this WORK and provide written approval prior to the CONTRACTOR prior to the CONTRACTOR being able to advance to the Stage 2 Hydrostatic Pressure Testing Work.
5. The CONTRACTOR shall be required to properly backfill and compact the new portions of the penstock, prior to conducting the Stage 2 Hydrostatic Pressure Test below. Finished grading of the site shall also be conducted prior to the Stage 2 Hydrostatic Pressure Testing work. (Final revegetation work and hydroseeding may occur afterwards at the CONTRACTOR's option.)

C. Penstock Stage 2 Hydrostatic Pressure Testing (full hydrostatic pressure up to 540 – 545 psig). The CONTRACTOR shall work with the OWNER's staff to fill the entire penstock pipe up all the way to the dam / intake valve house, such that the hydrostatic pressure at the new penstock thrust block is the full Project 540 psig +/- pressure. Prior to this pressure testing occurring, all essential Work at the powerhouse and all penstock

and bypass piping work just outside the powerhouse shall be fully complete, QC checked and inspected, and granted substantial completion by the OWNER.

1. This pressure test shall last a minimum of 24 hours and the CONTRACTOR shall provide a temporary pressure gauge for monitoring pressures on the new 12-inch bypass pipeline.
2. Any visual leaks thru any of the new piping systems, fittings, accessories, valves, etc provided by the CONTRACTOR shall constitute a failed test and require fixes / repairs be made to the system by the CONTRACTOR.
3. Once repairs have been made and quality checked by the OWNER or OWNER's RPR, the Stage 2 Hydrostatic Pressure Test shall be repeated. The CONTRACTOR and OWNER shall work together to develop the new testing date, but not more than five (5) Working Days after the piping / fitting repairs have been made and approved, unless agreed to by both parties. The OWNER shall witness this WORK and provide written approval of the testing CONTRACTOR prior to the CONTRACTOR being able to advance to the Stage 2 Hydrostatic Pressure Testing Work.

D. **Hydrostatic Test Fill Rate.** The test shall be made by closing valves when available or by placing bulkheads and filling the pipeline slowly with water. The pipeline shall be filled at a rate which will not cause any surges or exceed the rate at which the air can be released through the release valves at a reasonable velocity. The air within the pipeline shall be allowed to escape completely.

1. Each 1,000 lineal feet of penstock pipeline shall be filled over a time period of no less than 1 hour (i.e. the fill flow rate shall not exceed 250 gpm or 0.56 cfs).
2. The differential pressure across the orifices in the air release valves shall not be allowed to exceed 5 psi at any time during filling.
3. After the pipeline or section thereof has been filled, it shall be allowed to stand under pressure for at least 8 hours. During this period, any temporary bulkheads, new or existing penstock valves, new penstock pipe couplings and connections shall be examined for leaks. If leaks are found, corrective measures satisfactory to the OWNER and OWNER's RPR shall be taken by the CONTRACTOR.

E. **Allowable Leakage.** The maximum allowable leakage for Joint Option A (mechanical coupling joint) or Joint Option B (single bevel, outside butt-weld joint) water transmission and penstock pipelines shall be:

1. For buried piping: no visible leaks and no pressure loss during the test.
2. Exposed piping, including all penstock piping placed upon the existing concrete pedestals and including piping within the new thrust-block, shall show no visible leaks and no pressure loss during the test.
3. In the case of pipelines that fail to pass the leakage test, the CONTRACTOR shall in cooperation with the OWNER and OWNER's RPR, determine the cause of the leakage, take corrective measures as appropriate to repair the leaks, and shall again test the pipeline, repeating as necessary until the pipeline passes.

Note that the maximum allowable laying lengths for each of these joint options is defined in Part 2.1 of Section 33 11 11 – Steel Penstock Pipe and Fittings.

- END OF SECTION -

SECTION 01 77 00 - PROJECT CLOSEOUT

PART 1 -- GENERAL

1.1 FINAL CLEANUP

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

1.2 CLOSEOUT TIMETABLE

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

1.3 TECHNICAL MANUAL SUBMITTAL

- A. Failure to submit the approved Technical Manual on or before the 75 percent construction completion point shall mean that an additional set aside will be made with progress payments due to the CONTRACTOR under Article 15 of the General Conditions.

1.4 FINAL SUBMITTALS

- A. The CONTRACTOR, prior to requesting final payment, shall obtain and submit the following items to the ENGINEER for transmittal to the OWNER:
 - 1. Written guarantees, where required.
 - 2. Technical Manuals and instructions.
 - 3. New permanent cylinders and key blanks for all locks.
 - 4. Maintenance stock items; spare parts; special tools.
 - 5. Completed record drawings.
 - 6. Bonds for roofing, maintenance, etc., as required.
 - 7. Certificates of inspection and acceptance by local governing agencies having jurisdiction.
 - 8. Releases from all parties who are entitled to claims against the subject project, property, or improvement pursuant to the provisions of law.

1.5 MAINTENANCE AND GUARANTEE

- A. The CONTRACTOR shall comply with the maintenance guarantee requirements contained in Article 15 of the General Conditions (Correction Period).
- B. Replacement of earth fill or backfill, where it has settled below the required finish elevations, shall be considered as a part of such required repair work, and any repair or resurfacing constructed by the CONTRACTOR which becomes necessary by reason of such settlement shall likewise be considered as a part of such required repair work unless the CONTRACTOR shall have obtained a statement in writing from the affected private owner or public agency releasing the OWNER from further responsibility in connection with such repair or resurfacing.
- C. The CONTRACTOR shall make all repairs and replacements promptly upon receipt of written order from the OWNER. If the CONTRACTOR fails to make such repairs or replacements promptly, the OWNER reserves the right to do the WORK and the CONTRACTOR, and its surety shall be liable to the OWNER for the cost thereof.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

- END OF SECTION -

SECTION 01 78 36 – EQUIPMENT WARRANTIES

PART 1 - GENERAL

1.1 REQUIREMENTS

- A. CONTRACTOR shall compile specified warranties and review warranty submittals to verify compliance with Contract Documents.
- B. Submit to the OWNER for review.
- C. Minimum acceptable Equipment warranty shall be 30 months after completion of 100% of the delivery of all equipment to the Project site, or 24 months after issuance of FINAL COMPLETION CERTIFICATE, whichever is shorter.
- D. When Manufacturer's warranties are valid for a period longer than the CONTRACTOR'S warranties as required by the Specifications, CONTRACTOR shall provide the Manufacturer's warranty to the OWNER

1.2 SUBMITTAL REQUIREMENTS

- A. Assemble warranties and guarantees executed by each of the respective manufacturers, suppliers, and subcontractors.
- B. Number of original signed copies required: Two (2) each.
- C. Table of Contents: Neatly typed, with numbered sequence. Provide complete information for each Product or Work item.
 - 1. Manufacturer, with name of principal, address and telephone number.
 - 2. Scope.
 - 3. Date of beginning of warranties and guarantee.
 - 4. Duration of warranty or guarantee.
 - 5. Proper procedure to follow in case of failure
 - 6. Instances which might affect the validity of warranty.
 - 7. CONTRACTOR, name of responsible principal, address and telephone number.
- D. Prepare submittals in duplicate using the following format:
 - 1. Size 8-1/2 inches by 11 inches; punch sheets for standard commercial quality 3-ring binder; fold larger sheets to fit binders.
 - 2. Identify binder with typed or printed title "WARRANTIES" and list the Project title along with the name of CONTRACTOR. Warranties may be included as a separate section in the O&M Manual.

E. Time of Warranty Submittals:

1. For equipment or component parts of equipment put into service during progress of construction: Submit warranty documents within 10 days after inspection and acceptance.
2. Otherwise make submittals prior to final request for payment.
3. For items of work, where acceptance is delayed materially beyond shipment and delivery of goods, provide updated submittal within ten days after acceptance, listing date of acceptance as start of warranty period.

1.3 CORRECTION OF DEFECTS

- A. Repairs of alterations required of CONTRACTOR shall be made by the CONTRACTOR at such times as directed, in a manner as will affect a minimum interruption of service to the OWNER.

1.4 RIGHT TO OPERATE UNSATISFACTORY EQUIPMENT

- A. The OWNER shall have the right to operate any and all equipment as soon as, and as long as it is in operating condition, whether or not such equipment has been accepted as complete and satisfactory, except that this shall not be construed to permit operation of any equipment which may be materially damaged by such operation

1.5 REQUIRED WARRANTY TERMS

- A. The CONTRACTOR warrants the Equipment to be new, free from defects in design, material, and workmanship disclosed or discovered under normal use and operation for a period of thirty (30) months from completion of delivery, or twenty four (24) months after written issuance of the FINAL COMPLETION CERTIFICATE by the OWNER, whichever is shorter. CONTRACTOR further warrants and covenants to the OWNER that all services performed under this Agreement by CONTRACTOR, CONTRACTOR subcontractors, assignees and agents (including but not limited to installation supervision, start-up and testing services) shall be performed in a skillful and workmanlike manner, and that all stages of Work on the Project will comply with the specifications set forth in the Contract Documents.
1. If the OWNER notifies the Supplier in writing of any claimed defect in the Equipment and if, after appropriate tests and inspection by the CONTRACTOR, the Equipment is found not to be in conformity with this warranty, the CONTRACTOR shall at the OWNER's option, either repair the same at their cost including travel expenses, labor charges, shipping and costs to remove the nonconforming equipment from service and to place it back into service after repair, or provide and install a replacement free of charge at the OWNER's site.
 2. Any part repaired or replaced by the CONTRACTOR within the warranty period shall have its own warranty period limited to two (2) years after the date of completion of the repair or replacement of the Equipment.
 3. New or replaced parts supplied or installed after the expiration of this warranty

shall be covered by the manufacturer's standard new parts warranty.

4. Any services found not in conformity with this warranty shall be promptly re-performed at no cost to the OWNER, upon written notice from the OWNER of such non-conformity.
- B. The OWNER, without waiving any of its rights or remedies against CONTRACTOR hereunder, shall have the right to operate any and all equipment as soon as, and as long as, it is in operating condition whether or not such equipment has been accepted as complete and satisfactory, except that this shall not be construed to permit operation of any equipment which may be materially damaged by such operation before any required alterations or repairs have been made. All repairs or alterations required of the CONTRACTOR shall be made by the CONTRACTOR with due speed and with the understanding that time is of the essence in such repair or alterations. The repairs or alterations shall be made in such a manner and at such time as will cause the minimum interruption in the use of the equipment by the OWNER.
 - C. The foregoing warranty does not cover and the CONTRACTOR makes no warranty with respect to:
 1. Failures not reported to the CONTRACTOR within the warranty period above specified; and
 2. Failures or damage to the extent due to negligence of the OWNER, including abuse or improper maintenance.
 - D. As an accommodation to the OWNER, the CONTRACTOR will assign any rights beyond the stated warranty it may have under warranties given to it by the manufacturer of standard or accessory equipment (such as controls, motors, electrical equipment, etc.) purchased by the CONTRACTOR and sold by it to the OWNER.
 - E. The warranties of these CONTRACT DOCUMENTS are expressly in lieu of all implied warranties (except title), including but not limited to implied warranties of merchantability and fitness for a particular purpose.
 - F. Except as provided in sections regarding insurance, indemnity, performance guarantees and title to the WORK, the foregoing states OWNER's exclusive remedy against the CONTRACTOR and their Sub-suppliers for any defect in the goods or failure of the Equipment or services provided hereunder to be as warranted.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

- END OF SECTION -

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SECTION 01 78 39 - PROJECT RECORD DOCUMENTS

PART 1 -- GENERAL

1.1 SCOPE

- A. The WORK specified in this Section includes the record documents, which shall be maintained and annotated by the CONTRACTOR during construction.
- B. CONTRACTOR shall maintain at the project site one master, record copy of all of the following documents, each in a current state with corrections made to reflect any approved work changes and final modifications made:
 - 1. Contract Drawings.
 - 2. Contract Specifications.
 - 3. Addenda.
 - 4. Approved Shop Drawings.
 - 5. Change Orders and other modifications to the Contract Documents.
 - 6. Field Request for Engineering Change.
 - 7. Engineering Change Notice.
 - 8. Approved Samples.
 - 9. Field Test Records.
 - 10. SWPP Plan.
 - 11. Erosion and sediment control plan.
 - 12. Discharge Monitoring Reports.
 - 13. SPCC Plan.
 - 14. Site Specific Safety Plan.
- C. The CONTRACTOR will provide the OWNER with one record copy of each of the above listed items at the time of project completion.

1.2 CONTRACTOR SUBMITTALS

- A. Video surveys, photographs, and other data of the preconstruction conditions shall be submitted to the ENGINEER for record purposes prior to, but not more than three weeks before, commencement of any construction activities.
- B. Except as otherwise indicated, post-construction As-built professionally surveyed mapping shall be submitted to the ENGINEER within 60 days of completing WORK.

- C. A complete set of all photographs and survey data of the post-construction conditions shall be completed and submitted prior to final inspection by the OWNER and ENGINEER, in accordance with Section 01 33 00 – Contractor Submittals.

1.3 DESCRIPTION

- A. Keep accurate record documents for all additions, substitution of material, variations in Work, and any other revisions to the Contract Documents.
- B. Two (2) complete sets of design Drawings shall be designated for mark-up purposes to depict field changes for submission to the OWNER's Representative. These deviations from original particulars of construction do not change the intent of the design or necessitate engineering redesign, but require approval by the OWNER's Representative. Changes shall be recorded on the "As-Built" set of design drawings as they are instituted. Light green pencil shall be used to indicate deletions; red to show additions and changes.

1.4 MAINTENANCE OF DOCUMENTS AND SAMPLES

- A. Store documents and samples in CONTRACTOR's field office apart from documents used for construction.
- B. Maintain documents in a clean, dry, legible condition and in good order. Do not use record documents for construction purposes.
- C. Make documents and samples available at all times for inspection by OWNER's Representative.

1.5 RECORDING

- A. Label each document 'PROJECT RECORD' in neat large, printed letters.
- B. Record information concurrently with construction progress.
 - 1. Do not conceal any work until required information is recorded
 - 2. Record documents will be reviewed at the time of each pay application. Payment will not be made unless record documents are up to date.
- C. Drawings: Legibly mark to record actual construction:
 - 1. Field changes of dimension and detail.
 - 2. Changes made by Change Order.
 - 3. Details not on original Contract Drawings.
- D. Specifications and Addenda: Legibly mark each section to record:
 - 1. Supplier of each Product.
- E. Changes made by Change Order.

1.6 SUBMITTAL

- A. At Contract close-out, CONTRACTOR shall deliver all Records Documents to OWNER's Representative, with each major Record Document item accompanied by a cover transmittal page.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION

3.1 PHOTOGRAPHS AND VIDEO RECORDINGS

- A. CONTRACTOR, as a minimum, shall document pre- and post-construction conditions by preparing video (mp4 or other ENGINEER approved media) surveys of the following:
 - 1. Roadways used to access the Site or haul materials and equipment to the Site.
 - 2. Work areas, including actual work sites, materials processing and stockpiling areas, access corridors, disposal areas, and staging areas.
 - 3. Any work completed by other contractors or subcontractors at the Site that will be connected to or otherwise affected by the WORK.
- B. Supplement video surveys with photographs and spot elevation surveys as required to thoroughly document the original condition and location of existing features and facilities.

3.2 AS BUILT AND TOPOGRAPHIC MAPPING

- A. Topographic mapping shall be developed using the Project coordinates, shall be referenced to the Project base lines and benchmarks, and shall be adequate to ascertain pre-construction and post-construction elevations of all public and private property within and adjacent to the construction limits
- B. Topographic mapping shall be conducted to document the post-construction topography of the Site:
- C. Spot elevation surveys used to document the elevation on abutting ground lines at roadways and new penstock piping systems, shall be taken at approximately 20-foot intervals and at the point of juncture with any structure to which they are attached or otherwise influenced by the WORK.
- D. All pre- and post-construction As Built and topographic mapping and other data, including spot elevations, shall be prepared and sealed by a Professional Land Surveyor.
- E. All pre- and post-construction survey data shall be furnished as follows:
 - 1. Site mapping shall be submitted as a separate electronic drawing in AutoCAD Release 13, or later.
 - 2. Each AutoCAD site map shall also be submitted in hard copy plot format (six

copies).

3. ENGINEER will review hardcopy plots for accuracy relative to the indicated requirements.
4. CONTRACTOR shall amend mapping files as required, based on ENGINEER's comments.
5. The electronic mapping files shall be produced using field survey techniques with sufficient accuracy for reproduction use as base maps at a scale of 1" = 10' horizontal and 1-foot contour intervals as specified for National Map Accuracy Standards.
6. Electronic mapping files shall be three-dimensional.
7. Submit points lists for all topographic surveys in ASCII text file format.
8. All files shall be copied to one or more compact discs in a format acceptable by CONSTRUCTION MANAGER.
9. Submit no less than four (4) copies of the compact discs.

3.3 RECORD DRAWINGS

- A. The CONTRACTOR shall maintain the following record drawings for the PROJECT:
 1. A neat and legibly marked set of Contract Drawings showing the final location of piping, equipment, electrical conduits, outlet boxes, cables, etc.
 2. Additional documents such as schedules, lists, drawings and electrical and instrumentation diagrams included in the Contract Documents; and
 3. CONTRACTOR layout and installation drawings.
- B. Unless otherwise specified, record drawings shall be full-size and maintained in a clean, dry and legible condition. Record documents shall not be used for construction purposes and shall be available for review by the PROJECT LEAD during normal working hours at the CONTRACTOR'S field office. At the completion of the work, prior to final payment, all record drawings shall be submitted to the OWNER.
- C. Marking of the drawings shall be kept current and shall be done at the time the material and equipment are installed. Annotations to the record documents shall be made with an erasable colored pencil or pens conforming to the following color code;
 1. Additions - Red
 2. Deletions - Green
 3. Comments - Blue
 4. Dimensions - Graphite

- D. The CONTRACTOR shall be responsible for furnishing the OWNER with one full-size hard copy of all drawings, and with as-built information in AutoCAD format on CD or DVD-ROM. Each record drawing shall be clearly labelled by the CONTRACTOR as being a project Record Drawing
- E. The CONTRACTOR's record drawings (full-size hard copy) will be reviewed monthly for completeness by the PROJECT LEAD prior to preparing the progress estimate for payment. If the Record Drawings do not reflect the work performed, payment for that item of work will not be included in the progress estimate.

- END OF SECTION -

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SECTION 01 91 00 COMMISSIONING, START-UP AND TESTING

PART 1 - - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Project commissioning and startup is prerequisite to satisfactory completion of the contract requirements and shall be completed within the Contract Times
- B. The CONTRACTOR shall be responsible for providing supervision, labor, materials and equipment to perform and coordinate commissioning, startup and testing. CONTRACTOR shall cooperate with OWNER-furnished field service engineer(s) for OWNER-furnished equipment as required and as stated in the Contract Documents. OWNER will supply field service engineer for OWNER-supplied equipment as required. The OWNER-furnished field service engineer shall supervise the installation, commissioning, start-up and testing for all OWNER-furnished equipment with assistance of the OWNER's Representative.
- C. CONTRACTOR shall furnish all labor, materials and equipment for the commissioning, required testing equipment and specialized instrumentation, and perform start-up and testing of CONTRACTOR-furnished equipment. CONTRACTOR shall also provide all labor, materials and equipment, and required testing equipment and specialized instrumentation, necessary to adjust or otherwise modify OWNER-supplied equipment that has been installed by the CONTRACTOR.

1.2 DEFINITIONS

- A. **Startup.** Defined as testing, demonstrations, and other activities as required to achieve Substantial Completion. Startup includes pre-commissioning and commissioning activities, manufacturer's services, certifications of readiness for testing, and troubleshooting, checkout, and shakedown activities.
- B. **Pre-commissioning.** Defined as is the systematic demonstration through testing and extended operation that major equipment and auxiliary systems, including related components, sub-systems, and systems operate properly and consistent with their intended function. Pre-commissioning involves balancing, adjustments, calibration, loop checks, and loop validation. Pre-commissioning shall simulate shutdown conditions, failure conditions, power fail and restart, bypass conditions, and failure resets. Pre-commissioning will not be considered complete until successful results and documentation of tests and manufacturer's certifications required by the Contract Documents are submitted and accepted by the ENGINEER. Pre-commissioning of all portions of the WORK shall be successfully completed prior to starting Commissioning.
- C. **Commissioning.** Defined as the verification that the complete WORK functions on an extended basis in full conformance with the Contract requirements.

1.3 WORK INCLUDED

- A. OWNER will provide lube oil and hydraulic oil sufficient for one filling of OWNER-provided equipment. CONTRACTOR shall provide all other or additional materials required to startup units including any additional lube and hydraulic oil, cooling water,

greases, etc.

- B. CONTRACTOR shall be responsible to fill all systems, including lube oil, hydraulic, cooling water. Penstock filling will be performed by the CONTRACTOR under the supervision of the OWNER.
- C. CONTRACTOR shall conduct calibration and testing of all devices, control and alarm instrumentation for both OWNER and CONTRACTOR-furnished equipment and installed under this Contract.
- D. CONTRACTOR shall provide supervision, labor, materials and equipment to install, start-up, test, and commission OWNER-furnished equipment in coordination with Field Service Engineers from OWNER's equipment supplier.
- E. CONTRACTOR shall provide assistance for field acceptance tests of the equipment. Field acceptance tests include a three-day acceptance test followed by field performance tests. These field acceptance tests will largely be carried out by the OWNER-furnished Field Service Engineer with the assistance of the CONTRACTOR.
- F. CONTRACTOR shall cooperate with OWNER and OWNER-furnished Field Service Engineer in scheduling and performing start-up and commissioning tests for all equipment.

1.4 SUBMITTALS

- A. Before scheduling field tests, CONTRACTOR shall submit manufacturer's certified data, calculations, curves, charts, and published field test requirements, methods and procedures for CONTRACTOR-supplied equipment as required.
- B. The CONTRACTOR will work with the OWNER and OWNER-furnished Field Service Engineer to assist in the preparation of a schedule of field tests, start up and performance test dates and a testing program (Testing and Startup Plan) for the OWNER's review no less than 30 days in advance of the first scheduled test. The OWNER-furnished Field Service Engineer will prepare a testing program for OWNER-furnished equipment, and CONTRACTOR shall be responsible to prepare program for CONTRACTOR-supplied equipment. Testing program shall include, but not be limited to, the following:
 - 1. Schedules for providing the manufacturers' equipment certifications
 - 2. Schedules for submitting of final Technical Manuals,
 - 3. Schedule for training the OWNER's personnel,
 - 4. Description of temporary facilities and schedule for installation and decommissioning them
 - 5. List of OWNER and CONTRACTOR-furnished supplies
 - 6. Detailed schedule of operations to achieve successful pre-commissioning and commissioning WORK.

7. Checklists and data forms for each item of equipment.
8. Interconnection of new facilities to existing facilities.
 - a Date and time frame of proposed shutdown or interconnection, including detail steps, sequence of events, and activities to be conducted.
 - b A detailed description of sequences and activities for the planned shutdown and interconnection.
 - c Staff, equipment, and materials that will be at the Site before commencing the shutdown.
 - d Other provisions so that interconnection, testing, and startup will be completed within the planned time.
9. Hydrostatic testing of water-holding structures and pipelines. Schedule and plan shall indicate source of water and testing procedures, and the disposal of the water following testing. See Section 01 74 30 – Penstock Cleaning and Testing.
10. Calibration tests of all voltages, currents, watts, vars, power factor, level, pressure, flow, temperature, vibration monitoring instrumentation, and all required settings of the control systems and protective relays.
11. Operational tests for all valves, operators, control switches, computer and PLCs, breakers, disconnect switches, starters and motors.
12. On/off control, limit switches, indicating lamps in-service tests, and indicating meters.
13. Bolt torque and stress tension data.
14. Pressure and leak tests of pipe and fittings, gaskets, and seals.
15. Alarms, signals, and fail-safe or system shut-down controls.
16. All installation tests required in the technical sections of the specification.
17. Tests of control sequences and control logic diagrams.
18. Protective relay operations, including providing an independent NETA test firm performing checkout of the electrical relay protection systems, including unit, line, and station service.
19. Mechanical (bearing runs).
20. Synchronization testing including hot-stick phase checks at the generator breaker.
21. Excitation testing.
22. Load tests.

23. Load rejection testing.

- C. Within fifteen (15) calendar days after completion of startup and performance testing, CONTRACTOR shall provide one copy of all test reports in conformance with requirements of this Section and Section 01 33 00 – Submittal Procedures. Reports shall include list of calibrated instruments used and certified calibration data for all testing and recording equipment.

PART 2 – PRODUCTS

2.1 EQUIPMENT AND MATERIALS

- A. CONTRACTOR shall provide all testing, setting, and recording devices which may be required for specified start up and performance tests involving CONTRACTOR-furnished equipment. Obtain the OWNER's approval for all test equipment calibration certificates.

PART 3 – EXECUTION

3.1 GENERAL

- A. After installation and servicing is completed, CONTRACTOR shall complete all insulation, labeling and continuity tests of all circuits.
- B. CONTRACTOR shall adjust, check and test in-service operation of all systems and equipment.
- C. If it is determined by the OWNER that CONTRACTOR's Field Service Engineer(s) may not be qualified to perform testing of some equipment supplied by subcontractors, CONTRACTOR shall provide qualified test engineers from subcontractors at CONTRACTOR's expense.
- D. All tests shall be performed in the presence of OWNER representative unless such presence is expressly waived in writing. All tests witnessed by the OWNER representative shall be acknowledge in writing, with the representative "signing-off" the tests have been performed on a form provided by CONTRACTOR.
- E. Where testing requires electricity to be transmitted using the OWNER's transmission system, the CONTRACTOR shall coordinate testing coordination with the OWNER's operating personnel and power scheduling representatives and shall follow all operating and scheduling protocols specified by the OWNER. Notification of the testing date requiring transmission of electricity shall allow 3-days' notice of the date of testing.
- F. Additional tests required to correct deficiencies in CONTRACTOR's identified in the initial round of testing shall be at CONTRACTOR's expense.

3.2 PREPARATION

- A. Before start-up, the CONTRACTOR shall check instrumentation, fluid levels, pumps and piping, oil levels and other checks as recommended by the equipment manufacturer for proper installation and operation of all equipment.

3.3 PRE-COMMISSIONING

- A. After individual equipment items and subsystems have been tested and certified as required by the Technical Specifications, tests of systems comprised of single or multiple equipment items with appurtenant equipment and instruments and controls shall be conducted. Items of equipment shall be tested as part of a system to the maximum extent possible.
- B. Subject to the testing criteria above, each system shall be demonstrated for a continuous, 3-Day, 24 hour/day period. If any system malfunctions, the item or equipment shall be repaired and the test restarted at time zero with no credit given for the elapsed time before the malfunction.
- C. The CONTRACTOR shall demonstrate the manual and automatic modes of operation to verify proper control sequences, software interlocks, proper operation of software logic and controllers, etc. System testing shall include the use of water or other process media, as applicable, to simulate the actual conditions of operation.
- D. Systems testing activities shall follow the detailed procedures and checklists in the Testing and Startup submittal. Completion of systems shall be documented by a report.
- E. The CONTRACTOR shall demonstrate utility, safety equipment, and other support systems before whole process systems.
- F. Furnish the ENGINEER and OWNER at least 10 Days written notice confirming the start of pre-commissioning activities.

3.4 UNIT START-UP / COMMISSIONING

- A. Operation of the turbine-generator and auxiliary systems by the CONTRACTOR, under observation by OWNER and OWNER-furnished Field Service Engineers shall begin at a time mutually agreed upon by the CONTRACTOR and the OWNER. OWNER-furnished Field Service Engineers for turbine-generator and other OWNER-furnished equipment will recommend start-up time, speed of rotation, and shutdown time and provide detail step-by-step start-up procedures. The OWNER or OWNER's designated representative shall witness all such testing.

3.5 MECHANICAL RUN

- A. CONTRACTOR shall furnish labor, supervision, and equipment to perform the following:
 - 1. Watering of the penstock (under OWNER supervision) and turbine in accordance with an approved procedure developed by CONTRACTOR and approved by the OWNER.
 - 2. Start-up of generating unit shall proceed with speed increased in increments as recommended by the OWNER-furnished Field Service Engineer.
 - 3. Observe and record data including, but not limited to:
 - a. Shaft run-outs.

- b. Bearing temperatures.
 - c. Time required for temperature stabilization (at normal speed operation).
 - d. Vibration levels including orbits of the shaft at all bearings.
4. OWNER's Field Service Engineer can request the immediate shutdown of the unit during the mechanical run.
5. Tests and adjustments shall be made by OWNER's Field Service Engineers, with support from CONTRACTOR, including, but not limited to, the following:
- a. Governor at rated speed, at no-load.
 - b. Shutdown circuits.
 - c. Speed indicator settings.
 - d. Speed switch calibration and adjustment.
 - e. Frequency control testing and adjustment.

3.6 ON-LINE OPERATION

- A. Following required Utility check-out, synchronizing phasing tests by CONTRACTOR and other required work, once a unit is on-line, CONTRACTOR shall coordinate with OWNERS operating personnel in testing and adjusting the following:
- 1. Load rejection in incremental stages to unit maximum.
 - 2. Tests and adjustments as directed by OWNER's Field Service Engineers, which shall include but not be limited to excitation tests, voltage regulation tests, etc.
 - 3. Measurements of turbine and generator temperatures, flow rates and other parameters shall be recorded and monitored.
 - 4. All trip and lockout relay operations.

3.7 PERFORMANCE TESTS

- A. In accordance with approved procedures, CONTRACTOR shall perform tests, including but not limited to those below and as elsewhere specified, under the supervision of OWNER and with participation of the OWNER-furnished Field Service Engineer.
- 1. Operational tests of all auxiliary equipment, including hydraulic power and all water systems.
 - 2. Running tests from no-load to full-load to establish tolerances and inspections for final adjustment of alignment, shaft run-outs and clearances, rotor balance, and all other components.

3. Megger test for insulation resistance of generator and main transformer per ANSI/IEEE No. 62.
 4. Heat run to determine the temperature rise of various parts of generator when operating continuously at rated output.
- B. Confirm the accuracy of turbine-generator balance and alignment by measurement of vibration amplitudes of the installed unit.
 - C. Excitation equipment test: the excitation response and general adequacy of the systems will be tested and adjusted in conjunction with acceptance tests, forming a part of the generator tests.
 - D. Switchgear test: Switchgear and control panels shall be tested to verify specified performance and functions.
 - E. Substation tests: Substation tests shall be tested to verify specified performance and functions of controls modified by CONTRACTOR.
 - F. Control system test: Control system shall be tested to verify programming accuracy. All inputs, outputs, alarm and trip points shall be tested. Full automatic and manual operating modes shall be fully tested to verify all features are operational. Auto synchronizer shall be adjusted and test-operated to assure good performance. Interface with Remote SCADA system shall be fully tested to verify acceptable operation.
 - G. Dam / Intake: Control and monitoring of the energy recovery pumps by the unit control system at the powerhouse, and accurate reading of all instrumentation at the intake.
 - H. Auxiliary Equipment tests: CONTRACTOR shall test and verify correct operation of CONTRACTOR-supplied auxiliary equipment, including but not limited to: lighting system, air ventilation system with louver interlocks, control room air conditioning system, fire alarm system, and turbidity monitoring instrumentation system.
 - I. Video Surveillance: Verify operation of all video cameras, including at the dam, are being recorded by the NVR, and can be view remotely from the OWNER's dispatch office in Petersburg.

3.8 TEN-DAY TEST

- A. After all testing and calibration described above is satisfactorily completed, CONTRACTOR shall request approval from OWNER to begin a 10-day acceptance test. Upon approval by OWNER, CONTRACTOR in cooperation with Field Service Engineers from OWNER's equipment suppliers, shall continuously operate the completed project for 10 continuous days with no more than a cumulative total of four hours of plant shutdown. The CONTRACTOR will man the plant continuously for 24-hours per day during this test using his own and project operations staff. Should the plant be shutdown for more than four hours during this test, the entire test must be restarted for a new 10-day continuous period, with the same four-hour shutdown limitation. After completion of the ten-day test to the satisfaction of the OWNER, all responsibility for plant operations passes to the OWNER and CONTRACTOR may apply for Substantial Completion.

- END OF SECTION -

SECTION 02 24 00 – SUBSURFACE EXPLORATION SURVEY

PART 1 -- GENERAL

1.1 SUMMARY

- A. Subsurface soil borings and investigations in the vicinity of the construction site powerhouse have been made and are exhibited in the geotechnical investigation reports included in the Contract Documents (Appendix) for review and reference by the CONTRACTOR. The report is titled *Geotechnical Report – Blind Slough Hydroelectric Project*
 - 1 The above referenced reports, as bound herein, are for reference only as an indication of the existing conditions in the areas tested. The information and recommendations contained in the reports were used as a basis for the preparation of the Contract Documents but have not necessarily been followed in every aspect. In the event of conflict between the specifications or Drawings and the geotechnical reports, the specifications and drawings shall take precedent.
 - 2 The CONTRACTOR may use the reports as an advisory document but is obligated to identify all other conditions that may exist above or below the site in order to perform the work in accordance with the Contract Documents
- B. CONTRACTOR shall examine the site and make any additional subsurface investigations necessary to ascertain the conditions they might encounter as deemed necessary by the CONTRACTOR.
- C. Any conclusions or decisions arrived at on the basis of soils borings shall be the responsibility of the CONTRACTOR. For boring logs provided in the Geotechnical Reports provided by the OWNER, the OWNER does not indicate or infer that they represent underground conditions at other parts of the site.
- D. CONTRACTOR is advised that ground water tables could change from those observed at the time of bidding or from those observed at the time of field investigations. Any such variation in the water table elevations will not be considered as a changed condition by the OWNER and no extra costs will be allowed for such circumstance.
- E. CONTRACTOR shall visit the site and become thoroughly familiar with all site conditions prior to submitting a bid. No additional compensation will be considered for the bidder's failure to become thoroughly familiar with the site conditions.

1.2 DESCRIPTION

- A. Subsurface explorations have been performed by McMillen Jacobs Associates. for the powerhouse area of the project only and they are bound herein in their entirety.
- B. The above referenced reports, as bound herein, are for reference only as an indication of the existing conditions in the areas tested. The information and recommendations contained in the report were used as a basis for the preparation of the Contract Documents but have not necessarily been followed in every aspect. In the event of conflict between the specifications and drawings and the geotechnical

report, the specifications and drawings will take precedent.

- C. The CONTRACTOR may use the report as an advisory document but is obligated to identify all other conditions that may exist on and below the site in order to prepare the site to support the structures and access roads in accordance with the Contract Documents.

1.3 SITE INVESTIGATION

- A. The CONTRACTOR and all other affected contractors shall visit the site and become acquainted with the site conditions, prior to submittal of Bid Proposal.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

- END OF SECTION -

SECTION 02 41 00 – DEMOLITION, SALVAGE, AND REHABILITATION

PART 1 -- GENERAL

1.1 SUMMARY

- A. The CONTRACTOR shall demolish and reconstruct existing powerhouse structural, architectural doors, turbine-generator system mechanical and electrical facilities, and HVAC components as indicated on the Contract Drawings. In addition, CONTRACTOR shall demolish and reconstruct existing portion of the lower penstock pipeline and construct new thrust blocks and reconstruct existing penstock features (pipe supports, coupling accessories, etc.) as indicated on the Contract Drawings.

1.2 COORDINATION

- A. **Construction and Schedule Constraints.** The CONTRACTOR shall carefully coordinate the WORK in areas where existing facilities are interconnected with new facilities and where existing facilities remain operational. The WORK as indicated is not all inclusive, and the CONTRACTOR shall be responsible to perform the reconstruction indicated plus that which can be reasonably inferred from the Contract Documents as necessary to complete the Project. The Specifications and Drawings identify the major facilities that shall be demolished and reconstructed, but auxiliary utilities such as water, air, drainage, lubrication, hydraulic oil systems, electrical wiring, controls, and instrumentation are not necessarily shown. The CONTRACTOR shall comply with any sequencing requirements and scheduling constraints as indicated in Section 01 14 16 - Construction and Schedule Constraints.
- B. **Incomplete Record Drawings.** The CONTRACTOR shall note that the Drawings used to indicate demolition and reconstruction are based on OWNER furnished design drawings of the existing facilities, which are known to be incomplete and may not have all existing facilities properly represented. These record drawings have been reproduced to show existing conditions and to clarify the scope of WORK as much as possible. Prior to bidding, the CONTRACTOR shall conduct a comprehensive survey at the Site to verify the correctness and exactness of the Drawings, the scope of WORK, and the extent of auxiliary utilities.
- C. While demolition and reconstruction are being performed, the CONTRACTOR shall provide adequate access for the continued maintenance of flows to the Crystal Lake Fish Hatchery. The CONTRACTOR shall erect and maintain fences, warning signs, barricades, and other devices around the reconstruction as required for the protection of the CONTRACTOR's employees and the OWNER's personnel at the plant. The CONTRACTOR shall remove such protection when reconstruction activities are complete, or as work progresses, or when directed by the ENGINEER.

1.3 CONTRACTOR SUBMITTALS

- A. Demolition and reconstruction activities and procedures, including operational sequence, shall be submitted to the ENGINEER for approval. The procedures shall provide for safe conduct of the WORK, careful removal and disposition of materials and equipment, protection of existing facilities which are to remain undisturbed, coordination with existing facilities to remain in service, and timely disconnection and reconnection of utility

services. The procedures shall include a detailed description and time schedule of the methods and equipment to be used for each operation and the sequence of operation. A storage plan for salvaged items shall be included.

1.4 DEMOLITION

- A. Existing structures, equipment, piping, valves, ductwork, electrical gear, instrumentation, utilities, and related appurtenances such as existing turbine-generator equipment and related accessories indicated or required to be demolished as part of the WORK shall be removed and disposed of unless otherwise indicated. Removal of buried structures, utilities, and appurtenances includes the related excavation and backfill as required. Removed items shall be disposed of offsite, at approved locations by the OWNER and State of Alaska, by the CONTRACTOR.
- B. CONTRACTOR shall consult the Contract Drawings to determine all items and equipment that require removal.

1.5 SALVAGE

- A. Items of existing equipment, piping, valves, electrical gear, instrumentation, utilities, and appurtenances indicated to be salvaged shall be removed without any degradation in condition from that prior to removal. Salvaged items shall be stockpiled and protected on the Site at a location directed by the ENGINEER. The CONTRACTOR shall be responsible to properly safeguard the salvaged items against damage and loss during removal and handling.
- B. CONTRACTOR shall consult the Contract Drawings to determine all items and equipment that require salvaging.

1.6 RELOCATION

- A. Items of existing equipment, piping, valves, electrical gear, instrumentation, utilities, and appurtenances required to be relocated shall be removed without any degradation in condition from that prior to removal. The CONTRACTOR shall be responsible to properly safeguard the relocated items against damage and loss during removal, handling, storage, and installation in the new location.
- B. CONTRACTOR shall consult the Contract Drawings to determine all items and equipment that require relocation.

1.7 ABANDONMENT

- A. Items of existing equipment, piping, valves, electrical gear, instrumentation, utilities, and appurtenances required to be abandoned shall be prepared by the CONTRACTOR as indicated.
- B. CONTRACTOR shall consult the Contract Drawings to determine all items and equipment that require abandonment.

1.8 REHABILITATION

- A. Existing civil, landscaping, structural, architectural, mechanical, HVAC, electrical, and

instrumentation WORK disturbed or damaged by reconstruction activities shall be repaired and rehabilitated as indicated.

- B. Damaged items shall be repaired or replaced with new items to restore items or surfaces to a condition equal to and matching that existing prior to damage.
- C. In buildings with reconstruction work, the CONTRACTOR shall not use any OWNER equipment (e.g., bridge cranes and monorails) unless authorized in advance in writing by the ENGINEER. Such authorization shall be subject to documentation by the CONTRACTOR of the load proposed to place on the equipment and be subject to OWNER requirements for crane use for operating and maintenance needs. Any damage to a crane shall be repaired or replaced to the ENGINEER's satisfaction.

1.9 DISPOSAL

- A. The CONTRACTOR shall be responsible for the offsite disposal of debris resulting from reconstruction in compliance with local, state, and federal codes and requirements.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION

3.1 GENERAL

- A. The CONTRACTOR shall coordinate demolition and reconstruction WORK with the OWNER and ENGINEER. Unless otherwise indicated, the CONTRACTOR shall be responsible for the sequence of activities. WORK shall be performed in accordance with applicable safety rules and regulations.
- B. The CONTRACTOR shall verify that any utilities connected to structures, equipment, and facilities to be removed, relocated, salvaged, replaced, or abandoned are rendered inoperable, replaced with new utilities, or adequately bypassed with temporary utilities before proceeding with demolition and reconstruction.
- C. The CONTRACTOR shall take precautions to avoid damage to adjacent facilities and to limit the WORK activities to the extent indicated. If reconstruction beyond the scope indicated is required, the CONTRACTOR shall obtain approval from the ENGINEER prior to commencing.

3.2 PROTECTION OF EXISTING FACILITIES

- A. Before beginning any reconstruction, the CONTRACTOR shall carefully survey the existing facilities and examine the Specifications and Drawings to determine the extent of reconstruction and coordination with the WORK. Existing facilities not subject to reconstruction shall be protected and maintained in accordance with Section 01 56 10 - Protection of Existing Facilities. Damaged existing facilities shall be repaired to the previous condition or replaced.
- B. Persons shall be afforded safe passages around areas of demolition.
- C. Structural elements shall not be overloaded. The CONTRACTOR shall be responsible

for shoring, bracing, or adding new supports as may be required for adequate structural support as a result of WORK performed under this Section. The CONTRACTOR shall remove temporary protection when the WORK is complete or when so authorized by the ENGINEER.

- D. The CONTRACTOR shall carefully consider bearing loads and capacities before placement of equipment and material on Site. In the event of any questions as to whether an area to be loaded has adequate bearing capacity, the CONTRACTOR shall consult with the ENGINEER prior to the placement of such equipment or material.

3.3 DEMOLITION, SALVAGE, AND RELOCATION

- A. The Contract Documents indicate existing facilities to be demolished, salvaged, and/or relocated. Auxiliary utilities including such services as water, air, chemicals, drainage, lubrication, fluid power, electrical wiring, controls, and instrumentation are not necessarily indicated. The CONTRACTOR shall verify the scope of the WORK to remove the equipment indicated; coordinate its shutdown, removal, replacement, or relocation; and submit an outage plan in accordance with Section 01 14 00 - Construction Constraints. The removal of existing facilities for demolition, salvage, and relocation shall include the following requirements:

1. Equipment supports, including concrete pads, baseplates, mounting bolts, and support hangers, shall be removed. Damage to the existing structure shall be repaired as indicated.
2. Exposed piping including vents, drains, and valves shall be removed. Where exposed piping penetrates existing floors and walls, the piping, including wall thimbles, shall be removed to a minimum depth of 2-inches. Resultant openings in the structure shall be repaired as indicated.
3. Electrical control panels, junction boxes, motor control centers, and local switches and pushbuttons shall be removed.
4. Exposed electrical conduits and associated wiring shall be removed. Resultant openings in structures shall be repaired as indicated.
5. Connections to embedded electrical conduits shall be removed a minimum of 2-inches inside the finished surface of the existing structure. Wiring shall be removed and the resulting openings shall be repaired as indicated.
6. Associated instrumentation devices shall be removed.
7. Auxiliary utility support systems shall be removed.
8. The area shall be thoroughly cleaned such that little or no evidence of the previous equipment installation will remain.
9. Asphalt and concrete pavement, curbs, and gutters shall be removed as necessary to perform reconstruction. The limits of removal shall be sawcut. When the required improvements have been constructed, new asphalt and concrete pavement, curbs, and gutters shall be placed to match the original unless otherwise indicated.

10. Footings, foundation walls, below-grade construction and concrete slabs on grade shall be demolished and removed to a depth which will not interfere with new construction, but not less than 36-inches below existing ground surface or future ground surface, whichever is lower.
 11. Below-grade areas and voids resulting from demolition of structures shall be completely filled. Fill and compaction shall be in accordance with Section 31 00 00 - Earthwork. After fill and compaction, surfaces shall be graded to meet adjacent contours and to provide flow to surface drainage structures, or as indicated.
 12. When existing pipe is removed, the CONTRACTOR shall plug the resulting open ends whether or not so indicated. Where removed piping is exposed, the remaining piping shall be blind-flanged or fitted with a removable cap or plug.
 13. When existing piping is removed from existing structures, the CONTRACTOR shall fill resulting openings in the structures and repair any damage such that the finished rehabilitated structure shall appear as a new homogeneous unit with little or no indication of where the new and old materials join. The openings in water-bearing structures shall be filled with non-shrink grout to be watertight and reinforced as required or indicated. In locations where the surface of the grout will be exposed to view, the grout shall be recessed approximately 0.5-inch and the recessed area filled with cement mortar grout.
 14. Electrical reconstruction shall be conducted by the CONTRACTOR in a safe and proper manner to avoid injury from electrical shock to the OWNER's and CONTRACTOR's personnel. Electrical equipment to be shut off for a period of time shall be tagged, locked out, and sealed with a crimped wire and lead seal and made inoperable. At no time shall electrical wiring or connections which are energized or could become energized be accessible to CONTRACTOR, OWNER, or other personnel without suitable protection or warning signs.
- B. The CONTRACTOR shall perform a functional test of existing equipment that is relocated and reinstalled to ensure the equipment functions in the manner documented during the initial inspection. The CONTRACTOR shall inform the ENGINEER in writing a minimum of 5 Days prior to the functional testing in order for the OWNER and ENGINEER to witness the test. If, in the opinion of the ENGINEER, the relocated equipment does not function in a satisfactory manner, the CONTRACTOR shall make repairs and modifications necessary to restore the equipment to its original operating condition at no additional cost to the OWNER.

3.4 ABANDONMENT

- A. Existing facilities to be abandoned shall be prepared as indicated. Where existing buried piping is to be abandoned, the CONTRACTOR shall remove the abandoned pipe for a distance of 5-feet from any connecting structures. Openings at the existing structures shall be repaired. The remaining pipe shall be capped at both ends prior to backfill. Buried piping, 12-inches diameter or greater shall be completely sand-filled prior to closure of the piping ends.

3.5 REHABILITATION

- A. Certain areas of existing structures, piping, conduits, and the like will be affected by WORK necessary to complete modifications under this Contract. The CONTRACTOR shall be responsible to rehabilitate those areas affected by its construction activities.
- B. Where new rectangular openings are to be installed in concrete walls or floors, the CONTRACTOR shall score the edges of each opening (both sides of wall or floor slab) by saw-cutting clean straight lines to a minimum depth of 1-inch and then chipping out the concrete. Alternately, the sides of the opening (not the corners) may be formed by saw cutting completely through the slab or wall. Saw cuts deeper than 1-inch (or the depth of cover over existing reinforcing steel, whichever is less) shall not be allowed to extend beyond the limits of the opening. Corners shall be made square and true by a combination of core drilling and chipping or grinding. Necessary precautions shall be taken during removal of concrete to prevent debris from falling into or entering adjacent tanks in service or from damaging adjacent equipment or piping. Saw cuts allowed to extend beyond the opening shall be repaired by filling with non-shrink grout. The concrete around any exposed reinforcement steel shall be chipped back and exposed reinforcement steel cut a minimum of 2-inches from the finished face of the new opening and be painted with epoxy paint. The inside face of the new opening shall be grouted with an epoxy cement grout to fill any voids and cover the exposed aggregate and shall be trowel-finished to provide a plumb and square opening.
- C. Where new piping is installed in existing structures, the CONTRACTOR shall accurately position core-drilled openings in the concrete as indicated or otherwise required. Openings shall be of sufficient size to permit a final alignment of pipelines and fittings without deflection of any part and to allow adequate space for satisfactory packing where pipe passes through the wall to provide watertightness around openings so formed. The boxes or cores shall be provided with continuous keyways to hold the filling material in place, and they shall have a slight flare to facilitate grouting and the escape of entrained air during grouting. Before placing the non-shrink grout, concrete surfaces shall be sandblasted, thoroughly cleaned of sand and any other foreign matter, and coated with epoxy bonding compound.
- D. Pipes, castings, or conduits shall be grouted in place by pouring in grout under a head of at least 4-inches. The grout shall be poured or rammed or vibrated into place to fill completely the space between the pipes, castings, or conduits, and the sides of the openings so as to obtain the same watertightness as through the wall itself. The grouted casings shall then be water cured.
- E. In locations where the surface of the grout will be exposed to view, the non-shrink grout shall be recessed approximately 0.5-inch and the recessed area filled with cement mortar grout.
- F. When new piping is to be connected to existing piping, the existing piping shall be cut square and ends properly prepared for the connection. Any damage to the lining and coating of the existing piping shall be repaired. Dielectric insulating joints shall be installed at interconnections between new and existing piping.
- G. Where existing equipment, piping, and supports, electrical panels and devices, conduits, and associated appurtenances are removed, the CONTRACTOR shall rehabilitate the

affected area such that little or no evidence of the previous installation remains. Openings in concrete floors, walls, and ceilings from piping, conduit, and fastener penetrations shall be filled with non-shrink grout and finished to match the adjacent area. Concrete pads, bases associated with equipment, supports, and appurtenances shall be removed by chipping away concrete and cutting any exposed reinforced steel and anchor bolts a minimum of 2-inches below finished grade and be painted with epoxy paint. The area of concrete to be rehabilitated shall be scored by saw cutting clean, straight lines to a minimum depth of 1.5-inches, and concrete within the scored lines removed to a depth of 1.5-inches (or the depth of cover over reinforcing steel, whichever is less). The area within the scored lines shall be patched with non-shrink grout to match the adjacent grade and finish. Abandoned connections to piping and conduits shall be terminated with blind flanges, caps, and plugs suited for the material, type, and service of the pipe or conduit.

- H. Existing reinforcement to remain in place shall be protected, cleaned, and extended into new concrete. Existing reinforcement not to be retained shall be cut-off as follows:
 - 1. Where new concrete joins existing concrete at the removal line, reinforcement shall be cut-off flush with the concrete surface at the removal line.
 - 2. Where the concrete surface at the removal line is the finished surface, the reinforcement shall be cut back 2-inches below the finished concrete surface, the ends painted with epoxy paint and the remaining holes patched with a cement mortar grout.
- I. Where existing handrailing is removed, post embedments and anchors shall be removed and post holes shall be filled with non-shrink grout flush to the floor or adjoining surface. At the point of continuation of existing handrailing, a new post with rail connections matching the existing handrailing system shall be installed. New posts in existing concrete floors shall be installed in core-drilled socket holes and the annular space between the post and hole filled with non-shrink grout.
- J. Where reconstruction activities damage the painting and coating of adjacent or nearby facilities, the damaged areas shall be surface prepared and coated in accordance with Section 09 96 00 - Protective Coatings to match the original painting and coating with a compatible system. Surfaces of equipment items that are to be relocated shall be prepared and be coated in accordance with Section 09 96 00 - Protective Coatings.

3.6 DISPOSAL

- A. Demolition and removal of debris shall minimize interference with roads, streets, walks, and other adjacent occupied or used facilities which shall not be closed or obstructed without permission from the OWNER. Alternate routes shall be provided around closed or obstructed traffic ways.
- B. Site debris, rubbish, and other materials resulting from reconstruction operations shall be legally removed and disposed of. Structures and equipment to be demolished shall be cleaned prior to demolition and the wash water properly disposed of. No trace of these structures shall remain prior to placing of backfill in the areas from which structures were removed.

- C. Refuse, debris, and waste materials resulting from demolition and clearing operations shall not be burned.

3.7 OCCUPANCY AND POLLUTION CONTROL

- A. Water sprinkling, temporary enclosures, chutes, and other suitable methods shall be used to limit dust and dirt rising and scattering in the area. The CONTRACTOR shall comply with government regulations pertaining to environmental protection.
- B. Water shall not be used if it creates hazardous or objectionable conditions such as ice, flooding, or pollution.

3.8 CLEANING

- A. During and upon completion of WORK, the CONTRACTOR shall promptly remove tools and equipment, surplus materials, rubbish, debris, and dust and shall leave areas affected by WORK in a clean, approved condition.
- B. Adjacent structures shall be cleaned of dust, dirt, and debris caused by reconstruction, as directed by the ENGINEER or governing authorities, and adjacent areas shall be returned to condition existing prior to start of WORK.

- END OF SECTION -

SECTION 03 11 13 - CONCRETE FORMWORK

PART 1 -- GENERAL

1.1 SUMMARY

- A. The CONTRACTOR shall furnish concrete formwork, bracing, shoring, and supports for cast-in-place concrete and shall design and construct falsework, all in accordance with the Contract Documents.

1.2 CONTRACTOR SUBMITTALS

- A. Furnish submittals in accordance with Section 01 33 00 - Contractor Submittals.
- B. Manufacturer's information demonstrating compliance with requirements for the following:
 - 1. Form ties and related accessories.
 - 2. Form gaskets.
 - 3. Form release agent, including NSF certification if not using mineral oil.

1.3 QUALITY CONTROL

- A. **Tolerances:** The variation from required lines or grade shall not exceed 1/4-inch in 10-feet, non-cumulative, and there shall be no offsets or visible waviness in the finished surface. Other tolerances shall be within the tolerances of ACI 117 - Standard Tolerances for Concrete Construction and Materials

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Except as otherwise expressly accepted by the ENGINEER, lumber brought on the Site for use as forms, shoring, or bracing shall be new material. Forms shall be smooth surface forms and shall be of the following materials:

Walls	Steel, fiberglass, or plywood panel
Floor	Plywood
All other WORK	Steel panels, plywood or tongue and groove lumber

2.2 FORM AND FALSEWORK MATERIALS

- A. **Materials.** Materials for concrete forms, formwork, and falsework shall conform to the following requirements:

1. Lumber shall be Douglas Fir or Southern Yellow Pine, construction grade or better, in conformance with U.S. Product Standard PS 20 - American Softwood Lumber Standard
 2. Plywood for concrete formwork shall be new, waterproof, synthetic resin bonded, exterior type Douglas Fir or Southern Yellow Pine plywood manufactured especially for concrete formwork, shall conform to the requirements of PS 1 – Construction and Industrial Plywood, for Concrete Forms, Class I, and shall be edge sealed.
 3. Form materials shall be metal, wood, plywood, or other material that will not adversely affect the concrete and will facilitate placement of concrete to the shape, form, line, and grade indicated. Metal forms shall accomplish such results. Wood forms for surfaces to be painted shall be Medium Density Overlaid plywood, MDO Ext. Grade.
 4. Steel leave in place forms shall not be used.
- B. **Chamfer Edges.** Unless otherwise indicated, exterior corners in concrete members shall be provided with 3/4-inch chamfers or be tooled to 0.5-inch radius. Re-entrant corners in concrete members shall not have fillets unless otherwise indicated.

2.3 FORM TIES

- A. Form ties shall be provided with a plastic cone or other suitable means for forming a conical hole to insure that the form tie may be broken off back of the face of the concrete. The maximum diameter of removable cones for rod ties or other removable form tie fasteners having a circular cross-section shall not exceed 1.5 inches; and all such fasteners shall be such as to leave holes of regular shape for reaming. Form ties for water-retaining structures shall have integral waterstops that tightly fit the form tie so that they cannot be moved from mid-point of the tie. Form ties shall be **Wrench Head Snap Tie** by **MeadowBurke**; **Snap-Ties** by **Dayton/Richmond**; or equal.
- B. Removable taper ties may be used when approved by the ENGINEER. A preformed neoprene or polyurethane tapered plug sized to seat at the center of the wall shall be inserted in the hole left by the removal of the taper tie. Use **Taper-Tie** by **MeadowBurke**, **Taper-Tie** by **Dayton/Richmond**, or equal.

PART 3 -- EXECUTION

3.1 GENERAL

- A. **Design Responsibility.** Forms to confine the concrete and shape it to the required lines shall be used wherever necessary. The CONTRACTOR shall assume full responsibility for the adequate design of forms, and any forms that are unsafe or inadequate in any respect shall promptly be removed from the WORK and replaced.
1. A sufficient number of forms of each kind shall be available to permit the required rate of progress to be maintained.
 2. Provide worker protection from protruding reinforcement bars in accordance with applicable safety codes.

3. The design and inspection of concrete forms, and shoring shall comply with applicable local, state, and Federal regulations.
 4. Plumb and string lines shall be installed before concrete placement and shall be maintained during placement. Such lines shall be used by CONTRACTOR's personnel and by the ENGINEER and shall be in sufficient number and properly installed. During concrete placement, the CONTRACTOR shall continually monitor plumb and string line form positions and immediately correct deficiencies.
- B. **Quality Control & Bracing.** Concrete forms shall conform to the shape, lines, and dimensions of members required, and shall be substantial, free from surface defects, and sufficiently tight to prevent leakage. Forms shall be properly braced or tied together to maintain their position and shape under a load of freshly-placed concrete. If adequate foundation for shores cannot be secured, trussed supports shall be provided.
- C. All forms shall be removed, after the appropriate curing times have been obtained, unless approved otherwise by the ENGINEER.

3.2 FORM DESIGN

- A. Forms shall be true in every respect to the required shape and size, shall conform to the established alignment and grade, and shall be of sufficient strength and rigidity to maintain their position and shape under the loads and operations incident to placing and vibrating the concrete. Suitable and effective means shall be provided on forms for holding adjacent edges and ends of panels and sections tightly together and in accurate alignment so as to prevent the formation of ridges, fins, offsets, or similar surface defects in the finished concrete.
1. Plywood, 5/8-inch and greater in thickness, may be fastened directly to studding if the studs are spaced close enough to prevent visible deflection marks in the concrete.
 2. The forms shall be tight so as to prevent the loss of water, cement, and fines during placing and vibrating of the concrete. Specifically, the bottom of wall forms that rest on concrete footings or slabs shall be provided with a gasket to prevent loss of fines and paste during placement and vibration of concrete. Such gasket may be a 1.0- to 1.5-inch diameter polyethylene rod held in position to the underside of the wall form.
 3. Adequate clean-out holes shall be provided at the bottom of each lift of forms. The size, number, and location of such clean-outs shall be as acceptable to the ENGINEER.
 4. Whenever concrete cannot be placed from the top of a wall form in a manner that meets the requirements of the Contract Documents, form windows shall be provided in the size and spacing needed to allow placement of concrete to the requirements of Section 03 30 00 - Cast-in-Place Concrete. The size, number, and location of such form windows shall be as acceptable to the ENGINEER.

3.3 CONSTRUCTION

- A. **Vertical Surfaces:** Vertical surfaces of concrete members shall be formed, except where placement of the concrete against the ground is indicated. Not less than 1-inch of concrete shall be added to the indicated thickness of a concrete member where concrete is permitted to be placed against trimmed ground in lieu of forms. Permission to do this on other concrete members will be granted only for members of comparatively limited height and where the character of the ground is such that it can be trimmed to the required lines and will stand securely without caving or sloughing until the concrete has been placed.
- B. **Form Ties**
1. **Embedded Ties:** Holes left by the removal of form tie cones shall be reamed with suitable toothed reamers so as to leave the surface of the holes clean and rough before being filled with mortar. Wire ties for holding forms will not be permitted. No form-tying device or part thereof, other than metal, shall be left embedded in the concrete. Ties shall not be removed in such manner as to leave a hole extending through the interior of the concrete members. The use of snap-ties that cause spalling of the concrete upon form stripping or tie removal will not be permitted. If steel panel forms are used, rubber grommets shall be provided where the ties pass through the form in order to prevent loss of cement paste. Where metal rods extending through the concrete are used to support or to strengthen forms, the rods shall remain embedded and shall terminate not less than 1-inch back from the formed face or faces of the concrete.

3.4 REUSE OF FORMS

- A. Forms may be reused only if in good condition and only if acceptable to the ENGINEER. Light sanding between uses will be required wherever necessary to obtain uniform surface texture on exposed concrete surfaces. Exposed concrete surfaces are defined as surfaces which are permanently exposed to view. In the case of forms for the inside wall surfaces of hydraulic/water retaining structures, unused tie rod holes in forms shall be covered with metal caps or shall be filled by other methods acceptable to the ENGINEER.

3.5 REMOVAL OF FORMS

- A. Careful procedures for the removal of forms shall be strictly followed, and this WORK shall be done with care so as to avoid injury to the concrete. No heavy loading on green concrete will be permitted.
1. For vertical walls of water holding structures, forms shall remain in place at least 36 hours after the concrete has been placed.
 2. For parts of the WORK not specifically mentioned herein, forms shall remain in place for periods of time as recommended in ACI 347 - Guide to Formwork for Concrete.

3.6 MAINTENANCE OF FORMS

- A. **General Condition.** Forms shall be maintained in good condition, particularly as to size, shape, strength, rigidity, tightness, and smoothness of surface. Before concrete is placed, the forms shall be thoroughly cleaned.
- B. **Form Oil.** The form surfaces shall be treated with a non-staining mineral oil or other lubricant acceptable to the ENGINEER. Any excess lubricant shall be satisfactorily removed before placing the concrete. Where field oiling of forms is required, the CONTRACTOR shall perform the oiling at least 2 weeks in advance of their use. Care shall be exercised to keep oil off the surfaces of steel reinforcement and other metal items to be embedded in concrete.

- END OF SECTION -

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SECTION 03 20 00 - REINFORCEMENT STEEL

PART 1 -- GENERAL

1.1 SUMMARY

- A. The CONTRACTOR shall provide reinforcement steel and appurtenant WORK, complete and in place, in accordance with the Contract Documents.

1.2 CONTRACTOR SUBMITTALS

- A. Furnish submittals in accordance with Section 01 33 00 - Contractor Submittals.

B. Shop Drawings

1. Shop bending diagrams, placing lists, and drawings of reinforcement steel prior to fabrication. The shop bending diagrams shall show the actual lengths of bars to the nearest inch measured to the intersection of the extensions (tangents for bars of circular cross section) of the outside surface. Include bar placement diagrams that clearly indicate the dimensions of each bar splice.
2. Details of the concrete reinforcement steel and concrete inserts shall be submitted at the earliest possible date after receipt by the CONTRACTOR of the Notice to Proceed. Said details of reinforcement steel for fabrication and erection shall conform to ACI 315 - Details and Detailing of Concrete Reinforcement and the requirements herein.

1.3 QUALITY CONTROL

- A. If requested by the ENGINEER, the CONTRACTOR shall furnish samples from each heat of reinforcement steel in a quantity adequate for testing. Costs of initial tests will be paid by the OWNER. Costs of additional tests if material fails initial tests shall be the CONTRACTOR's responsibility.

PART 2 -- PRODUCTS

2.1 REINFORCEMENT STEEL

- A. **Reinforcement Steel ASTM Standards.** Reinforcement steel for cast-in-place reinforced concrete construction shall conform to the following requirements:

1. Bar and spiral reinforcement shall conform to ASTM A 615 - Deformed and Plain Billet - Steel Bars, for Grade 60 reinforcement unless otherwise indicated.

B. Accessories

1. Accessories shall include necessary chairs, slab bolsters, concrete blocks, tie wires, dips, supports, spacers, and other devices to position reinforcement during concrete placement. Bar supports shall meet the requirements of the CRSI Manual of Standard Practice. Wire bar supports shall be CRSI Class 1 for maximum

protection with a 1/8-inch minimum thickness of plastic coating that extends at least 0.5-inch from the concrete surface. Plastic shall be gray in color.

2. Concrete blocks (i.e. dobies) used to support and position reinforcement steel shall have the same or higher compressive strength as required for the concrete in which they are located. Wire ties shall be embedded in concrete block bar supports.

2.2 EPOXY RESIN ADHESIVE SYSTEMS

- A. Adhesive Systems for grouting reinforcing bars, including those using adhesive systems other than epoxy resins, shall comply with the requirements of Section 03 65 00 – Epoxy Resin Adhesive Systems.

PART 3 -- EXECUTION

3.1 GENERAL

- A. Reinforcement steel and other appurtenances shall be fabricated, and placed in accordance with the Building Code and the supplementary requirements herein.

3.2 FABRICATION

A. **General**

1. Reinforcement steel shall be accurately formed to the dimensions and shapes indicated, and the fabricating details shall be prepared in accordance with ACI 315 and ACI 318 - Building Code Requirements for Reinforced Concrete, except as modified by the Drawings. Bars shall be bent cold. Bars shall be bent per ACI 318.
2. The CONTRACTOR shall fabricate reinforcement bars for structures in accordance with bending diagrams, placing lists, and placing drawings.

- B. **Fabricating Tolerances:** Bars used for concrete reinforcement shall satisfy the following fabricating tolerances:

1. Sheared length: plus and minus 1-inch
2. Depth of truss bars: plus zero, minus 0.5-inch
3. Stirrups, ties, and spirals: plus and minus 0.5-inch
4. Other bends: plus and minus 1-inch

3.3 PLACING

- A. Reinforcement steel shall be accurately positioned as indicated and shall be supported and wired together to prevent displacement, using annealed iron wire ties or suitable clips at intersections. Reinforcement steel shall be supported by concrete, plastic or metal support spacers, or metal hangers that are strong and rigid enough to prevent any displacement of the reinforcement steel. Where concrete is to be placed on the ground, supporting concrete blocks (or dobies) shall be used in sufficient numbers to support the

bars without settlement, but in no case shall such support be continuous. Concrete blocks used to support reinforcement steel shall be tied to the steel with wire ties that are embedded in the blocks. For concrete over formwork, the CONTRACTOR shall provide concrete, metal, plastic, or other acceptable bar chairs and spacers.

- B. Limitations on the use of bar support materials shall be as follows.
 - 1. Concrete Dobbies
 - a. Permitted at any location except where architectural finish is required.
 - 2. Wire Bar Supports: permitted only at slabs over dry areas, interior dry wall surfaces, and exterior wall surfaces.
 - 3. Plastic Bar Supports: permitted at every location except on grade.
- C. Tie wires shall be bent away from the forms in order to provide the required concrete coverage.
- D. Bars additional to those indicated that may be found necessary or desirable by the CONTRACTOR for the purpose of securing reinforcement in position shall be provided by the CONTRACTOR at its own expense.
- E. Unless otherwise indicated, reinforcement placing tolerances shall be within the limits in Section 7.5 of ACI 318 except where in conflict with the Building Code.
- F. Bars may be moved as necessary to avoid interference with other reinforcement steel, conduits, or embedded items. If bars are moved more than one bar diameter or enough to exceed the above tolerances, the resulting arrangement of bars shall be as reviewed and accepted by the ENGINEER.
- G. Accessories supporting reinforcing bars shall be spaced such that there is no deflection of the accessory from the weight of the supported bars. When used to space the reinforcing bars from wall forms, the forms and bars shall be located so that there is no deflection of the accessory when the forms are tightened into position.

3.4 SPACING OF BARS

- A. The clear distance between parallel bars (except between multiple layers of bars in beams) shall be not less than the nominal diameter of the bars, nor less than 1-1/3 times the maximum size of the coarse aggregate, nor less than one-inch.
- B. Where reinforcement in beams or girders is placed in 2 or more layers, the clear distance between layers shall be not less than one-inch.
- C. The clear distance between bars shall also apply to the distance between a contact splice and adjacent splices or bars.

3.5 SPLICING

- A. **General**

1. Reinforcement bar splices shall only be used at locations indicated. When it is necessary to splice reinforcement at points other than where indicated, the character of the splice shall be as reviewed and accepted by the ENGINEER.
2. Unless otherwise indicated, dowels shall match the size and spacing of the spliced bar.

B. Splices of Reinforcement

1. The length of lap for reinforcement bars, unless otherwise indicated, shall be in accordance with ACI 318, Section 12.15.1 for a Class B splice.

- C. Bending or Straightening:** Reinforcement shall not be straightened or rebent in a manner which will injure the material. Bars shall be bent or straight as indicated. Do not use bends different from the bends indicated. Bars shall be bent cold, unless otherwise permitted by the ENGINEER. No bars partially embedded in concrete shall be field-bent except as indicated or specifically permitted by the ENGINEER.

3.6 CLEANING AND PROTECTION

- A. Reinforcement steel shall always be protected from conditions conducive to corrosion until concrete is placed around it.
- B. The surfaces of reinforcement steel and other metalwork to be in contact with concrete shall be thoroughly cleaned of dirt, grease, loose scale and rust, grout, mortar, and other foreign substances immediately before the concrete is placed. Where there is delay in depositing concrete, reinforcement shall be reinspected and, if necessary, recleaned.

3.7 EMBEDMENT OF DRILLED REINFORCING STEEL DOWELS

A. Hole Preparation

1. Preparation of the hole for the dowel shall be performed in strict accordance with the recommendations of the adhesive manufacturer.
2. The hole diameter shall be as recommended by the epoxy manufacturer but shall be no larger than 1/4-inch greater than the diameter of the outer surface of the reinforcing bar deformations, unless as recommended per the adhesive manufacturer installation procedures.
3. The depth of the hole shall be as recommended by the epoxy manufacturer to fully develop the bar but shall not be less than 12 bar diameters, unless indicated otherwise.
4. Existing reinforcing steel in the vicinity of proposed holes shall be located prior to drilling. The location of holes shall be adjusted to avoid drilling through or nicking any existing reinforcing bars.

B. Embedment

1. Epoxy shall be injected into the hole through a tube placed to the bottom of the hole. The tube shall be withdrawn as epoxy is placed but kept immersed to prevent

formation of air pockets. The hole shall be filled to a depth that insures excess material will be expelled from the hole during dowel placement.

2. Dowels shall be twisted during insertion into the partially filled hole so as to guarantee full wetting of the bar surface with epoxy. The bar shall be inserted slowly enough to avoid developing air pockets.

- END OF SECTION -

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SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 -- GENERAL

1.1 SUMMARY

- A. The CONTRACTOR shall provide cast-in-place concrete in accordance with the Contract Documents.
- B. The term "hydraulic structure" used in these Specifications means environmental engineering concrete structures for the containment, treatment, or transmission of water, wastewater, other fluids, or gases.
- C. The following types of concrete are covered in this Section:
 - 1. **Structural Concrete**
 - a. Regular Mix: Equipment pads, thrust blocks, site work, and other concrete items not indicated otherwise in the Contract Documents.

1.2 CONTRACTOR SUBMITTALS

- A. Furnish submittals in accordance with Section 01 33 00 – Contractor Submittals.
- B. **Mix Designs:** Prior to beginning the WORK and within 14 Days of the Notice to Proceed, submit preliminary concrete mix designs which shall show the proportions and gradations of materials proposed for each class and type of concrete. Mix designs shall be checked through laboratory testing by an independent testing laboratory acceptable to the ENGINEER. Costs related to laboratory testing shall be CONTRACTOR's responsibility as part of the WORK.
- C. **Delivery Tickets:** Where ready-mix concrete is used, the CONTRACTOR shall furnish delivery tickets at the time of delivery of each load of concrete. Each ticket shall show the state-certified equipment used for measuring and the total quantities, by weight, of cement, sand, each class of aggregate, admixtures, the amount of water in the aggregate added at the batching plant, and the amount allowed to be added at the Site for the specific design mix. In addition, each ticket shall state the mix number, total yield in cubic yards, and the time of day, to the nearest minute, corresponding to the times when the batch was dispatched, when it left the plant, when it arrived at the Site, when unloading began, and when unloading was finished.
- D. **Additional Submittals.** Test data relating to the cement, aggregate, and admixtures shall be less than 6 months old. Furnish the following submittals in accordance with ACI 301 – Structural Concrete:
 - 1. Mill tests for cement.
 - 2. Admixture certification. Chloride ion content shall be included.
 - 3. Aggregate gradation test results and certification.
 - 4. Materials and methods for curing.

1.3 QUALITY CONTROL

A. General

1. Tests on component materials and for compressive strength and shrinkage of concrete shall be performed as indicated. Tests for determining slump shall be in accordance with ASTM C 143 – Test Method for Slump of Hydraulic Cement Concrete.
2. Testing for aggregate shall include sand equivalence, reactivity, organic impurities, abrasion resistance, and soundness, according to ASTM C 33 – Concrete Aggregates.
3. The cost of laboratory tests on cement, aggregates, and concrete shall be the CONTRACTOR's responsibility. The cost of laboratory tests on field-placed cement, aggregates, and concrete will be the OWNER'S responsibility. However, the CONTRACTOR shall be responsible for the cost of any tests and investigations of WORK that is determined to be Defective WORK. The laboratory shall meet or exceed ASTM C 1077 – Practice for Laboratories Testing Concrete and Concrete Aggregates for use in Construction and Criteria for Laboratory Evaluation.
4. Concrete for testing shall be furnished by the CONTRACTOR, and the CONTRACTOR shall assist the ENGINEER in obtaining samples and disposal and cleanup of excess material.

B. Field Compression Tests

1. Each set of specimens shall be a minimum of 5 cylinders.
2. Compression test specimens for concrete shall be made in accordance with Section 9.2 of ASTM C 31 – Practices for Making and Curing Concrete Test Specimens in the Field. Specimens shall be 6-inches diameter by 12-inches tall cylinders.
3. Frequency of Testing
 - a. Sampling frequency and testing for each class of concrete shall be in accordance with ACI 318 section 5.6 as follows:
 - 1) Not less than once a day for each class of concrete placed, nor less than:
 - 2) Once for each 150 yd³ of each class of concrete placed each day, nor less than.
 - 3) If total volume of concrete is such that frequency of testing would provide less than five strength tests for a given class of concrete, tests shall be made from at least five randomly selected batches or from each batch if fewer than five batches are used
 - b. Frequency of testing may be changed at the discretion of the ENGINEER.
4. Compression tests shall be performed in accordance with ASTM C 39 – Test Method for Compressive Strength of Cylindrical Concrete Specimens. One test

cylinder will be tested at 7 Days and 2 at 28 Days. The remaining cylinders will be held to verify test results, if needed.

C. Evaluation and Acceptance of Concrete

1. Evaluation and acceptance of the compressive strength of concrete will be according to ACI 318 – Building Code Requirements for Reinforced Concrete, Chapter 5 "Concrete Quality," and as indicated.
2. A statistical analysis of compression test results will be performed according to ACI 214 – Recommended Practice for Evaluation of Strength Test Methods. The standard deviation of the test results shall not exceed 640 psi, when ordered at equivalent water content as estimated by slump.
3. If any concrete fails to meet these requirements, immediate corrective action shall be taken to increase the compressive strength for subsequent batches of the type of concrete affected.
4. When the standard deviation of the test results exceeds 640 psi, the average strength for which the mix is designed shall be increased by an amount necessary to satisfy the statistical requirement that the probability of any test being more than 500 psi below or the average of any 3 consecutive tests being below the required compressive strength is 1 in 100. The required average strength shall be calculated by Criterion No. 3 of ACI 214 using the actual standard deviation.
5. Concrete that fails to meet the ACI requirements and these Specifications is subject to removal and replacement.

D. Aggregate Testing: Aggregate testing shall be performed within 12 months of the start of construction and every 12 months during construction to determine continued compliance.

E. Construction Tolerances: The CONTRACTOR shall set and maintain concrete forms and perform finishing operations to ensure that the completed WORK is within tolerances. Surface defects and irregularities are defined as finishes and are different from tolerances. Tolerance is the permissible variation from lines, grades, or dimensions indicated on the Drawings. Where tolerances are not stated in the Specifications, permissible deviations will be in accordance with ACI 117 – Standard Tolerance for Concrete Construction and Materials.

1. The following non-cumulative construction tolerances apply to finished walls and slabs unless otherwise indicated:

Item	Tolerance
Variation of the constructed linear outline from the established position in plan.	In 10-feet: 1/4-inch; In 20-feet or more: 1/2-inch
Variation from the level or from the grades indicated.	In 10-feet: 1/4-inch; In 20-feet or more: 1/2-inch

Variation from plumb	In 10-feet: 1/4-inch; In 20-feet or more: 1/2-inch
Variation in the thickness of slabs and walls.	Minus 1/4-inch; Plus 1/2-inch
Variation in the locations and sizes of slabs and wall openings	Plus or minus 1/4-inch

PART 2 -- PRODUCTS

2.1 CONCRETE MATERIALS

A. General

1. Ready-mix concrete shall conform to the requirements of ASTM C 94 – Ready Mixed Concrete.
2. Cement for concrete that will contact potable water shall not be obtained from kilns that burn metal rich hazardous waste fuel.
3. Materials shall be delivered, stored, and handled so as to prevent damage by water or breakage. Cement reclaimed from cleaning bags or leaking containers shall not be used. Cement shall be used in the sequence of receipt of shipments.

B. Storage of materials shall comply with ACI 301, as applicable.

C. **Materials.** Materials for concrete shall comply with ACI 301 and shall conform to the following requirements:

1. **Cement.** Cement shall be standard brand portland cement conforming to ASTM C 150 –Portland Cement, for Type I/II or Type V. A minimum of 85 percent of cement by weight shall pass a 325 screen. A single brand of cement shall be used throughout the WORK, and prior to its use, the brand shall be accepted by the ENGINEER. The cement shall be suitably protected from exposure to moisture until used. Cement that has become lumpy shall not be used. Sacked cement shall be stored in such a manner so as to permit access for inspection and sampling. Certified mill test reports, including fineness, for each shipment of cement to be used shall be submitted to the ENGINEER, if requested, regarding compliance with the Specifications.
2. **Water.** Water for mixing and curing shall be potable, clean, and free from objectionable quantities of silty organic matter, alkali, salts, and other impurities. The water shall be considered potable, for the purposes of this Section only, if it meets the requirements of the local governmental agencies. Agricultural water with high total dissolved solids (greater than 1000 mg/l TDS) shall not be used.
3. **Aggregates.** Aggregates shall be obtained from pits acceptable to the ENGINEER, shall be non-reactive, and shall conform to ASTM C 33 – Concrete Aggregates.

Maximum size of coarse aggregate shall be as indicated. Substituting lightweight sand for fine aggregate will not be permitted.

a. Coarse aggregates shall consist of clean, hard, durable gravel, crushed gravel, crushed rock, or a combination thereof. The coarse aggregates shall be prepared and handled in 2 or more size groups for combined aggregates with a maximum size greater than 3/4-inch. When the aggregates are proportioned for each batch of concrete, the 2 size groups shall be combined.

b. Fine aggregates shall be natural sand or a combination of natural and manufactured sand that is hard and durable. When tested in accordance with ASTM D 2419 – Test Methods for Sand Equivalent Value of Soils and Fine Aggregate, the sand equivalency shall not be less than 75 percent for an average of 3 samples, nor less than 70 percent for an individual test. Gradation of fine aggregate shall conform to ASTM C 33 when tested in accordance with ASTM C 136 for the fineness modulus of the sand used, including the optional grading in Section 6.2. The fineness modulus of sand used shall not be over 3.1.

c. Combined aggregates shall be well graded from coarse to fine sizes and shall be uniformly graded between screen sizes to produce concrete that has optimum workability and consolidation characteristics.

d. When tested in accordance with ASTM C 33, the ratio of silica released to reduction in alkalinity shall not exceed 1.0.

e. When tested in accordance with ASTM C 33, the fine aggregate shall produce a color in the supernatant liquid no darker than the reference standard color solution.

f. When tested in accordance with ASTM C 33, the coarse aggregate shall show a loss not exceeding 42 percent after 500 revolutions or 10.5 percent after 100 revolutions.

g. When tested in accordance with ASTM C 33, the loss resulting after 5 cycles of the soundness test shall not exceed 10 percent for fine aggregate and 12 percent for coarse aggregate when using sodium sulfate.

4. **Flyash.** If used, flyash shall be Class F and meet ASTM C618.

5. **Admixtures.** Admixtures shall be compatible and be furnished by a single manufacturer capable of providing qualified field service representation. Admixtures shall be used in accordance with manufacturer's recommendations. If the use of an admixture is producing an inferior end result, the CONTRACTOR shall discontinue use of the admixture. Admixtures shall not contain thiocyanates nor more than 0.05 percent chloride ion, and shall be non-toxic after 30 days.

a. **Air-entraining agents:** Agents shall meet the requirements of ASTM C 260 – Air Entraining Admixtures for Concrete shall be used. The OWNER reserves the right, at any time, to sample and test the air-entraining agent. The air-entraining agent shall be added to the batch in a portion of the mixing water. The solution shall be batched by means of a mechanical batcher capable of accurate

measurement. Air content shall be tested at the point of placement. Air-entraining admixture shall be approved by the ENGINEER prior to use.

b. **Set controlling and water reducing admixtures:** Admixtures may be added at the CONTRACTOR's option, subject to the ENGINEER's approval, to control the set, effect water reduction, and increase workability. The cost of adding an admixture shall be the CONTRACTOR's responsibility. Concrete containing an admixture shall be first placed at a location determined by the ENGINEER. Admixtures shall conform to ASTM C 494 – Chemical Admixtures for Concrete. The required quantity of cement shall be used in the mix regardless of whether or not an admixture is used.

- 1) Concrete shall not contain more than one water reducing admixture.
- 2) Set controlling admixture may be either with or without water-reducing properties. Admixture shall be appropriate for the air temperature at time of placement. Set controlling admixture shall be approved by the ENGINEER prior to use.
- 3) Normal range water reducer shall conform to ASTM C 494, Type A. The quantity of admixture used and the method of mixing shall be in accordance with the manufacturer's instructions and recommendations. Normal range water reducing admixtures shall be approved by the ENGINEER prior to use.
- 4) High range water reducer shall conform to ASTM C 494, Type F or G. High range water reducer shall be added to the concrete after all other ingredients have been mixed and initial slump has been verified. No more than 14 ounces of water reducer per sack of cement shall be used. Water reducer shall be considered as part of the mixing water when calculating the water/cement ratio. High range water reducing admixtures shall be approved by the ENGINEER prior to use.
- 5) If the high range water reducer is added to the concrete at the Site, it may be used in conjunction with the same water reducer added at the batch plant. Concrete shall have a slump of 3-inches plus or minus 1/2-inch prior to adding the high range water reducing admixture at the Site. The high range water reducing admixture shall be accurately measured and pressure injected into the mixer as a single dose by an experienced technician. A standby system shall be provided and tested prior to each day's operation of the primary system.
- 6) Concrete shall be mixed at mixing speed for a minimum of 70 mixer revolutions or 5 minutes after the addition of the high range water reducer, unless recommended otherwise by the manufacturer.

6. **Lithium Additives:** Lithium additives shall not be used in concrete mix design for water bearing structures.

D. **Alkali-Silica Reactivity (ASR) of Aggregates.** All aggregates used in the concrete mix designs shall generally be considered non-reactive (innocuous) aggregate according to

the requirements of ASTM C1260 or ASTM 1567 and tested according to the requirements listed below.

1. Fine and coarse aggregates to be used in all concrete shall be evaluated individually and tested for alkali-aggregate reactivity, according to ASTM C1260. The average expansion of the mortar bars for the fine aggregate test according to ASTM C1260 shall not exceed 0.10% at 16-days of immersion in a 1N NaOH solution. Likewise, the average expansion of the mortar bars for the coarse aggregate test according to ASTM C1260 shall not exceed 0.10% at 16-days of immersion in a 1N NaOH solution.
2. If either of the aggregates do not pass the ASTM C1260 test requirements as described above, CONTRACTOR shall provide information to the CONTRACTOR that the proposed fine and course aggregate is the best (i.e. least reactive) locally available material within [[50]] [[100]]-miles of the project site. In addition, the CONTRACTOR shall provide additional testing of the proposed aggregates (fine and course) along with approved mitigating additives (i.e. fly ash, class N pozzolan, GGBF slag, silica fume or other approved additives) to the concrete mix design, according to the requirements of ASTM C1567 and the following requirements:
 - a. The concrete mix design parameters used in the ASTM C1567 expansion test shall be within the allowable ranges of mix design parameters as specified under Part 2.4.D of this Section. After 16-days of immersion in a 1N NaOH solution, the average expansion of the three mortar bars shall not exceed 0.10% as measured according to ASTM C1567 standards and protocol.
 - b. ASR test on both the fine and course aggregate and concrete mix additives (i.e. flyash, pozzolan, or other approved additives), sample bar preparation, testing and all analytical methods shall meet the ASTM C1567 testing procedural requirements.
 - c. Alkali content of the cement in the proposed concrete mix design shall not be greater than the alkali content of the cement used in the test samples.
 - d. Results of the ASR test show that expansion of the concrete sample is less than 0.10% at 16-days after the start of the expansion test procedure.
 - e. Test results shall be reported to the CONTRACTOR and Design Engineer at 7-days, 11-days, and 16-days.
 - f. The Concrete Supplier is still actively mining and using aggregate from the same representative portion of the aggregate pit from which the aggregate samples were taken for testing.]]
3. In lieu of the ASR testing above the aggregate may be tested in accordance with the requirements of ASTM C1293.
 - a. The concrete mix design parameters used in the ASTM C1293 expansion test shall be within the allowable ranges of mix design parameters as specified under Part 2.4.D of this Section.

- b. Alkali content of the cement in the proposed concrete mix design shall not be greater than the alkali content of the cement used in the test samples.
- c. Results of the test, in accordance with ASTM C33, shall indicate less than 0.04% expansion at 1-year for cement aggregate combinations to demonstrate aggregates to be non-reactive.
- d. Results of the test, in accordance with ASTM C33, shall indicate less than 0.04% expansion at 2-years for cement aggregate combinations with pozzolan or slag to demonstrate aggregates to be non-reactive

2.2 CURING MATERIALS

- A. Curing compounds shall be resin-based and compliant with local VOC requirements.
 - 1. Regular curing compounds shall be white pigmented and conform to ASTM C 309 - Liquid Membrane-Forming Compounds for Curing Concrete, Type 2, Class B. Sodium silicate compounds shall not be allowed. Concrete curing compound shall be approved by the ENGINEER prior to use.
 - 2. When curing compound must be removed for finishes or grouting, compounds shall be a dissipating type meeting ASTM C 309, type 1 or 2, Class B. Concrete curing compound shall be approved by the ENGINEER prior to use.
- B. Polyethylene sheet for use as concrete curing blanket shall be white and shall have a nominal thickness of 6-mils. The loss of moisture when determined in accordance with ASTM C 156 – Test Method for Water Retention by Concrete Curing Materials, shall not exceed 0.055 grams per square centimeter of surface.
- C. Polyethylene-coated waterproof paper sheeting for use as concrete curing blanket shall consist of white polyethylene sheeting free of visible defects, uniform in appearance, have a nominal thickness of 2-mils, and be permanently bonded to waterproof paper conforming to the requirements of Federal Specification UU-B-790A – Building Paper, Vegetable Fiber (Kraft, Waterproofed, Water Repellant and Fire Resistant). The loss of moisture, when determined in accordance with ASTM C 156, shall not exceed 0.055 gram per square centimeter of surface.
- D. Polyethylene-coated burlap for use as concrete curing blanket shall be 4-mils thick with white opaque polyethylene film impregnated or extruded into one side of the burlap. Burlap shall weigh not less than 9 ounces per square yard. The loss of moisture, when determined in accordance with ASTM C 156, shall not exceed 0.055 grams per square centimeter of surface.
- E. Curing mats for use in Curing Method 6 below shall be heavy shag rugs or carpets or cotton mats quilted at 4-inches on center. Curing mats shall weigh a minimum of 12 ounces per square yard when dry.
- F. Evaporation retardant shall be a material such as **Confilm** by **BASF**, **Eucobar** by **Euclid Chemical Company**, **E-CON** by **L & M Construction Chemicals, Inc.**, or equal.

2.3 MISCELLANEOUS MATERIALS

- A. **Bonding Agents.** Bonding agents shall be epoxy adhesives conforming to the following:
1. For bonding freshly-mixed, plastic concrete to hardened concrete, **Sikadur 32 Hi-Mod Epoxy Adhesive** by **Sika Corporation**, **Concresive Liquid (LPL)** by **BASF**, **BurkEpoxy MV** by **Burke** by **Edoco**, or equal.
 2. For bonding hardened concrete or masonry to steel, **Sikadur 31 Hi-Mod Gel** by **Sika Corporation**, **BurkEpoxy NS** by **Burke** by **Edoco**, **Concresive Paste (LPL)** by **BASF**, or equal.

2.4 CONCRETE DESIGN REQUIREMENTS

- A. **General:** Concrete shall be composed of cement, admixtures, aggregates, and water of the qualities indicated. In general, the mix shall be designed to produce a concrete capable of being deposited so as to obtain maximum density and minimum shrinkage, and where deposited in forms, to have good consolidation properties and maximum smoothness of surface. The aggregate gradations shall be formulated to provide fresh concrete that will not promote rock pockets around reinforcing steel or embedded items. The proportions shall be changed whenever necessary or desirable to meet the required results. Changes shall be subject to review by the ENGINEER.
- B. **Fine Aggregate Composition:** In mix designs for structural concrete, the percentage of fine aggregate in total aggregate by weight shall be as indicated in the following table.

FINE AGGREGATE	
Fineness Modulus	Maximum Percent
2.7 or less	41
2.7 to 2.8	42
2.8 to 2.9	43
2.9 to 3.1	44

1. For other concrete, the maximum percentage of fine aggregate of total aggregate by weight shall not exceed 50.
- C. **Water/Cement Ratio W/C:** The water/cement ratio indicated is for saturated-surface dry condition of aggregate. Every Day, throughout the day, the batch water added shall be adjusted for the total free water in the aggregates.
1. Total free moisture of aggregates shall be determined by:
 - a. Starting with the total moisture content of all aggregate, calculated by ASTM C 566 -Test Method for Total Moisture Content of Aggregate by Drying

b. Subtracting the moisture absorbed by the coarse aggregate, calculated by ASTM C 127 – Standard Test Method for Density, Relative Density (Specific Gravity) and Absorption of Coarse Aggregate

c. Subtracting the moisture absorbed by the fine aggregate, calculated by ASTM C 128 – Standard Test Method for Density, Relative Density (Specific Gravity) and Absorption of Fine Aggregate

D. Concrete Property Tables

Type of WORK	Structural Concrete - Regular Mix (Equipment pads, thrust blocks, site work, and other concrete items not categorized elsewhere)
Min 28 Day Compressive Strength, psi	4,500
Max Aggregate Size, in	1
Cement Content, lbs /cubic yard,	564 to 600
Max Allowable Fly Ash Content (FA); lbs/cubic yard	Up to 150 (i.e up to 20 % max of cement content)
Max W/C Ratio by weight	0.42
Total Air Content, percent	4 to 7
Slump, in	3-in +/- 1-in with high range water reducer 7-in +/- 2-in

NOTE: The CONTRACTOR is cautioned that the limiting parameters above are not a mix design. Admixtures may be required to achieve workability required by the CONTRACTOR's construction methods and aggregates. The CONTRACTOR is responsible for providing concrete with the required workability and strength.

- E. **Adjustments to Mix Design:** The CONTRACTOR may elect to decrease the water/cement ratio to achieve the strength and shrinkage requirements and/or add water reducers, as required to achieve workability. The mixes shall be changed whenever such change is necessary or desirable to secure the required strength, density, workability, and surface finish, and the CONTRACTOR shall be entitled to no additional compensation because of such changes. Any changes to the accepted concrete mix design shall be submitted to the ENGINEER for review and shall be tested again in accordance with these Specifications.

2.5 CONSISTENCY

- A. The quantity of water in a batch of concrete shall be just sufficient, with a normal mixing period, to produce a concrete that can be worked properly into place without segregation and which can be compacted by vibratory methods to give the desired density, impermeability, and smoothness of surface. The quantity of water shall be changed as necessary, with variations in the nature or moisture content of the aggregates, to maintain uniform production of a desired consistency. The consistency of the concrete in successive batches shall be determined by slump tests in accordance with ASTM C 143 – Test Method for Slump of Hydraulic Cement Concrete. The slumps shall be as indicated with the concrete properties.

2.6 LABORATORY TESTS

- A. The CONTRACTOR shall only use a mix design for construction that has first met the approved historical concrete testing results as specified below.

1. **Historical Concrete Testing.** For ASR expansion testing requirements, the CONTRACTOR may propose the use of historical test results on these tests provided that all of the following conditions are met:

a. The test results are no more than 6-months old from the project Notice-to-Proceed date.

b. The mix design used in the proposed historical tests has the same characteristics, as described below, as the mix design proposed for use on the project:

- 1) The type and quantity of cement used in the historical tested mix, is the same as that of the proposed mix design.
- 2) The quantity and source location of the coarse and fine aggregate used in the historical tested mix is the same as that of the proposed mix design. In addition, the aggregate used in the historical tests must be screened to the same gradations as that proposed for the project mix design.
- 3) The type and quantity of cementations substitutes (fly ash or slag or other approved substitute) used in the historical tested mix, is the same as that of the proposed mix design.
- 4) The water to cement ratio of the historical tested mix is within +/- 5% of the proposed water to cement ratio.

- 5) The air content of the historical tested mix is within 1% of the proposed air content (for example: for a proposed air content of 6% in the proposed mix design, the historical air content must be in the range of 5 to 7%.)
- 6) The same additives, including water reducing additives, that were used in the historical batch test results are being proposed for the new concrete mix design, and the proportions of those additives used in the historical mix design are within +/- 5% of that of the proposed project mix design.

B. **Compressive Strength Testing.** The determination of compressive strength will be made by testing 6-inch diameter by 12-inch high cylinders; made, cured, and tested in accordance with ASTM C 192 - Practice for Making and Curing Concrete Test Specimens in the Laboratory and ASTM C 39. Three compression test cylinders will be tested at 7 Days and 3 at 28 Days. The average compressive strength for the 3 cylinders tested at 28 Days for any given trial batch shall not be less than 125 percent of the indicated compressive strength.

C. **Sieve Analyses.** A sieve analysis of the combined aggregate for each trial batch shall be performed according to the requirements of ASTM C 136 – Method for Sieve Analysis of Fine and Coarse Aggregates. Values shall be given for percent passing each sieve.

2.7 MEASUREMENT OF CEMENT AND AGGREGATE

A. The amount of cement and of each separate size of aggregate entering into each batch of concrete shall be determined by direct weighing equipment furnished by the CONTRACTOR and acceptable to the ENGINEER. Weighing tolerances for the materials shall be a maximum of that given below.

Material	Percent of Total Weight
Cement	1
Aggregates	3
Admixtures	3

2.8 MEASUREMENT OF WATER

A. The quantity of water entering the mixer shall be measured by a suitable water meter or other measuring device of a type acceptable to the ENGINEER and capable of measuring the water in variable amounts within a tolerance of one percent. The water feed control mechanism shall be capable of being locked in position so as to deliver constantly any required amount of water to each batch of concrete. A positive quick-acting valve shall be used for a cut-off in the water line to the mixer. The operating mechanism shall prevent leakage when the valves are closed.

2.9 READY-MIXED CONCRETE

A. At the CONTRACTOR'S option, ready-mixed concrete may be used if it meets the requirements as to materials, batching, mixing, transporting, and placing indicated herein and is in accordance with ASTM C 94, including the following supplementary requirements.

- B. Ready-mixed concrete shall be delivered to the WORK, and discharge shall be completed within one hour after the addition of the cement to the aggregates or before the drum has been revolved 250 revolutions, whichever occurs first.
- C. Truck mixers shall be equipped with electrically-actuated counters by which the number of revolutions of the drum or blades may be readily verified. The counter shall be the resettable, recording type and shall be mounted in the driver's cab. The counters shall be actuated at the time of starting mixers at mixing speeds.
- D. Each batch of concrete shall be mixed in a truck mixer for not less than 70 revolutions of the drum or blades at the rate of rotation designated by the manufacturer of equipment. Additional mixing, if any, shall be at the speed designated by the manufacturer of the equipment as agitating speed. Materials including mixing water shall be in the mixer drum before actuating the revolution counter for determining the number of revolutions of mixing.
- E. Truck mixers and their operation shall be such that the concrete throughout the mixed batch as discharged is within acceptable limits of uniformity with respect to consistency, mix, and grading. If slump tests taken at approximately the 1/4 and 3/4 points of the load during discharge give slumps differing by more than one-inch when the required slump is 3-inches or less, or if they differ by more than 2-inches when the required slump is more than 3-inches, the mixer shall not be used on the WORK unless the causative condition is corrected and satisfactory performance is verified by additional slump tests. Mechanical details of the mixer, such as water measuring and discharge apparatus, condition of the blades, speed of rotation, general mechanical condition of the unit, and clearance of the drum, shall be checked before a further attempt to use the unit will be permitted.
- F. Each batch of ready-mixed concrete delivered to the Site shall be accompanied by a delivery ticket that is furnished to the ENGINEER in accordance with the Paragraph above entitled "Delivery Tickets."
- G. The use of non-agitating equipment for transporting ready-mixed concrete will not be permitted. Combination truck and trailer equipment for transporting ready-mixed concrete will not be permitted. The quality and quantity of materials used in ready-mixed concrete and in batch aggregates shall be subject to continuous inspection at the batching plant by the ENGINEER.

PART 3 -- EXECUTION

3.1 PROPORTIONING AND MIXING

- A. **Proportioning:** Proportioning of the mix shall conform to ACI 301.
- B. **Mixing:** Mixing shall conform to ACI 301.
- C. **Slump:** Slumps shall be as indicated.
- D. **Retempering:** Retempering of concrete or mortar that has partially hardened shall not be permitted.

3.2 PREPARATION OF SURFACES FOR CONCRETING

- A. **General:** Earth surfaces shall be thoroughly wetted by sprinkling prior to the placing of any concrete, and these surfaces shall be kept moist by frequent sprinkling up to the time of placing concrete thereon. The surface shall be free from standing water, mud, and debris at the time of placing concrete.
- B. **Joints in Concrete:** Construction joints are defined as concrete surfaces upon which or against which concrete is to be placed but placement of concrete has been stopped or interrupted and the ENGINEER has determined that the new concrete cannot be incorporated integrally with the concrete previously placed. The surfaces of horizontal joints shall be given a compacted, roughened surface for good bonding. Except where the Drawings call for joint surfaces to be coated, the joint surfaces shall be cleaned of laitance, loose or defective concrete, foreign material, and be roughened to a minimum 1/4-inch amplitude. Such cleaning and roughening shall be accomplished by hydroblasting or sandblasting (exposing aggregate) followed by thorough washing. Pools of water shall be removed from the surface of construction joints before the new concrete is placed.
- C. After the surfaces have been prepared, each approximately horizontal construction joint shall be covered with a 6-inch lift of a pea gravel mix. The mix shall be placed and spread uniformly. Wall concrete shall follow immediately and shall be placed upon the fresh pea gravel mix.
- D. **Placing Interruptions:** When placing of concrete is to be interrupted long enough for the concrete to take a set, the working face shall be given a shape by the use of forms or other means that will secure proper union with subsequent WORK; provided that construction joints shall be made only where acceptable to the ENGINEER.
- E. **Embedded Items:** No concrete shall be placed until formwork, installation of parts to be embedded, reinforcement steel, and preparation of surfaces involved in the placing have been completed and accepted by the ENGINEER at least 4 hours before placement of concrete. Surfaces of forms and embedded items that have become encrusted with dried grout from previous usage shall be cleaned before the surrounding or adjacent concrete is placed.
- F. Inserts or other embedded items shall conform to the requirements herein.
- G. Reinforcement, anchor bolts, sleeves, inserts, and similar items shall be set and secured in the forms at locations indicated on the Drawings or shown by Shop Drawings and shall be acceptable to the ENGINEER before any concrete is placed. Accuracy of placement is the responsibility of the CONTRACTOR.
- H. **Casting New Concrete Against Old:** Where concrete is to be cast against old concrete (defined as any concrete which is greater than 60 Days old), the surface of the old concrete shall be thoroughly cleaned and roughened by hydroblasting or sandblasting to expose aggregate. The joint surface shall be coated with an epoxy bonding agent unless determined otherwise by the ENGINEER. This provision shall not apply to joints where waterstop is provided.
- I. No concrete shall be placed in any structure until water entering the space to be filled with concrete has been properly cut off or has been diverted by pipes or other means,

and carried out of the forms, clear of the WORK. No concrete shall be deposited underwater nor shall the CONTRACTOR allow still water to rise on any concrete until the concrete has attained its initial set. Water shall not be permitted to flow over the surface of any concrete in such manner and at such velocity as will injure the surface finish of the concrete. Pumping or other necessary dewatering operations for removing ground water, if required, shall be subject to review by the ENGINEER.

- J. **Corrosion Protection:** Pipe, conduit, dowels, and other ferrous items required to be embedded in concrete construction shall be so positioned and supported prior to placement of concrete that there will be a minimum of 2-inches clearance between said items and any part of the concrete reinforcement. Securing such items in position by wiring or welding them to the reinforcement will not be permitted.
- K. Openings for pipes, inserts for pipe hangers and brackets, and anchors shall, where practicable, be provided during the placing of concrete.
- L. Anchor bolts shall be accurately set and shall be maintained in position by templates while embedded in concrete.
- M. **Cleaning:** The surfaces of metalwork to be in contact with concrete shall be thoroughly cleaned of dirt, grease, loose scale and rust, grout, mortar, and other foreign substances immediately before the concrete is placed.

3.3 HANDLING, TRANSPORTING, AND PLACING

- A. **General:** Placing of concrete shall conform to the applicable portions of ACI 301 and the requirements of this Section. No aluminum materials shall be used in conveying any concrete.
- B. **Non-Conforming WORK or Materials:** Concrete which during or before placing is found not to conform to the requirements indicated herein shall be rejected and immediately removed from the WORK. Concrete that is not placed in accordance with these requirements or which is of inferior quality shall be removed and replaced.
- C. **Unauthorized Placement:** No concrete shall be placed except in the presence of a duly authorized representative of the ENGINEER. The CONTRACTOR shall notify the ENGINEER in writing at least 24 hours in advance of placement of any concrete.
- D. **Placement in Wall Forms:** Concrete shall not be dropped through reinforcement steel or into any deep form, nor shall concrete be placed in any form in such a manner as to leave accumulation of mortar on the form surfaces above the placed concrete. In such cases, means such as hoppers and, if necessary, vertical ducts of canvas, rubber, or metal shall be used for placing concrete in the forms in a manner that it may reach the place of final deposit without separation. In no case shall the free fall of concrete below the ends of ducts, chutes, or buggies exceed 4-feet in walls and 8-feet in columns. Concrete shall be uniformly distributed during the process of depositing and in no case after depositing shall any portion be displaced in the forms more than 6-feet in horizontal direction. Concrete in wall forms shall be deposited in uniform horizontal layers not deeper than 2-feet; and care shall be taken to avoid inclined layers or inclined construction joints except where such are required for sloping members. Each layer shall be placed while the previous layer is still soft. The rate of placing concrete in wall forms shall not exceed 5-feet of vertical rise per hour. Sufficient illumination shall be

provided in the interior of forms so that the concrete at the places of deposit is visible from the deck or runway.

E. **Placement in Slabs:** Concrete placement in sloping slabs shall proceed uniformly from the bottom of the slab to the top for the full width of the placement. As the WORK progresses, the concrete shall be vibrated and carefully worked around the slab reinforcement, and the surface of the slab shall be screeded in an up-slope direction.

F. **Temperature of Concrete:** The temperature of concrete when it is being placed shall be not more than 90 degrees F nor less than 50 degrees F. For sections less than 12-inches thick the temperature of concrete when placed shall be not less than 55 degrees.

1. If required by ENGINEER, CONTRACTOR shall submit detailed procedures for production, transportation, placement, protection, curing, and temperature monitoring of concrete during hot or cold weather. The submittal shall include procedures to be implemented upon abrupt changes in weather conditions or equipment failures.

2. CONTRACTOR shall not be entitled to additional compensation for satisfying the hot weather placement or the cold weather placement requirements below.

G. **Hot Weather Placement**

1. If the temperature of the concrete is 85 degrees F or greater, the time between introducing the cement into the aggregates and discharge shall not exceed 45 minutes.

2. If concrete is placed when the weather is such that the temperature of the concrete would exceed 90 degrees F, CONTRACTOR shall employ effective means such as precooling of aggregates and using ice as mixing water or placing at night as necessary to maintain the temperature of the concrete below 90 degrees F as it is placed.

3. During the curing period, the maximum temperature decrease measured at the surface of the concrete shall not exceed 50 degrees F in 24 hours nor 5 degrees F in one hour.

H. **Cold Weather Placement**

1. Placement of concrete shall conform to ACI 306.1 - Cold Weather Concreting, and the following.

2. Remove snow, ice, and frost from the surfaces, including reinforcement, against which concrete is to be placed. Before beginning concrete placement, thaw the subgrade to a minimum depth of 6-inches. Reinforcement and embedded items shall be warmed to above 32 degrees F prior to concrete placement.

3. Maintain the concrete temperature above 50 degrees F for at least 72 hours after placement.

4. Concrete ingredients shall not be heated more than necessary to prevent the temperature of the mixed concrete, as placed, from falling below the minimum temperature criterion.

3.4 PUMPING OF CONCRETE

- A. **General:** If the pumped concrete does not produce satisfactory end results, the CONTRACTOR shall discontinue the pumping operation and proceed with the placing of concrete using conventional methods.
- B. **Pumping Equipment:** The pumping equipment shall have 2 cylinders and be designed to operate with one cylinder in case the other one is not functioning. In lieu of this requirement, the CONTRACTOR may have a standby pump on the Site during pumping.
- C. The minimum diameter of the hose conduits shall be in accordance with ACI 304.2R – Placing Concrete by Pumping Methods.
- D. Pumping equipment and hose conduits that are not functioning properly shall be replaced.
- E. Aluminum conduits for conveying the concrete shall not be permitted.
- F. **Field Control:** Concrete samples for slump, air content, and test cylinders will be taken at the placement end of the hose.

3.5 ORDER OF PLACING CONCRETE

- A. The order of placing concrete in the WORK shall be acceptable to the ENGINEER. To minimize the effects of shrinkage, the concrete shall be placed in units as bounded by construction joints at the indicated locations. The placing of units shall be done by placing alternate units in a manner such that each unit placed shall have cured at least 5 Days for hydraulic structures and 2 Days for all other structures before the contiguous unit or units are placed, except that the corner sections of vertical walls shall not be placed until the 2 adjacent wall panels have cured at least 10 Days for hydraulic structures and 4 Days for all other structures.
- B. The surface of the concrete shall be level whenever a run of concrete is stopped. For a level, straight joint on the exposed surface of walls, a wood strip at least 3/4-inch thick shall be tacked to the forms on these surfaces. The concrete shall be carried about 1/2-inch above the underside of the strip. About one hour after the concrete is placed, the strip shall be removed and any irregularities in the edge formed by the strip shall be leveled with a trowel and laitance shall be removed.

3.6 TAMPING AND VIBRATING

- A. As concrete is placed in the forms or in excavations, it shall be thoroughly settled and compacted throughout the entire depth of the layer which is being consolidated into a dense, homogeneous mass, filling all corners and angles, thoroughly embedding the reinforcement, eliminating rock pockets, and bringing only a slight excess of water to the exposed surface of concrete. Vibrators shall be Group 3 per ACI 309 – Consolidation of Concrete, high speed power vibrators (8000 to 12,000 rpm) of an immersion type in

sufficient number and with at least one standby unit as required. Group 2 vibrators may be used only at specific locations when accepted by the ENGINEER.

- B. Care shall be used in placing concrete around waterstops. The concrete shall be carefully worked by rodding and vibrating to make sure that air and rock pockets have been eliminated. Where flat-strip type waterstops are placed horizontally, the concrete shall be worked under the waterstops by hand, making sure that air and rock pockets have been eliminated. Concrete surrounding the waterstops shall be given additional vibration over and above that used for adjacent concrete placement to assure complete embedment of the waterstops in the concrete.
- C. Concrete in walls shall be internally vibrated and at the same time rammed, stirred, or worked with suitable appliances, tamping bars, shovels, or forked tools until it completely fills the forms or excavations and closes snugly against each surface. Subsequent layers of concrete shall not be placed until the layers previously placed have been worked thoroughly. Vibrators shall be provided in sufficient numbers, with standby units as required, to accomplish the required results within 15 minutes after concrete of the prescribed consistency is placed in the forms. The vibrating head shall not contact the surfaces of the forms. Care shall be taken not to vibrate concrete excessively or to work it in any manner that causes segregation of its constituents.

3.7 FINISHING CONCRETE SURFACES

- A. **General:** Surfaces shall be free from fins, bulges, ridges, offsets, honeycombing, or roughness of any kind, and shall present a finished, smooth, continuous hard surface. Allowable deviations from plumb or level and from the alignment, profiles, and dimensions indicated are defined as tolerances and are indicated above. These tolerances are to be distinguished from irregularities in finish as described herein. Aluminum finishing tools shall not be used.
- B. **Formed Surfaces:** No treatment is required after form removal except for curing, repair of Defective concrete, and treatment of surface defects. Where architectural finish is required, it shall be as indicated.
- C. **Unformed Surfaces:** After proper and adequate vibration and tamping, unformed top surfaces of slabs, floors, walls, and curbs shall be brought to a uniform surface with suitable tools. Immediately after the concrete has been screeded, it shall be treated with a liquid evaporation retardant. The retardant shall be used again after each operation as necessary to prevent drying shrinkage cracks. The classes of finish for unformed concrete surfaces are defined as follows:
 - 1. Finish U1 - Sufficient leveling and screeding to produce an even, uniform surface with surface irregularities not to exceed 3/8-inch. No further special finish is required.

3.8 CURING

- A. **General:** Concrete shall be cured for not less than 7 Days after placing, in accordance with the methods indicated below for the different parts of the WORK.

Surface to be Cured or Dampproofed	Method
Unstripped forms	1
Wall sections with forms removed	2

B. **Method 1:** Wooden forms shall be wetted immediately after concrete has been placed and shall be kept wet with water until removal. If steel forms are used the exposed concrete surfaces shall be kept continuously wet until the forms are removed. If forms are removed within 7 Days of placing the concrete, curing shall be continued in accordance with Method 6 below.

C. **Method 2:** This method applies to both walls and slabs.

1. The concrete shall be kept continuously wet by the application of water for a minimum period of at least 7 Days beginning immediately after the concrete has reached final set or forms have been removed.
2. Until the concrete surface is covered with the curing medium, the entire surface shall be kept damp by applying water using nozzles that atomize the flow so that the surface is not marred or washed.
3. Heavy curing mats shall be used as a curing medium to retain the moisture during the curing period. The curing medium shall be weighted or otherwise held substantially in contact with the concrete surface to prevent dislodging by wind or any other causes. Edges shall be continuously held in place.
4. The curing blankets and concrete shall be kept continuously wet by the use of sprinklers or other means both during and after normal working hours.
5. Immediately after the application of water has terminated at the end of the curing period, the curing medium shall be removed, the entire concrete surface shall be wetted, and curing compound shall be immediately applied to the entire surface in accordance with Method 4 above.
6. The CONTRACTOR shall dispose of excess water from the curing operation to avoid damage to the WORK.

3.9 PROTECTION

- A. The CONTRACTOR shall protect concrete against injury until final acceptance.
- B. Fresh concrete shall be protected from damage due to rain, hail, sleet, or snow. The CONTRACTOR shall provide such protection while the concrete is still plastic and whenever precipitation is imminent or occurring.

3.10 CURING IN COLD WEATHER

- A. Water curing of concrete may be reduced to 6 Days during periods when the mean daily temperature in the vicinity of the Site is less than 40 degrees F; provided that during the

prescribed period of water curing, when temperatures are such that concrete surfaces may freeze, water curing is temporarily discontinued.

- B. Concrete cured by an application of curing compound will require no additional protection from freezing if the protection at 50 degrees F for 72 hours is obtained by means of approved insulation in contact with the forms or concrete surfaces; otherwise the concrete shall be protected against freezing temperatures for 72 hours immediately following 72 hours protection at 50 degrees F. Concrete cured by water shall be protected against freezing temperatures for 72 hours immediately following the 72 hours of protection at 50 degrees F.
- C. Discontinuance of protection against freezing temperatures shall be such that the drop in temperature of any portion of the concrete will be gradual and will not exceed 40 degrees F in 24 hours. In the spring, when the mean daily temperature rises above 40 degrees F for more than 3 successive Days, the required 72-hour protection at a temperature not lower than 50 degrees F may be discontinued for as long as the mean daily temperature remains above 40 degrees F; provided, that the concrete shall be protected against freezing temperatures for not less than 48 hours after placement.
- D. Where artificial heat is employed, special care shall be taken to prevent the concrete from drying. Use of unvented heaters will be permitted only when unformed surfaces of concrete adjacent to the heaters are protected for the first 24 hours from an excessive carbon dioxide atmosphere by application of curing compound; provided, that the use of curing compound for such surfaces is otherwise permitted.

3.11 TREATMENT OF SURFACE DEFECTS

- A. As soon as forms are removed, exposed surfaces shall be carefully examined and any irregularities shall be immediately rubbed or ground in a satisfactory manner in order to secure a smooth, uniform, and continuous surface. Plastering or coating of surfaces to be smoothed will not be permitted. No repairs shall be made until after inspection by the ENGINEER. In no case will extensive patching of honeycombed concrete be permitted. Concrete containing minor voids, holes, honeycombing, or similar depression defects shall be repaired as indicated below. Concrete containing extensive voids, holes, honeycombing, or similar depression defects shall be completely removed and replaced. Repairs and replacements shall be performed promptly.
- B. Defective surfaces to be repaired shall be cut back from trueline a minimum depth of 1/2-inch over the entire area. Feathered edges will not be permitted. Where chipping or cutting tools are not required in order to deepen the area properly, the surface shall be prepared for bonding by the removal of laitance and soft material, plus not less than 1/32-inch depth of the surface film from hard portions by means of an efficient sandblast. After cutting and sandblasting, the surface shall be wetted sufficiently in advance of shooting with shotcrete or with cement mortar so that while the repair material is being applied, the surfaces underneath will remain moist but not so wet as to overcome the suction upon which a good bond depends. The material used for repair shall consist of a mixture of one sack of cement to 3 cubic feet of sand. For exposed walls, the cement shall contain such a proportion of **Atlas white** portland cement as is required to make the color of the patch match the color of the surrounding concrete.
- C. Holes left by tie-rod cones shall be reamed with suitable toothed reamers so as to leave the surfaces of the holes clean and rough. Holes then shall be repaired in an approved

manner with dry-packed cement grout. Holes left by form-tying devices having a rectangular cross section and other imperfections having a depth greater than their least surface dimension shall not be reamed but shall be repaired in an approved manner with dry-packed cement grout.

- D. Repairs shall be built up and shaped in such a manner that the completed WORK will conform to the requirements of this Section, as applicable, using approved methods which will not disturb the bond, cause sagging, or cause horizontal fractures. Surfaces of repairs shall receive the same kind and amount of curing treatment as required for the concrete in the repaired section.

3.12 PATCHING HOLES IN CONCRETE

A. Patching Small Holes

1. Holes that are less than 12-inches in the least dimension and extend completely through concrete members shall be filled.
2. Small holes in members that are water-bearing or in contact with soil or other fill material shall be filled with non-shrink grout. Where a face of the member is exposed to view, the non-shrink grout shall be held back 2-inches from the finished surface. The remaining 2-inches shall then be patched according to the Article above entitled "Treatment of Surface Defects."
3. Small holes through other concrete members shall be filled with non-shrink grout, with exposed faces treated as above.

B. Patching Large Holes

1. Holes which are larger than 12-inches in the least dimension shall have a keyway chipped into the edge around the opening, unless a formed keyway exists. The holes shall then be filled with concrete as indicated herein.
2. Holes which are larger than 24-inches in the least dimension and which do not have reinforcing steel extending from the existing concrete, shall have reinforcing steel set in grout in drilled holes. The reinforcing added shall match the reinforcing in the existing wall unless indicated otherwise.
3. Large holes in members that are water bearing or in contact with soil or other fill shall have a hydrophilic type waterstop material placed around the perimeter of the hole in accordance with Section 03 32 00 – Joints in Concrete unless there is an existing waterstop in place.

3.13 CARE AND REPAIR OF CONCRETE

- A. The CONTRACTOR shall protect concrete against injury or damage from excessive heat, lack of moisture, overstress, or any other cause until final acceptance. Particular care shall be taken to prevent the drying of concrete and to avoid roughening or otherwise damaging the surface. Any concrete found to be damaged, or which may have been originally defective, or which becomes defective at any time prior to the final acceptance of the completed WORK, or which departs from the established line or grade, or which, for any other reason, does not conform to the requirements of the

Contract Documents, shall be satisfactorily repaired or removed and replaced with acceptable concrete.

- END OF SECTION -

SECTION 03 32 00 - JOINTS IN CONCRETE

PART 1 -- GENERAL

1.1 SUMMARY

- A. The CONTRACTOR shall provide joints in concrete, complete and in place, in accordance with the Contract Documents.
- B. Joints in concrete structures shall be the types defined below and will be permitted only where indicated, unless specifically accepted by the ENGINEER.

1.2 TYPES OF JOINTS

A. Construction Joints (CJ)

- 1. These joints are typically identified / abbreviated as "CJ" on the Contract Drawings.
- 2. The purpose of a construction joint is to bond concrete from an earlier pour to that of a later pour, and if in a water-bearing member, prevent water seepage at the joint location.
- 3. When fresh concrete is placed against a hardened concrete surface, the joint between the pours shall be defined as a construction joint.
- 4. Reinforcement typical to the slab exists across the joint.
- 5. Unless otherwise indicated, joints in water-bearing members shall be provided with a waterstop and/or joint sealant groove of the shape indicated.

B. Expansion Joints (EJ)

- 1. These joints are typically identified / abbreviated as "EJ" on the Contract Drawings.
- 2. The purpose of an expansion joint is to allow concrete to expand freely as required, and if in a water-bearing member, prevent water seepage at the joint location.
- 3. In order to allow the concrete to expand freely, a space shall be provided between the pours. The space shall be obtained by placing a joint filler (premolded expansion joint material) against the earlier pour to act as a form for the later pour.
- 4. Reinforcement typical to the slab does not pass through the joint. Sleeve-like dowels may exist across the joint, as indicated.
- 5. Unless otherwise indicated, joints in water-bearing members shall be provided with a waterstop of the shape indicated.

C. Crack Control Joints (CCJ)

- 1. These joints are typically identified / abbreviated as "CCJ" on the Contract Drawings.

2. The function of the control joint is to provide a weaker plane in the concrete where shrinkage cracks would likely occur, and if in a water-bearing member, prevent water seepage at the joint location. There are different alternatives that can achieve this goal. The alternative(s) selected for the WORK is (are) provided in the Contract Documents.
3. Reinforcement typical to the slab exists across the joint.
4. Unless otherwise indicated, joints in water-bearing members shall be provided with a waterstop and/or joint sealant groove of the shape indicated.

1.3 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with the requirements of Section 01 33 00 – Contractor Submittals.

B. **Shop Drawings**

1. Furnish placement drawings showing the location and types of joints for each structure.

C. **Manufacturer's Information and Certificates**

1. Furnish manufacturer's information demonstrating compliance of the following with the indicated requirements:
 - a. **Waterstops.** Prior to use of the waterstop material in the field, a sample of a prefabricated (shop made fitting) mitered cross and a tee constructed of each size or shape of material to be used shall be submitted. Samples shall be prefabricated (shop made fitting) so that the material and workmanship represent the fittings to be provided.
 - b. preformed joint filler
 - c. backing rod
 - d. bearing pad
 - e. slip dowels
2. Furnish written certification from the manufacturer, as an integral part of the shipping form, that the material shipped to the Site meets or exceeds the indicated physical property requirements.
3. Supplier certificates will not be accepted.

D. **Samples**

1. Prior to production of the material required under this Section, submit qualification samples of waterstops which accurately represent the material being provided.

2. Such samples shall be extruded or molded sections of each size or shape to be installed.
3. The balance of the material to be used shall not be produced until after the ENGINEER has reviewed the qualification samples.

E. Welding Certification

1. Furnish copies of the waterstop welding certification by manufacturer or authorized agent of the manufacturer.
2. Every person who is to be involved with waterstop installation shall be required to have individual certification on file with the ENGINEER, stating that the named individual is certified and trained to install waterstop in accordance with the manufacturer's recommendations and specifications.

1.4 QUALITY CONTROL

A. Waterstops

1. Inspections.

- a. Waterstop field joints shall be subject to inspection, and no such WORK shall be scheduled or started without having made prior arrangements with the ENGINEER for the required inspections.
- b. Provide not less than 24 hours notice for the scheduling of such inspections.
- c. Field joints in waterstops shall be subject to inspection for misalignment, bubbles, inadequate bond, porosity, cracks, offsets, and other defects that would reduce the potential resistance of the material to water pressure at any point.

2. Defects. The following waterstop defects represent a partial list of defects which shall be grounds for rejection:

- a. Offsets at joints greater than 1/16 inch or 15 percent of material thickness at any point, whichever is less.
- b. Exterior cracking at the joint due to incomplete bond, which is deeper than 1/16 inch or 15 percent of material thickness at any point, whichever is less.
- c. Any combination of offset or exterior cracking that will result in a net reduction in the cross-section of the waterstop in excess of 1/16 inch or 15 percent of material thickness at any point, whichever is less.
- d. Misalignment of the joint which results in misalignment of the waterstop in excess of 1/2 inch in 10 feet.
- e. Porosity in the welded joint as evidenced by visual inspection.

- f. Bubbles or inadequate bonding which can be detected with a penknife test. (If, while prodding the entire joint with the point of a penknife, the knife breaks through the outer portion of the weld into a bubble, the joint shall be considered defective.)
- g. Visible signs of separation when the cooled splice is bent by hand at any sharp angle.
- h. Evidence of burned material.

1.5 CORRECTION OF DEFECTS

- A. **Waterstops.** If inspections find waterstops to be defective, these joints shall be replaced with material that passes inspection, and faulty material shall be removed from the Site and destroyed.
- B. **Joint Sealant.** The CONTRACTOR shall furnish a 5-year written warranty of the entire joint sealant installation against faulty and/or incompatible materials and workmanship, together with a statement that the CONTRACTOR agrees to repair or replace, to the satisfaction of the OWNER, any defective areas which become evident within the 5-year period.

PART 2 -- PRODUCTS

2.1 WATERSTOPS

A. **Preformed Hydrophilic Waterstop**

1. Hydrophilic (bentonite-free) waterstops shall be **Hydro-Flex Waterstop** as manufactured by **Henry Co., Earthshield Type 23**, as manufactured by **JP Specialties, Hydrotite CJ-1020-2K** as manufactured by **Sika, Sika Swellstop Waterstop MC-2010MN** as manufactured by **Adeka** or equal.
2. The cross-sectional area of the waterstop shall not be less than 0.5 square inch.
3. Hydrophilic waterstop shall be the type that expands in the presence of water to form a watertight joint seal without damaging the concrete in which it is cast.
4. The waterstop shall be manufactured from butyl rubber with hydrophilic properties.
5. The waterstop shall have a delay coating to inhibit initial expansion due to moisture present in fresh concrete.
6. The minimum expansion ratio of modified chloroprene shall be not less than 2-to-1 volumetric change in distilled water at 70 degrees F (21 degrees C).
7. The bonding agent for hydrophilic waterstop shall be the manufacturer's recommended adhesive for wet, rough concrete.

B. **Other Waterstops**

1. When types of waterstops not listed above are indicated, they shall be subjected to the same requirements as those listed in this Section.

2.2 JOINT SEALANT FOR WATER-BEARING JOINTS

- A. The joint sealant shall be a polyurethane polymer designed for bonding to concrete which is continuously submerged in water.
- B. No material will be accepted which has an unsatisfactory history as to bond or durability when used in the joints of water-retaining structures.
- C. Joint sealant material shall meet the following requirements (73 degrees F and 5 percent R.H.):

Work Life, minutes	45 - 180
Time to Reach 20 Shore A Hardness (at 77 degrees F, 200 gram quantity), max	24 hours
Ultimate Hardness (ASTM D 2240, Shore A)	20 - 45
Tensile Strength (ASTM D 412), min	175 psi
Ultimate Elongation (ASTM D 412), minimum	400 percent
Tear Resistance (Die C, ASTM D 624), pounds per inch of thickness, min	75
Color	Light Gray

- D. Polyurethane joint sealants for waterstop joints in concrete shall conform to the following requirements:
 1. Joint sealant shall be 2-part polyurethane with the physical properties of the cured joint sealant conforming to or exceeding the requirements of ASTM C 920 – Elastomeric Joint Sealant, or Federal Specification TT-S-0227 E(3) - Sealing Compound, Elastomeric Type, Multicomponent, for Caulking, Sealing, and Glazing Buildings and Other Structures, for 2-part material, as applicable.
 2. For vertical joints and overhead horizontal joints, only "non-sag" compounds shall be used, conforming to the requirements of ASTM C 920, Class 25, Grade NS, or Federal Specification TT-S-0227 E(3), Type II, Class A.
 3. For plane horizontal joints, use the self-leveling compounds meeting the requirements of ASTM C 920 Class 25, Grade P, or Federal Specification TT-S-0227 E(3), Type I.
 4. For joints subject to either pedestrian or vehicular traffic, a compound providing non-tracking characteristics and having a Shore A hardness range of 35 to 45 shall be used.

5. Primer materials, if recommended by the joint sealant manufacturer, shall conform to the printed recommendations of the manufacturer.

E. Joint Sealant Manufacturers

1. Joint sealants shall be **PSI-270** as manufactured by **Polymeric Systems Inc.**, **Sikaflex 2C**, as manufactured by **Sika Corporation**, or equal.

2.3 JOINT SEALER FOR NON-WATER-BEARING JOINTS

- A. Joint sealer for non-waterstop joints in concrete shall be a material that is composed of special asphalts or similar materials blended with lubricating and plasticizing agents to form a tough, durable mastic substance that shall:

1. Not contain evaporating solvents, or volatile oils/lubricants;
2. Strongly adhere to concrete surfaces;
3. Remain permanently resilient and pliable;
4. Not be affected by continuous presence of water;
5. Not in any way contaminate potable water;
6. Effectively seal the joints against moisture infiltration even when the joints are subjected to movement from expansion and contraction.

2.4 JOINT FILLER

- A. Joint filler for expansion joints in waterholding structures shall be neoprene conforming to ASTM D 1056, Type 2C5-E1.
- B. Joint filler material in other locations shall be of the preformed non-extruding type, constructed of cellular neoprene sponge rubber or polyurethane of firm texture.
- C. Bituminous fiber type will not be accepted.
- D. Non-extruding and resilient-type preformed expansion joint fillers shall conform to the requirements and tests set forth in ASTM D 1752 - Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction, for Type I, except as otherwise indicated.
- E. **Neoprene Sponge.** The sponge shall be neoprene, closed-cell, expanded, conforming to ASTM D 1056 - Flexible Cellular Materials - Sponge or Expanded Rubber, Type 2C5-E1.

2.5 BACKING ROD

- A. The backing rod shall be an extruded closed-cell, polyethylene foam rod.

- B. The rod material shall be compatible with the joint sealant material, and shall have a tensile strength of not less than 40 psi and a compression deflection of approximately 25 percent at 8 psi.
- C. The rod shall be 1/8 inch larger in diameter than the joint width except that a one-inch diameter rod shall be used for a 3/4-inch wide joint.

2.6 BEARING PAD

- A. The bearing pad shall be neoprene conforming to ASTM D 2000 - Standard Classification System for Rubber Products in Automotive Applications, BC 420, 40 durometer hardness, unless otherwise indicated.

2.7 SLIP DOWELS

- A. Slip dowels in joints shall be smooth epoxy-coated bars conforming to ASTM A 775 - Epoxy Coated Reinforcing Steel Bars.

2.8 PVC TUBING

- A. PVC tubing in joints shall be SDR 13.5, conforming to ASTM D 2241 - Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).

PART 3 -- EXECUTION

3.1 GENERAL - WATERSTOPS

- A. Waterstops shall be embedded in the concrete across joints as indicated.
- B. Waterstops shall be fully continuous for the extent of the joint.
- C. Splices necessary to provide such continuity shall conform to the printed instructions of the waterstop manufacturer.
- D. The CONTRACTOR shall take suitable precautions and provide means to support and protect the waterstops during the progress of the WORK, and shall repair or replace any waterstops damaged during progress of the WORK at no additional cost to the OWNER.
- E. Waterstops shall be stored so as to permit free circulation of air around the waterstop material.
- F. When any waterstop is installed in the concrete on one side of a joint while the other portion of the waterstop remains exposed to the atmosphere for more than 2 Days, suitable precautions shall be taken to shade and protect the exposed waterstop from direct rays of the sun during the entire exposure time until the exposed portion of waterstop is embedded in concrete.

3.2 SPLICES IN PVC WATERSTOPS

- A. Splices in PVC waterstops shall be performed by heat sealing the adjacent waterstop sections in accordance with the manufacturer's printed recommendations.

- B. It is essential that:
 - 1. The material shall not be damaged by heat sealing.
 - 2. The splices shall have a tensile strength of not less than 80 percent of the unspliced material.
 - 3. The continuity of the waterstop ribs and of its tubular center axis shall be maintained.
 - 4. No edge welding will be accepted.
- C. Butt joints of the ends of 2 identical waterstop sections may be made while the material is in the forms.
- D. Other Joints
 - 1. Joints with waterstops involving more than 2 ends to be jointed together, and joints that involve an angle cut, alignment change, or the joining of 2 dissimilar waterstop sections, shall be prefabricated prior to placement in the forms, allowing not less than 24-inch long strips of waterstop material beyond the joint.
 - 2. Upon inspection and approval, such prefabricated waterstop joint assemblies shall be installed in the forms and the ends of the 24-inch strips shall be butt-welded to the straight run portions of waterstop in place in the forms.
- E. Where a centerbulb waterstop intersects and is jointed with a non-centerbulb waterstop, care shall be taken to seal the end of the centerbulb, using additional PVC material if needed.

3.3 JOINT CONSTRUCTION

A. **Setting Waterstops**

- 1. In order to eliminate faulty installation that may result in joint leakage, particular care shall be taken as to the correct positioning of the waterstops during installation.
- 2. Adequate provisions shall be made to support and anchor the waterstops during the progress of the WORK and to ensure proper embedment in the concrete.
- 3. The symmetrical halves of the waterstops shall be equally divided between the concrete pours at the joints.
- 4. The center axis of the waterstops shall be coincident with the joint openings.
- 5. Thoroughly work the concrete in the vicinity of joints for maximum density and imperviousness.

B. **Waterstop Placement**

- 1. In placing waterstops in the forms, means shall be provided to prevent them from being folded over by the concrete as it is placed.

2. Waterstops shall be held in place with light wire ties on 12-inch centers, which shall be passed through hog rings at the edge of the waterstop and tied to the curtain of reinforcing steel.
3. Horizontal waterstops, with their flat face in a vertical plane, shall be held in place with continuous supports to which the top edge of the waterstop shall be tacked.
4. In placing concrete around horizontal waterstops with their flat face in a horizontal plane, the concrete shall be worked under the waterstops by hand in order to avoid the formation of air and rock pockets.
5. In placing center-bulb waterstops in expansion joints, the center-bulb shall be centered on the joint filler material.
6. Waterstop in vertical wall joints shall terminate 6 inches from the top of the wall, where such waterstop does not connect with any other waterstop and is not to be connected to a future concrete placement.

C. Joint Location

1. Construction joints and other types of joints shall be provided where indicated.
2. If not indicated, construction joints shall be provided at a 25-foot maximum spacing.
3. Where joints are indicated to be spaced greater than 40 feet apart, additional joints shall be provided to maintain the 25-foot maximum spacing.
4. The location of joints, regardless of type, shall be submitted for acceptance by the ENGINEER.

D. Joint Preparation

1. **Construction Joints:** The surfaces of horizontal joints shall be given a compacted, roughened surface for good bonding. Except where the Drawings call for joint surfaces to be coated, the joint surfaces shall be cleaned of laitance, loose or defective concrete, foreign material, and be roughened to a minimum of 1/4-inch amplitude. Such cleaning and roughening shall be accomplished by hydroblasting or sandblasting (exposing aggregate) followed by thorough washing. Pools of water shall be removed from the surface of construction joints before the new concrete is placed. The following is also required:
 - a. Special care shall be used in preparing concrete surfaces at joints where bonding between 2 sections of concrete is required.
 - b. Unless otherwise indicated, such bonding shall be required at every horizontal joint in walls.
2. **Old Concrete:** Where concrete is to be cast against old concrete (defined as any concrete which is greater than 60 Days old), the surface of the old concrete shall be thoroughly cleaned and roughened by hydroblasting or sandblasting to expose aggregate. The joint surface shall be coated with an epoxy bonding agent unless

determined otherwise by the OWNER. This provision shall not apply to joints where waterstop is provided.

E. Retrofit Waterstops

1. Joint Preparation

- a. Existing surfaces to receive a retrofit waterstop shall be clean and free from any loose or foreign material.
 - b. The surface shall be given a light sandblast or hydroblast finish to 1/8-inch amplitude prior to the application of epoxy and waterstop.
2. Retrofit waterstops shall be set in a bed of epoxy over a sandblasted surface with stainless steel batten bars and 1/4-inch diameter stainless steel anchors at 6 inches on-center, staggered, and in accordance with the manufacturer's written recommendations.

F. Joint Sealant

1. Crack control joints in water-bearing floor slabs and elsewhere as indicated shall be provided with tapered grooves which shall be filled with a joint sealant, as indicated.
2. The material used to form the tapered grooves shall be left in the grooves until just before the grooves are cleaned and filled with joint sealant.
3. After removing the forms from the grooves, laitance and fins shall be removed, and the grooves shall be sand blasted.
4. The grooves shall be allowed to thoroughly dry, after which they shall be blown out and immediately thereafter they shall be primed and filled with the construction joint sealant.
5. No joint sealant shall be used without a primer. The primer and sealant shall be placed strictly in accordance with the printed recommendations of the manufacturer, taking special care to properly mix the sealant prior to application.
6. The sides of the sealant groove shall not be coated with bond breaker, curing compound, or any other substance which would interfere with proper bonding of the joint sealant.
7. Care shall be used to completely fill the sealant grooves.
8. The joint sealant shall be installed by a competent waterproofing specialty contractor with a successful record of performance in similar installations.
9. The joint sealant shall achieve final cure at least 7 Days before the structure is filled with water.
10. **Mixing**

- a. Catalyst-cured, 2-part materials shall be thoroughly and uniformly mixed, and special care shall be taken to properly mix the sealer before its application.
- b. Before any sealer is placed, the CONTRACTOR shall arrange to have workers performing the WORK carefully instructed on the proper method of mixing and application by a representative of the joint sealant manufacturer.

11. **Failure to Cure**

- a. Any joint sealant that fails to fully and properly cure after the manufacturer's recommended curing time for the conditions of the WORK shall be completely removed, and the groove shall be thoroughly sandblasted to remove traces of the uncured or partially cured sealant and primer.
- b. The groove shall be re-sealed with the indicated joint sealant.
- c. Costs of such removal, joint treatment, re-sealing, and appurtenant WORK shall be the CONTRACTOR's responsibility as part of the WORK.

G. **Hydrophilic Waterstop**

1. Where a hydrophilic waterstop is indicated, it shall be installed in accordance with the manufacturer's instructions and recommendations except as may be modified in this Section.
2. When requested by the ENGINEER, the CONTRACTOR shall arrange for the manufacturer to furnish technical assistance in the field.
3. Hydrophilic waterstop shall only be used where complete confinement by concrete is provided.
4. Hydrophilic waterstop shall not be used in expansion or contraction joints nor in the first 6 inches of a non-intersecting joint.
5. **Location**
 - a. The hydrophilic waterstop shall be located as near as possible to the center of the joint, and it shall be continuous around the entire joint.
 - b. The minimum distance from the edge of the waterstop to the face of the member shall be 5 inches.
6. **Placement**
 - a. Where the thickness of the concrete member to be placed on the hydrophilic waterstop is less than 12 inches, the waterstop shall be placed in grooves formed or ground into the concrete.
 - b. The groove shall be at least 3/4-inch-deep and 1-1/4 inches wide.
 - c. When placed in the groove, the minimum distance from the edge of the waterstop to the face of the member shall be 2-1/2 inches.

7. Where a hydrophilic waterstop is used in combination with PVC waterstop, the hydrophilic waterstop shall overlap the PVC waterstop for a minimum of 6 inches and shall be adhered to PVC waterstop by a single component water-swelling sealant as recommended by the manufacturer.
8. The hydrophilic waterstop shall not be installed where the air temperature falls below the manufacturer's recommended range.
9. **Preparation**
 - a. The concrete surface under the hydrophilic waterstop shall be smooth and uniform, and the concrete shall be ground smooth if needed.
 - b. Alternatively, the hydrophilic waterstop shall be bonded to the surface using an epoxy grout that completely fills voids and irregularities beneath the waterstop material.
 - c. Prior to installation, the concrete surface shall be wire brushed to remove any laitance or other materials that may interfere with the bonding of epoxy.
10. **Securing**
 - a. The hydrophilic waterstop shall be secured in place with concrete nails and washers at 12-inch maximum spacing.
 - b. The above requirement shall be in addition to the adhesive recommended by the manufacturer.

- END OF SECTION -

SECTION 03 60 00 – CEMENTITIOUS GROUT

PART 1 -- GENERAL

1.1 SUMMARY

- A. The CONTRACTOR shall provide grout, complete and in place, in accordance with the Contract Documents
- B. **Grout Types.** The following types of grout are covered in this Section:
 - 1. Cement Grout
 - 2. Non-Shrink Grout - Class I (cement-based)
 - 3. Epoxy Grouts

1.2 CONTRACTOR SUBMITTALS

- A. Furnish submittals in accordance with Section 01 33 00 - Contractor Submittals.
 - 1. Certified testing lab reports for tests indicated herein.
 - 2. Test results and service report from the field tests and the demonstration and training session verifying the requirements indicated herein.
 - 3. Certification that grouts used on the project contain no chlorides or other chemicals that cause corrosion.
 - 4. Manufacturer's literature containing instructions and recommendations on the mixing, handling, placement, curing, and appropriate uses for each type of grout used in the WORK, and location of use. ICBO/ES report shall be submitted for epoxy anchor grout for adhesive anchors.
 - 5. Manufacturer's certification that its non-shrink grout does not contain aluminum, zinc, or magnesium powders as a method of expansion.
 - 6. Submit manufacturer's written warranty as indicated herein.
 - 7. Name and telephone number of grout manufacturer's representative who will give on-Site service. The representative shall have at least one year of experience with the indicated grouts.

1.3 QUALITY CONTROL

A. **Field Tests**

- 1. Compression test specimens will be taken from the first placement of each type of grout, and at intervals thereafter selected by the ENGINEER. The specimens will be made by the ENGINEER or its representative.

2. Compression tests and fabrication of specimens for cement grout and cement based non-shrink grout will be performed in accordance with ASTM C 1107 - Packaged Dry, Hydraulic-Cement Grout (Nonshrink), at intervals during construction selected by the ENGINEER. A set of 3 specimens will be made for testing at 7 Days, 28 Days, and each additional time period as appropriate.
 3. Compression tests and fabrication of specimens for concrete/grout fill will be performed in accordance with Section 03 30 00 - Cast-in-Place Concrete, at intervals during construction selected by the ENGINEER.
 4. The cost of laboratory tests on grout will be paid by the OWNER except where test results show the grout to be defective. In such case, the CONTRACTOR shall pay for the tests, removal and replacement of Defective Work, and re-testing, all as part of the WORK.
 5. The CONTRACTOR shall assist the ENGINEER in obtaining specimens for testing and shall furnish materials necessary for fabricating the test specimens.
- B. **Construction Tolerances:** Construction tolerances shall be as indicated in Section 03 30 00 - Cast-in-Place Concrete, unless indicated otherwise.

C. **Pre-Installation Demonstration and Training**

1. **Epoxy-Based Non-Shrink Resins**

- a. The resin manufacturer shall give a demonstration and training session for the epoxy non-shrink resins to be used on the project, before any installation of resin is allowed.
- b. Training session shall use a minimum of 2 bags of epoxy-based non-shrink resin mixed to fluid consistency. Tests shall be conducted for flow cone and bleed tests. Six cubes for testing at 1, 3, and 28 Days shall be made. The remaining resin shall be placed, and curing may be initiated on actual project placements such as baseplates and tie holes to provide on-the-job training for the CONTRACTOR and ENGINEER. The CONTRACTOR employees who will be doing the resining shall participate in this training and demonstration session. The training session shall include methods for curing the resin.
- c. The manufacturer shall mix enough epoxy-based non-shrink resin for a minimum of 8 tie holes and shall train the CONTRACTOR'S employees in how to perform the WORK and cure the resin. The CONTRACTOR shall have the employees assisting in the mixing and sealing of the tie holes.
- d. If the project includes patching, throughbolt holes, epoxy anchors, and/or blockouts, the manufacturer shall also train the CONTRACTOR'S employees in the mixing and curing of the epoxy resins for each of these applications.
- e. The CONTRACTOR shall transport the test cubes to an independent test laboratory, obtain the test reports, and report these demonstration and training test cube strengths to the ENGINEER.

1.4 SPECIAL CORRECTION OF DEFECTS PROVISIONS

A. **Manufacturer's Warranty**

1. Furnish one year warranty for WORK provided under this section.
2. Manufacturer's warranty shall not contain a disclaimer limiting responsibility to the purchase price of products or materials.

PART 2 -- PRODUCTS

2.1 APPLICATION

- A. Unless indicated otherwise, grouts shall be provided as listed below whether indicated on the Drawings or not.

Application	Type of Grout
Anchor bolts and reinforcing steel required to be set in grout in which the average working or operating temperature will be over 100 degrees F or in high fire risk areas.	Non-Shrink - Class I
Anchor bolts and reinforcing steel required to be set in grout that is not in high temperature, high vibration, or high fire risk areas.	Epoxy Resin Adhesive System (See Spec 03 65 00)

2.2 NON-SHRINK EPOXY RESIN

- A. Non-shrink epoxy adhesives shall be a flowable, non-shrink, 100 percent solids system. The epoxy resin system shall have 3 components: resin, hardener, and specially blended aggregate, each premeasured and prepackaged. The resin component shall not contain any non-reactive diluents. Resins containing butyl glycidyl ether (BGE) or other highly volatile and hazardous reactive diluents are not acceptable. Variation of component ratios is not permitted unless specifically recommended by the manufacturer. Manufacturer's instructions shall be printed on each container in which the materials are packaged.
- B. Epoxy resin shall have a maximum early age height change of 4.0 percent expansion, and shall have no shrinkage (0.0 percent) in accordance with ASTM C 827, (modified for epoxy resins by using an indicator ball with a specific gravity between 0.9 and 1.1).
- C. Epoxy resin shall have a negligible (less than 0.0006 in/in) length change after hardening, and a coefficient of thermal expansion less than 0.00003 in/in F when tested according to ASTM C 531 - Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Resins, and Monolithic Surfacing.

- D. The epoxy resin shall develop a minimum compressive strength of 9000 psi in 24 hours and 13,000 psi in seven days when tested in accordance with ASTM C 579, method B.
- E. The mixed epoxy resin shall have a minimum working life of 90 to 120 minutes at 70 degrees F.
- F. The effective bearing area shall be a minimum of 95 percent EBA in accordance with ASTM C 1339 – Standard Test Method for Flowability and Bearing Area of Chemical-Resistant Polymer Machinery Resins, for bearing area and flow.
- G. The chemical formulation of the epoxy resin shall be that recommended by the manufacturer for the particular application. Do not reduce aggregate loading or add solvents to increase flowability.
- H. Non-shrink epoxy resin shall have the following minimum properties when tested at 7 Days:
 - 1. Minimum bond strength to concrete of 3000 psi per ASTM C 882 modified.
 - 2. Minimum bond strength to steel of 1700 psi per ASTM C 882 modified.
 - 3. Minimum flexural strength of 2500 psi per ASTM C 580.
 - 4. Minimum tensile strength of 2000 psi per ASTM C 307 -- Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Resins, and Monolithic Surfacing.
- I. Non-shrink epoxy resin shall be **Five Star DP Epoxy Resin** by **Five Star Products, Inc.**, **Masterflow 648 CP Plus** by **BASF**, **Sikadur 42 Resin-Pak** by **Sika Corporation**, or approved equal.

2.3 CEMENT GROUT

- A. Cement grout shall be composed of one part cement, 3 parts sand, and the minimum amount of water necessary to obtain the desired consistency. Where needed to match the color of adjacent concrete, white Portland cement shall be blended with regular cement as needed. The minimum compressive strength at 28 Days shall be 4,000 psi.
- B. Cement grout materials shall be as indicated in Section 03 30 00 - Cast-in-Place Concrete.

2.4 NON-SHRINK GROUTS (Cement-based)

A. **General**

- 1. Cement-based non-shrink grout shall be a prepackaged, inorganic, fluid, non-gas liberating, non-metallic, cement type grout requiring only the addition of water. Cement from kilns burning metal-rich hazardous waste fuel shall not be used.
- 2. Manufacturer's instructions shall be printed on each bag or other container in which the materials are packaged. The specific formulation for each class of non-shrink grout shall be as recommended by the manufacturer for the particular application.

3. Grout shall not contain chlorides or additives that may contribute to corrosion.
4. Grout shall be formulated to be used at any consistency from fluid to plastic.
5. Cement-based non-shrink grout shall have the following minimum properties when tested at a fluid consistency, at 28 Days:
 - a. Minimum tensile splitting strength of 500 psi per ASTM C 496 - Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens.
 - b. Minimum flexural strength of 1,000 psi per ASTM C 580 - Standard Test Method for Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes.
 - c. Minimum bond strength (concrete to grout) of 1,900 psi per modified ASTM C 882 - Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear.
 - d. If for Exterior Use, grout shall be certified for use in freeze/thaw environments.

B. Class I Non-Shrink Grout

1. Class I non-shrink grout shall have a minimum 28 Day compressive strength of 5,000 psi when mixed at a fluid consistency.
2. Class I non-shrink grout shall meet the requirements of ASTM C 1107, Grade B or C, when mixed to fluid, flowable, and plastic consistencies.
3. Grout shall have a maximum early age height change of 4.0 percent expansion, and shall have no shrinkage (0.0 percent) in accordance with ASTM C 827 – Test Method for Early Volume Change of Cementitious Mixtures. The grout when tested shall not bleed or segregate at maximum allowed water.
4. Grout shall have no shrinkage (0.0 percent) and a maximum of 0.3 percent expansion in the hardened state when tested in accordance with ASTM C 1090 - Test Method for Measuring Changes in Height of Cylindrical Specimens from Hydraulic-Cement Grout.
5. Furnish certification that the non-shrink property of grout is not based on gas production or gypsum expansion.
6. Class I Non-Shrink Grout shall be **Masterflow 713 Plus** by **BASF Systems**, **Five Star Grout** by **Five Star Products**, **Sikagrout 212** by **Sika Corporation**, **Premier** by **L&M Construction Chemicals**; **High-Flow Grout** by **Euclid Chemical Company**, **CG 200 PC** by **Hilti**, or approved equal.

C. Class II Non-Shrink Grout

1. Class II non-shrink grout shall be a high precision, fluid, extended working time grout. The minimum 28-Day compressive strength shall be 7,500 psi, when mixed at a fluid consistency.

2. Grout shall have a maximum early age height change of 4.0 percent expansion, and shall have no shrinkage (0.0 percent) in accordance with ASTM C 827.
3. Grout shall have no shrinkage (0.0 percent) and a maximum of 0.3 percent expansion in the hardened state when tested in accordance with ASTM C 1090.
4. Class II non-shrink grout shall have an extended working time of 30 minutes minimum when mixed to a fluid consistency as defined in ASTM C 827 at temperature extremes of 45 to 90 degrees F in accordance with ASTM C 1107.
5. Class II non-shrink grout shall meet the requirements of ASTM C 1107, Grade B or C when tested using the amount of water needed to achieve fluid consistency per ASTM C 939.
6. The grout when tested shall not bleed or segregate at maximum allowed water content.
7. Provide certification that its non-shrink property is not based on gas production or gypsum expansion.
8. Class II non-shrink grout shall be **Masterflow 928** by **BASF Systems**, **Five Star Fluid Grout 100** by **Five Star Products**, **Crystex** by **L&M Construction Chemicals**, or approved equal.

2.5 CONCRETE/GROUT FILL

- A. Where fill is thicker than 3-inches, structural concrete, as indicated in Section 03 30 00 - Cast-in-Place Concrete, may be used when accepted by the ENGINEER.
- B. Grout for concrete/grout fill for built-up surfaces of tank, channel, and basin bottoms shall be composed of cement, fine aggregate, coarse aggregate, water, and admixtures proportioned and be mixed as indicated. Materials and procedures indicated for normal concrete in Section 03 30 00 - Cast-in-Place Concrete, shall apply unless indicated otherwise.
- C. Concrete/grout fill shall contain a minimum of 564 pounds of cement per cubic yard with a maximum water cement ratio of 0.45.
- D. Coarse aggregate shall be graded as follows:

U.S. Standard Sieve Size	Percent By Weight Passing
1/2 in	100
3/8 in	90-100
No. 4	20-55
No. 8	5-30
No. 16	0-10

No. 30	0
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- E. Final mix design shall be as determined by trial mix design as indicated in Section 03 30 00 - Cast-in-Place Concrete, except that drying shrinkage tests are not required.
- F. Concrete grout/fill shall contain air-entraining agent per Section 03 30 00 - Cast-in-Place Concrete.
- G. **Strength:** Minimum compressive strength of concrete/grout fill at 28 Days shall be 4,000 psi.

2.6 CURING MATERIALS

- A. Curing materials shall be in accordance with Section 03 30 00 - Cast-in-Place Concrete and as recommended by the manufacturer of prepackaged grouts.

2.7 CONSISTENCY

- A. The consistency of grouts shall be that necessary to completely fill the space to be grouted for the particular application. Dry pack consistency is defined such that the grout is plastic and moldable but will not flow. Where "dry pack" is called for in the Contract Documents, it shall mean a grout of that consistency; the type of grout to be used shall be as indicated herein for the particular application.
- B. The slump for concrete/grout fill shall be adjusted to match placement and finishing conditions but shall not exceed 4-inches.

2.8 MEASUREMENT OF INGREDIENTS

- A. Measurements for cement grout shall be made accurately by volume using containers. Shovel measurements shall not be allowed.
- B. Prepackaged grouts shall have ingredients measured by means recommended by the manufacturer.

PART 3 -- EXECUTION

3.1 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Grout shall be stored in accordance with manufacturer's recommendations.

3.2 GENERAL

- A. CONTRACTOR shall arrange for the manufacturer of prepackaged grouts to provide on-Site technical assistance within 72 hours of request, as part of the WORK.
- B. Grout shall not be placed until base concrete or masonry has attained its design strength, unless authorized otherwise by the ENGINEER.
- C. When cementitious grouts are used on concrete surfaces, the concrete surface shall be saturated with water for 24 hours prior to placement. Upon completion of the saturation

period, excess water shall be removed with clean, oil free compressed air prior to grouting. Concrete substrate shall not be wet prior to placement of epoxy grouts.

- D. Surface preparation, curing, and protection of cement grout shall be in accordance with Section 03 30 00 - Cast-in-Place Concrete. The finish of the grout surface shall match that of the adjacent concrete unless otherwise indicated.
- E. Surfaces that will be in contact with grout shall be free of dirt, loose rust, oil, wax, grease, curing compounds, laitance, loose concrete, and other deleterious materials.
- F. Shade the WORK from sunlight for at least 24 hours before and 48 hours after grouting.
- G. Contact the grout manufacturer's representative for assistance on hot and cold weather grouting techniques and precautions if applicable.
- H. **Equipment, Tank, and Pipe Supports.** Structural, equipment, tank, and piping support bases shall be resined, unless indicated otherwise.
 - 1. The original concrete shall be blocked out or finished off a sufficient distance below the plate to provide for a minimum one-inch thickness of resin or other thickness if indicated.
 - 2. After the base plate has been set in position at the proper elevation by steel wedges or double nuts on the anchor bolts, the space between the bottom of the plate and the original pour of concrete shall be filled with non-shrink-type resin through a headbox of appropriate size. The mixture shall be of a fluid consistency and poured continuously into the space between the plate and the base concrete. Forms for resin shall be tight against retaining surfaces, and joints shall be sealed as recommended by the resin manufacturer to be liquid-tight. Forms shall be coated as recommended by the resin manufacturer for easy form release. Where this method of placement is not practical or where required by the ENGINEER, alternate resining methods shall be submitted for acceptance by the ENGINEER.
 - 3. Concrete equipment pads for equipment bases that will be epoxy-resined shall be sized so that, when the equipment base is fully resined, the epoxy resin is stopped not less than 4-inches from the edge of the pad.

3.3 GROUTING PROCEDURES

- A. **General:** Mixing, surface preparation, handling, placing, consolidation, curing, and other means of execution for prepackaged grouts shall be done according to the instructions and recommendations of the manufacturer.
- B. **Equipment, Tank, and Pipe Supports.** Structural, equipment, tank, and piping support bases shall be grouted, unless indicated otherwise.
 - 1. The original concrete shall be blocked out or finished off a sufficient distance below the plate to provide for a minimum one-inch thickness of grout or other thickness if indicated.
 - 2. After the base plate has been set in position at the proper elevation by steel wedges or double nuts on the anchor bolts, the space between the bottom of the plate and

the original pour of concrete shall be filled with non-shrink-type grout through a headbox of appropriate size. The mixture shall be of a fluid consistency and poured continuously into the space between the plate and the base concrete. Forms for grout shall be tight against retaining surfaces, and joints shall be sealed as recommended by the grout manufacturer to be liquid-tight. Forms shall be coated as recommended by the grout manufacturer for easy form release. Where this method of placement is not practical or where required by the ENGINEER, alternate grouting methods shall be submitted for acceptance by the ENGINEER.

3. Concrete equipment pads for equipment bases that will be epoxy-grouted shall be sized so that, when the equipment base is fully grouted, the epoxy grout is stopped not less than 4-inches from the edge of the pad.

C. Drilled Anchors and Reinforcing Bars

1. General

- a. Drilled anchors and reinforcing bars shall be installed in strict accordance with the manufacturer's instructions. Holes shall be roughened with a brush on a power drill, and cleaned. Drilled anchors shall not be installed until the concrete has reached the required 28 Day compressive strength. Anchors shall not be loaded until the grout has reached its indicated strength in accordance with the manufacturer's instructions.
- b. The CONTRACTOR shall identify position of reinforcing steel and other embedded items prior to drilling holes. Care shall be exercised in coring and drilling to avoid damaging existing reinforcing or embedded items. Notify the ENGINEER if reinforcing steel or other embedded items are encountered during drilling. Take precautions as necessary to avoid damaging prestressing tendons, electrical and communications conduit, and piping.

2. Cement Based Non-Shrink Grout

- a. In places of high temperature or fire hazard, anchor bolts shall be grouted in using cement based non-shrink grout, Class I.
- b. Unless otherwise indicated, embedment shall be sufficient to develop the ultimate tensile strength of the anchor or reinforcing bar per the manufacturer's ICC/ES report, but shall not be less than 16 diameters for threaded rod or 24 diameters for reinforcing or smooth bars.
- c. When the bolt diameter is one-inch or less, the hole diameter should be a minimum of 2-inches. When the bolt diameter is greater than one-inch, the hole diameter should be at least twice the bolt diameter.
- d. Drilled holes shall be saturated with water for not less than 24 hours before installation of anchor/rod/rebar.
- e. The non-shrink grout should be placed in the holes in a non-sag (trowelable) consistency. The grout should be placed in the holes before the anchor and then the anchor inserted and vibrated to ensure proper coverage.

D. Concrete / Grout Fill

1. Mechanical, electrical, and finish WORK shall be completed prior to placement of topping or concrete/grout fill. To ensure bonding to the base slab, the base slab shall be given an exposed aggregate finish. Alternatively where accepted by the ENGINEER, the base slab shall be given a roughened textured surface by a close-spaced rake while the surface is green. After curing, high pressure washing shall expose the aggregates and produce not less than a 3/16-inch amplitude roughness. Jackhammers or chipping hammers shall not be used.
2. The minimum thickness of concrete/grout fill shall be one-inch. Where the finished surface of concrete/grout fill is to form an intersecting angle of less than 45 degrees with the concrete surface it is to be placed against, a key shall be formed in the concrete surface at the intersection point. The key shall be a minimum of 3-1/2 inches wide by 1-1/2 inches deep.
3. The base slab shall be thoroughly cleaned and wetted to saturated surface dry (SSD) condition per the International Concrete Repair Institute (ICRI) -- Technical Guide for Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays, prior to placing topping and fill. No topping concrete shall be placed until the slab is completely free from standing pools or ponds of water. A thin coat of neat cement grout shall be broomed into the surface of the slab just before topping or fill placement. The neat cement grout shall not be allowed to dry before topping placement. If it does dry, it must be immediately removed using wet stiff brooms and reapplied. The topping and fill shall be compacted by rolling or thorough tamping, brought to established grade, and floated. Grouted fill for tank and basin bottoms where scraping mechanisms are to be installed shall be screeded by blades attached to the revolving mechanism of the equipment in accordance with the procedures outlined by the equipment manufacturer after the grout is brought to the established grade. Coat surface with evaporation retardant as needed to prevent plastic shrinkage cracks.
4. Grout placed on sloping slabs shall proceed uniformly from the bottom of the slab to the top, for the full width of the placement.
5. The surface shall be tested with a straight edge to detect high and low spots which shall be immediately eliminated. When the topping or fill has hardened sufficiently, it shall be steel troweled to a smooth surface free from pinholes and other imperfections. An approved type of mechanical trowel may be used as an assist in this operation, but the last pass over the surface shall be by hand-troweling. During finishing, no water, dry cement, or mixture of dry cement and sand shall be applied to the surface.

3.4 CONSOLIDATION

- A. Grout shall be placed in such a manner, for the consistency necessary for each application, to assure that the space to be grouted is completely filled.

3.5 CURING

- A. Cement based grouts shall be cured per Section 03 30 00 - Cast-in-Place Concrete and per the manufacturer's recommendations.

- END OF SECTION -

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SECTION 03 65 00 – EPOXY RESIN ADHESIVE SYSTEMS

PART 1 -- GENERAL

1.1 SUMMARY

- A. The CONTRACTOR shall provide epoxy resin adhesives, complete and in place, in accordance with the Contract Documents

1.2 CONTRACTOR SUBMITTALS

- A. Furnish submittals in accordance with Section 01 33 00 - Contractor Submittals.
 - 1. Certified testing lab reports for tests indicated herein.
 - 2. Test results and service report from the field tests and the demonstration and training session verifying the requirements indicated herein.
 - 3. Certification that resins used on the project contain no chlorides or other chemicals that cause corrosion.
 - 4. Manufacturer's literature containing instructions and recommendations on the mixing, handling, placement, curing, and appropriate uses for each type of resin used in the WORK, and location of use. ICC/ES report shall be submitted for epoxy anchor resin for adhesive anchors.
 - 5. Manufacturer's certification that its non-shrink resin does not contain aluminum, zinc, or magnesium powders as a method of expansion.
 - 6. Submit manufacturer's written warranty as indicated herein.
 - 7. Name and telephone number of resin manufacturer's representative who will give on-Site service. The representative shall have at least one year of experience with the indicated resins.

1.3 QUALITY CONTROL

A. **Field Tests**

- 1. The cost of laboratory tests on resin will be paid by the OWNER except where test results show the resin to be defective. In such case, the CONTRACTOR shall pay for the tests, removal and replacement of Defective Work, and re-testing, all as part of the WORK.
- 2. The CONTRACTOR shall assist the ENGINEER in obtaining specimens for testing and shall furnish materials necessary for fabricating the test specimens.

- B. **Construction Tolerances:** Construction tolerances shall be as indicated in Section 03 30 00 - Cast-in-Place Concrete, unless indicated otherwise.

C. **Pre-Installation Demonstration and Training**

1. Epoxy Anchor Resins for Adhesive Anchors

- a. Special inspection as recommended by the ICC/ES report or as required by the building department shall be required for adhesive anchor installations. Cost of special inspection of adhesive anchors will be paid by the OWNER.
- b. Before installing adhesive anchors in the WORK, adhesive anchor installers shall be trained and qualified at the Site by the manufacturer's representative. Training and qualification for each installer shall include at least:
 - 1) Hole drilling procedure, hole preparation and cleaning techniques, adhesive injection technique and dispenser training/maintenance, rebar dowel preparation and installation, and proof loading/torquing.
 - 2) Anchors installed in both the vertical and horizontal positions in a mock-up concrete panel of adequate size and thickness. Anchors shall be tested in tension and shear loading. A minimum of 3 anchors shall be tested for each installation position.
 - 3) Anchors shall be tested at 2 times the published allowable load in tension and in shear as indicated in the ICC/ES report.
 - 4) If any of the 3 test bolts in any installation position fail to reach the test loads, the installer shall be re-tested with the same procedure. Re-testing is required only for the failed installation position.
 - 5) An installer who has 3 consecutive successful bolt tests in the first or second trial is considered qualified for adhesive anchor installation for this project. The manufacturer's representative shall issue a certificate to the qualified installer, and a copy of the certificate shall be filed with the CONTRACTOR and be submitted to the ENGINEER.
 - 6) The test anchor size shall be the largest size adhesive anchor used on the project. The embedment length shall be long enough to develop the allowable steel strength per AISC Manual of Steel Construction.
 - 7) Each installer shall be re-qualified every 6 months for the duration of the project by the same qualifying procedure.
 - 8) The certification of each qualified installer shall be available for verification at the Special Inspector's request.
 - 9) Defective anchors noted by the Special Inspector shall be replaced and re-installed by the CONTRACTOR without any additional compensation.

1.4 SPECIAL CORRECTION OF DEFECTS PROVISIONS

A. Manufacturer's Warranty

1. Furnish one-year warranty for WORK provided under this section.

2. Manufacturer's warranty shall not contain a disclaimer limiting responsibility to the purchase price of products or materials.

PART 2 -- PRODUCTS

2.1 APPLICATION

- A. Unless indicated otherwise, epoxy adhesive resins shall be provided as listed below whether indicated on the Drawings or not.

Application	Type of Epoxy Resins
Anchor bolts and reinforcing steel required to be set in resin that is not in high temperature or high fire risk areas.	Epoxy Anchor Resin

2.2 EPOXY ANCHOR RESIN

- A. Epoxy anchor resin shall conform to ASTM C 881 - Epoxy-Resin-Base Bonding Systems for Concrete, Type IV, Class B & C, Grade 3 with the exception of gel time.
- B. Heat deflection temperature per ASTM D 648 -- Test Method for Deflection Temperature of Plastics Under Flexural Load shall be a minimum 120 degrees F.
- C. Manufacturer shall certify that the epoxy anchor resin will maintain 90 percent of its strength up to a temperature of 125 degrees F.
- D. Resin shall come in a 2 chambered cartridge with a metering system that provides the proper ratio of hardener and resin. The resin shall also come with a static mixer nozzle to thoroughly mix the hardener and resin together.
- E. Epoxy anchor resin shall be capable of being used in submersed applications once cured.
- F. Compressive strength per ASTM D 695 - Test Method for Compressive Properties of Rigid Plastics shall be 10,000 psi minimum.
- G. Whenever possible, overhead anchors subject to vibration, anchors in fire-resistive construction or high fire risk areas, and anchors subject to working or operating temperatures above 100 degrees F shall be cast-in-place anchors. Whenever cast-in-place anchors cannot be used in these applications, use cement based non-shrink resin and oversized holes.
- H. Embedment of adhesive anchors/rebar shall be deep enough to develop the anchor/rebar. Embedment shall not exceed 67 percent of the member depth.
- I. Epoxy anchor resin shall be **Power-Fast Epoxy Injection Gel** by **Powers Fasteners; HIT RE 500V3** by **Hilti**, or approved equal.

2.3 CURING MATERIALS

- A. Curing materials shall be in accordance with recommendations by the manufacturer of prepackaged resins.

2.4 CONSISTENCY

- A. The consistency of resins shall be that necessary to completely fill the space to be resined for the particular application.

2.5 MEASUREMENT OF INGREDIENTS

- A. Prepackaged resins shall have ingredients measured by means recommended by the manufacturer.

PART 3 -- EXECUTION

3.1 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Resin shall be stored in accordance with manufacturer's recommendations.

3.2 GENERAL

- A. CONTRACTOR shall arrange for the manufacturer of prepackaged resins to provide on-Site technical assistance within 72 hours of request, as part of the WORK.
- B. Resin shall not be placed until base concrete has attained its design strength, unless authorized otherwise by the ENGINEER.
- C. Concrete substrate shall not be wet prior to placement of epoxy resins, unless the use of a wet substrate is permitted by the Resin Manufacturer recommendations for the resin being applied.
- D. Surfaces that will be in contact with resin shall be free of dirt, loose rust, oil, wax, grease, curing compounds, laitance, loose concrete, and other deleterious materials.
- E. Shade the WORK from sunlight for at least 24 hours before and 48 hours after resining.
- F. Contact the resin manufacturer's representative for assistance on hot and cold weather resining techniques and precautions if applicable.

3.3 RESINING PROCEDURES

- A. **General:** Mixing, surface preparation, handling, placing, consolidation, curing, and other means of execution for prepackaged resins shall be done according to the instructions and recommendations of the manufacturer.
- B. **Equipment, Tank, and Pipe Supports.** Structural, equipment, tank, and piping support bases shall be resined, unless indicated otherwise.

1. The original concrete shall be blocked out or finished off a sufficient distance below the plate to provide for a minimum one-inch thickness of resin or other thickness if indicated.
2. After the base plate has been set in position at the proper elevation by steel wedges or double nuts on the anchor bolts, the space between the bottom of the plate and the original pour of concrete shall be filled with non-shrink-type resin through a headbox of appropriate size. The mixture shall be of a fluid consistency and poured continuously into the space between the plate and the base concrete. Forms for resin shall be tight against retaining surfaces, and joints shall be sealed as recommended by the resin manufacturer to be liquid-tight. Forms shall be coated as recommended by the resin manufacturer for easy form release. Where this method of placement is not practical or where required by the ENGINEER, alternate resining methods shall be submitted for acceptance by the ENGINEER.
3. Concrete equipment pads for equipment bases that will be epoxy-resined shall be sized so that, when the equipment base is fully resined, the epoxy resin is stopped not less than 4-inches from the edge of the pad.

C. Drilled Anchors and Reinforcing Bars

1. General

- a. Drilled anchors and reinforcing bars shall be installed in strict accordance with the manufacturer's instructions. Holes shall be roughened with a brush on a power drill, and cleaned. Drilled anchors shall not be installed until the concrete has reached the required 28 Day compressive strength. Anchors shall not be loaded until the resin has reached its indicated strength in accordance with the manufacturer's instructions.
- b. The CONTRACTOR shall identify position of reinforcing steel and other embedded items prior to drilling holes. Care shall be exercised in coring and drilling to avoid damaging existing reinforcing or embedded items. Notify the ENGINEER if reinforcing steel or other embedded items are encountered during drilling. Take precautions as necessary to avoid damaging prestressing tendons, electrical and communications conduit, and piping.

2. Epoxy Adhesive Anchors

- a. Resin shall be proportioned and mixed with automatic equipment.
- b. Unless otherwise indicated, embedment shall be sufficient to develop the ultimate tensile strength of the anchor or reinforcing bar per the manufacturer's ICC/ES report, but shall not be less than 8 diameters for threaded rod or 12 diameters for reinforcing or smooth bars.

3.4 CONSOLIDATION

- A. Resin shall be placed in such a manner, for the consistency necessary for each application, to assure that the space to be resined is completely filled.

3.5 CURING

- A. Cement based resins shall be cured per Section 03 30 00 - Cast-in-Place Concrete and per the manufacturer's recommendations.

- END OF SECTION -

SECTION 05 50 00 - MISCELLANEOUS METALWORK

PART 1 -- GENERAL

1.1 SUMMARY

- A. The CONTRACTOR shall provide miscellaneous metalwork and appurtenances, complete and in place, as indicated in accordance with the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Federal Specifications

MIL-G-18015 A (3) (Ships) Aluminum Planks. (6063-T6)

MIL-A-907E Antiseize Thread Compound, High Temperature

B. Codes

OSHA 1927.10 Fixed Ladders

C. Commercial Standards

AA-M32C22A41 Aluminum Assn.

AASHTO HS-20 Truck Loading

AISC Manual of Steel Construction

AISI Design of Light Gauge, Cold-Formed Steel Structural Members

ANSI / AWS D1.1 Structural Welding Code - Steel

ANSI / AWS D1.2 Structural Welding Code - Aluminum

ANSI / AWS QC1 Qualification and Certification of Welding Inspectors

ASTM A 36 Carbon Structural Steel

ASTM A 48 Gray Iron Castings

ASTM A 53 Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

ASTM A 123 Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A 153 Zinc Coating (Hot-Dip) on Iron and Steel Hardware

ASTM A 193 Alloy-Steel and Stainless Steel Bolting Materials for High Temperature Service

ASTM A 194	Carbon and Alloy Steel Nuts for Bolts for High Pressure and High Temperature Service
ASTM A 307	Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
ASTM A 325	Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A 500	Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 992	Steel for Structural Shapes for Use in Building Framing

1.3 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with the requirements of Section 01 33 00 – Contractor Submittals.

B. **Shop Drawings**

1. Shop Drawings shall conform to AISC recommendations and specifications, and shall show holes, and the like, as may be required for other parts of the WORK.
2. Shop Drawings shall include complete details of members and connections, anchor bolt layouts, schedules for fabrication procedures, and diagrams for the sequence of erection.
3. Anchors
 - a. Submit an ICC report listing the ultimate load capacity in tension and shear for each size and type of concrete anchor.
 - b. Submit manufacturer's recommended installation instructions and procedures for adhesive anchors.
 - c. Upon review by the ENGINEER, these instructions shall be followed specifically.
 - d. No substitution for the indicated adhesive anchors will be considered unless accompanied with ICC report verifying strength and material equivalency, including temperature at which load capacity is reduced to 90 percent of that determined at 75 degrees F.

1.4 QUALITY CONTROL

- A. Weld procedures and welder qualifications shall be available in the CONTRACTOR's field office for review.
- B. Welding shall be inspected by a CONTRACTOR-furnished inspector qualified in accordance with AWS requirements and approved by the ENGINEER.

PART 2 -- PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Steel

Shapes, Plates, Bars	ASTM A 36
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B. Corrosion Protection

1. Unless otherwise indicated, fabricated steel metalwork which will be used in a corrosive environment and/or will be submerged in water or wastewater shall be coated in accordance with the requirements of Section 09 96 00 - Protective Coatings, and shall not be galvanized prior to coating.
2. Other miscellaneous steel metalwork shall be hot-dip galvanized after fabrication.

2.2 BOLTS AND ANCHORS

A. Standard Service (Non-Corrosive Application)

1. Unless otherwise indicated, bolts, anchor bolts, washers, and nuts shall be fabricated from carbon steel as indicated, and hot dip galvanized after fabrication.
2. Threads on galvanized bolts and nuts shall be formed with suitable taps and dies such that they retain their normal clearance after hot-dip galvanizing.
3. Except as otherwise indicated, steel for bolt material, anchor bolts, and cap screws shall be in accordance with the following requirements:
 - a. Structural Connections: ASTM A 307, Grade A or B, hot-dip galvanized
 - b. Anchor Bolts: ASTM A 307, Grade A or B, or ASTM A 36, hot-dip galvanized
 - c. High-Strength Bolts, where indicated: ASTM A 325
 - d. Pipe and Equipment Flange Bolts: ASTM A 193, Grade B-7

B. Corrosive Service

1. Bolts, nuts, and washers in the locations listed below shall be fabricated from Type 316 stainless steel as indicated below, or as indicated otherwise on the Contract Drawings.
 - a. Buried locations
 - b. Submerged locations
 - c. Inside hydraulic structures below the top of the structure

- d. Locations indicated or designated by the ENGINEER to be provided with corrosion resistant steel bolts
2. **Stainless Steel Nuts on SS Bolts.** Unless otherwise indicated, stainless steel bolts, anchor bolts, nuts, and washers shall be fabricated from Type 316 stainless steel, Class 1, conforming to ASTM A 193 for bolts and to ASTM A 194 for nuts.

C. **Anti-seize Lubricant Coating**

1. Threads on stainless steel bolts shall be protected with an antiseize lubricant suitable for submerged stainless steel bolts, meeting government specification MIL-A-907E.
2. Buried bolts in poorly drained soil shall be coated the same as the buried pipe.
3. Antiseize lubricant shall be classified as acceptable for potable water use by the NSF.
4. Antiseize lubricant shall be "PURE WHITE" by **Anti-Seize Technology**, Franklin Park, IL, 60131, **AS-470** by **Dixon Ticonderoga Company**, Lakehurst, NJ, 08733, or equal.

D. **Bolt Requirements**

1. The bolt and nut material shall be free-cutting steel.
2. The nuts shall be capable of developing the full strength of the bolts.
3. Threads shall be Coarse Thread Series conforming to the requirements of the American Standard for Screw Threads.
4. Bolts and cap screws shall have hexagon heads and nuts shall be Heavy Hexagon Series.
5. Bolts and nuts shall be installed with washers fabricated from material matching the base material of bolts, except that hardened washers for high-strength bolts shall conform to the requirements of the AISC Specification.
6. Lock washers fabricated from material matching the bolts shall be installed where indicated.
7. The length of each bolt shall be such that the bolt extends at least 1/8-inch beyond the outside face of the nut before tightening, except for anchor bolts which shall be flush with the face of the nut before tightening.

2.3 Drilled Anchors in Concrete

A. **General**

1. Unless otherwise indicated, drilled concrete anchors shall be adhesive anchors.

2. No substitutions will be considered unless accompanied with an ICC report verifying strength and material equivalency.
3. Expanding type anchors are not permitted.

B. Epoxy Anchors

1. Epoxy adhesive anchors are required for drilled anchors for outdoor installations, in submerged, wet, splash, overhead, and corrosive conditions, and for anchoring handrails and reinforcing bars.
2. Epoxy shall be in accordance with the requirements of Section 03 65 00 – Epoxy Resin Adhesive Systems.
3. Threaded rod shall be galvanized for general purpose applications and fabricated from Type 316 stainless steel for use in corrosive applications.
4. Embedment depth shall be as the manufacturer recommends for the load to be supported.
5. Unless otherwise indicated, glass capsule, polyester resin adhesive anchors will be permitted in locations not included above, and shall be **Hilti HVA, Cobra Anchors**, or equal.
6. Threaded rod shall be fabricated from galvanized steel, unless otherwise noted in the Contract Documents.

C. Non-Shrink Grouted Anchors

1. Anchors, if indicated or permitted, shall be grouted with a non-shrink cementitious grout in accordance with the manufacturer's recommendations.
2. Non-shrink grout material shall be per Section 03 60 00 – Cementitious Grout.

PART 3 -- EXECUTION

3.1 FABRICATION AND INSTALLATION REQUIREMENTS

A. Fabrication and Erection

1. Except as otherwise indicated, the fabrication and erection of structural steel shall conform to the requirements of the American Institute of Steel Construction "Manual of Steel Construction."

3.2 WELDING

A. Methods & Qualifications

1. Welding shall be performed by the metal-arc method or gas-shielded arc method as described in the American Welding Society "Welding Handbook" as supplemented by other pertinent standards of the AWS.

2. The qualification of the welders shall be in accordance with the AWS Standards.

B. Quality

1. In assembly and during welding, the component parts shall be adequately clamped, supported, and restrained in order to minimize distortion and for control of dimensions.
2. Weld reinforcement shall be as indicated by the AWS Code.
3. Upon completion of welding, remove weld splatter, flux, slag, and burrs left by attachments.
4. Welds shall be repaired in order to produce a workmanlike appearance, with uniform weld contours and dimensions.
5. Sharp corners of material that is to be painted or coated shall be ground to a minimum of 1/32-inch on the flat.

3.3 GALVANIZING

- A. Structural steel plates, shapes, bars, and fabricated assemblies required to be galvanized shall, after the steel has been thoroughly cleaned of rust and scale, be galvanized in accordance with the requirements of ASTM A 123.
- B. Any galvanized part that becomes warped during the galvanizing operation shall be straightened.
- C. Bolts, anchor bolts, nuts, and similar threaded fasteners, after being properly cleaned, shall be galvanized in accordance with the requirements of ASTM A153.

D. Field Repairs

1. Field repairs to damaged galvanizing shall be performed by preparing the surface and applying a coating.
2. Surface preparation shall consist of removing oil, grease, soil, and soluble material by cleaning with water and detergent (SSPC SP1) followed by brush-off blast cleaning (SSPC SP7) over an area extending at least 4 inches into the undamaged area.
3. The coating shall be applied to at least 3 mils dry film thickness, and shall be **Zinc-Clad XI** by **Sherwin-Williams**, **Galvax** by **Alvin Products**, **Galvite** by **ZRC Worldwide**, or equal.

3.4 DRILLED ANCHORS

- A. Drilled anchors and reinforcing bars shall be installed in strict accordance with the manufacturer's instructions.
- B. Holes shall be roughened with a brush on a power drill, and then cleaned and dried.

- C. Drilled anchors shall not be installed until the concrete has reached the required 28-day compressive strength.
- D. Adhesive anchors shall not be loaded until the adhesive has reached its indicated strength in accordance with the manufacturer's instructions.

- END OF SECTION -

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SECTION 07 92 00 - SEALANTS AND CAULKING

PART 1 -- GENERAL

1.1 SUMMARY

- A. The CONTRACTOR shall provide caulking, sealing, and appurtenant work, complete and in place, in accordance with the Contract Documents.

1.2 REFERENCES

- A. The following is a list of standards which may be referenced in this Section:

1. Federal Specifications

- a. TT-S-001543A Sealing Compound, Silicone Rubber Base, (For Caulking, Sealing and Glazing in Buildings and Other Structures)
- b. SS-S-200D Sealants, Joint, Two Compound, Jet Blast Resistant, Cold Applied for Portland Cement Concrete Pavement.
- c. TT-S-00227E Sealing Compound, Elastomeric Type, Multi-Component, (For Caulking, Sealing and Glazing in Buildings and Other Structures)
- d. TT-S-00230C Sealing Compound, Elastomeric Type, Single Component, (For Caulking, Sealing, and Glazing in Buildings and Other Structures)

2. American Society for Testing and Materials (ASTM):

- a. ASTM C 557 Adhesives for Fastening Gypsum Wallboard to Wood Framing
- b. ASTM C 834 Latex Sealants
- c. ASTM C 919 Standard Practice for Use of Sealants in Acoustical Applications
- d. ASTM C 920 Elastomeric Joint Sealants
- e. ASTM D 1752 Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction
- f. ASTM E 84 Standard Test Methods for Surface Burning Characteristics of Building Materials
- g. ASTM E 814 Standard Test Methods for Fire Tests of Penetrations Firestop Systems

Underwriters' Laboratories Inc. (UL):

- a. UL 1479 Standard for Fire Tests of Penetration Firestops

1.3 CONTRACTOR SUBMITTALS

- A. Furnish submittals in accordance with the requirements of Section 01 33 00 - Contractor Submittals.
- B. **Technical Data:** A complete materials list along with the manufacturer's technical data and literature, specifications, joint width and depth tables, and installation instructions.
- C. **Certificates:** If requested by the ENGINEER, certificates from an independent testing laboratory approved by the ENGINEER, certifying that the submitted materials meet all the requirements of the ASTM and Federal Specifications cited.

PART 2 -- PRODUCTS

2.1 SEALANTS AND CAULKING MATERIALS

A. General

- 1. **Manufacturer's Standards:** In addition to the standards listed below, the sealants and caulking products and application shall be in accordance with the manufacturer's published recommendations and specifications.
- 2. Wherever manufacturer's names and products are listed in this Section, "or equal" products will be considered in accordance with Section 01 33 00 - Contractor Submittals.

B. Materials shall conform to the following requirements:

- 1. Significant Movement Sealants (plus or minus 25 percent movement capability)
 - a. For expansion wall joints; masonry and metal curtainwall joints; precast concrete joints and concrete panels; perimeter sealing (windows, doors, and panels); control joints; interior and non-traffic horizontal joints.
 - 1) Two (2) component, non-sag, polyurethane or polysulfide sealant conforming to Federal Specification TT-S-227E, Class A, Type II, and ASTM C 920, Type M, Class 25, Grade NS.

Products Research & Chemical Corp. "RC-2"

Progress Unlimited "Iso-Flex 2000"

- 2) One (1) component, non-sag, low modulus, polyurethane or polysulfide sealant conforming to Federal Specification TT-S230C, Class A, Type II, and ASTM C 920, Type S, Class 25, Grade NS.

Products Research & Chemical Corp. "RC-1"

Tremco "Dymonic"

- 3) One (1) component, non-sag, medium modulus, neutral cure, silicone sealant conforming to Federal Specification TT-S-1543A, Class A, and ASTM C 920, Type S, Class 25, Grade NS.

Products Research & Chemical Corp. "PRC-4000"

Dow Corning "795"

2. Glazing Sealants

a. For non-structural applications

- 1) One (1) component, non-sag, medium modulus, neutral cure, silicone sealant conforming to Federal Specification TT-S-1543A, Class A, and ASTM C 920, Type S, Class 25, Grade NS.

Products Research & Chemical Corp. "4000"

Dow Corning "795"

- 2) One (1) component, non-sag, high modulus, acetoxycure, silicone sealant conforming to Federal Specification TT-S-1543A, Class A, and ASTM C 920, Type S, Class 25, Grade NS.

3. Interior Sealant and Caulking

a. For general applications

- 1) One (1) component, acrylic latex caulking conforming to ASTM C 834

Pecora Corp. "AC-20"

Bostic "Chem-Calk 600"

b. For non-exposed acoustical applications

- 1) One (1) component, non-drying, non-hardening, non-shrinking, acoustical caulking conforming to ASTM C 557 and ASTM C 919.

Inmont Company "Prestite 579.64"

Tremco, "Acoustical Sealant"

United States Gypsum, "Acoustical Sealant"

W.W. Henry, "Type 313, Acoustical Sealant"

4. Acoustic Sheet Caulking: For use on all outlet boxes including intercoms, telephone or other services that require penetrations in the walls, acoustic sheet caulking shall be resilient synthetic polymer, self-adhesive, 1/8-inch thick, 6-inch x 8-inch sheet

acoustic sealer. Pads shall be **Lowry's Electrical Box Pads** as manufactured by **Harry A. Lowry & Associates, Inc.**, 11176 Penrose Street, Sun Valley, CA 91352; or equal.

5. **Preformed Sealants:** Preformed sealant shall be polybutylene or isoprene-butylene based pressure sensitive weather resistant tape or bead sealant capable of sealing out moisture, air, and dust when installed as recommended by the manufacturer. At temperatures from minus 30 to plus 160° F, the sealant shall be non-bleeding and shall have no loss of adhesion.
6. **Tape Sealant:** Dimensions shall be as required for application conditions. Tape sealants shall be type recommended by tape manufacturer for connecting and bonding to surfaces.
7. **Joint backing (backer rod) material** shall be resilient, closed-cell polyethylene foam conforming to ASTM D 1752, Type II or III, and/or bond breakers of proper size for joint widths. Joint backing shall be compatible with sealant manufacturer's product and shall not stain the sealant nor the materials to which applied.
8. **Primer:** Primers shall be as recommended in the manufacturer's printed instructions for caulking and sealants, and shall not stain the sealant nor the materials to which applied. Manufacturer shall be consulted for all surfaces not specifically covered in submittal application instructions. Primer shall be used in accordance with manufacturer's instructions with all primers being applied prior to the installation of any backer rod or bond breaker tape.
9. **Cleaning and cleanup solvents, agents, and accessory materials** shall be as recommended in the manufacturer's printed instructions for cleaning up.
10. **Fish Friendly Sealant:** Sealants that are required on surfaces that come into contact with fish shall be 3M™ Marine Adhesive/Sealant Fast Cure 5200 polyurethane sealant; Tremco Vulkem 921 polyurethane sealant; or equal.

2.2 COLOR OF SEALANTS

- A. Color of sealants that are visible after installation shall match adjacent building finish. If in doubt of color match, obtain color approval from ENGINEER.

PART 3 -- EXECUTION

3.1 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. **Delivery of Materials:** Manufactured materials shall be delivered in original, unbroken packages or containers bearing the manufacturer's label. Packages or containers shall be delivered to the Site with seals unbroken.
- B. **Shelf Life:** Materials whose shelf life dates have expired shall not be used in the WORK. Such materials shall be promptly removed from the Site.
- C. **Storage:** All materials shall be carefully stored in accordance with the manufacturer's instructions, in an area that is protected from deleterious elements, and in a manner that

will prevent damage to the product. Materials shall be stored at temperatures between 40 and 90 degrees unless otherwise specified by the manufacturer.

3.2 INSTALLATION

- A. **Manufacturer's Recommendations:** All work under this Section and all testing, where applicable, shall be performed in accordance with manufacturer's printed recommendations, specifications, and installation instructions except where more stringent requirements are indicated herein; and, except where project conditions require extra precautions or provisions to assure performance of the waterproofing system.
- B. **Authorized Installers:** Caulking and sealants shall be complete systems and be installed only by installers authorized and approved by the respective manufacturers.
- C. **Surface Preparation**
1. **General:** The surfaces of joints to be sealed shall be dry. Oil, grease, dirt, chalk, particles of mortar, dust, loose rust, loose mill scale, and other foreign substances shall be removed from surfaces of joints which will be in contact with the sealant. Ferrous metal surfaces shall be cleaned of all rust, mill scale, and other coatings by wire brush, grinding, or sandblasting. Oil and grease shall be removed by cleaning in accordance with sealant manufacturer's printed recommendations. Protective coatings shall be removed from all aluminum surfaces against which caulking or sealing compound is to be placed. Bituminous or resinous materials shall be removed from surfaces to receive caulking or sealants.
 2. **Concrete and Masonry Surfaces:** Where surfaces have been treated with curing compounds, oil, or other such materials, the materials shall be removed by sandblasting or wire brushing. Laitance, efflorescence, and loose mortar shall be removed from the joint cavity.
 3. **Steel Surfaces:** Steel surfaces to be in contact with sealant shall be sandblasted or, if sandblasting would not be practical or would damage adjacent finish WORK, the metal shall be scraped and wire brushed to remove loose mill scale. Protective coatings on steel surfaces shall be removed by sandblasting or by a solvent that leaves no residue.
 4. **Aluminum Surfaces:** Aluminum surfaces to be in contact with sealants shall be cleaned of temporary protective coatings. When masking tape is used for a protective cover, the tape and any residual adhesive shall be removed just prior to applying the sealant. Solvents used to remove protective coating shall be as recommended by the manufacturer of the aluminum work and shall be non-staining.
 5. **Wood Surfaces:** Wood surfaces to be in contact with sealants shall be free of splinters and sawdust or other loose particles.
- D. **Joint Types and Sizes:** Joint shapes and sizes shall be as indicated or as necessary for job conditions where not indicated. Joints to be caulked or sealed include through-bolt holes, door frames, louver and ventilator frames, joints between openings where items pass through exterior walls, concrete masonry, or combination of these surfaces, and as otherwise indicated or required for watertightness, weatherproofing, or

airtightness. Use sealing compound at both exterior and interior surfaces of exterior wall penetrations.

3.3 SEALANT FILLED JOINTS

- A. **Sealant:** Sealant shall be used before expiration of shelf life. Multi-component sealants shall be mixed according to manufacturer's printed instructions. Sealant in guns shall be applied with a nozzle of proper size to fit the width of joint. Sealant shall be installed to the required depth without displacing the backing. Unless otherwise indicated or recommended by the manufacturer, the installed sealant shall be tooled so that the surface is uniformly smooth and free of wrinkles and to assure full adhesion to the sides of the joint. Sealants shall be installed free of air pockets, foreign embedded matter, ridges, and sags. Sealer shall be applied over the sealant if recommended by the sealant manufacturer.
- B. **Sealant Depth:** Sealant depth in joints shall be 1/2 the width of joint, but not less than 1/8-inch deep and 1/4-inch wide nor more than 1/2-inch deep and 1-inch wide. All joints shall have a rigid filler material installed to proper depth prior to application of sealant.
- C. **Masking Tape:** Masking tape shall be placed on the finish surface on one or both sides of a joint cavity to protect adjacent finish surfaces from primer or sealant smears. Masking tape shall be removed within 10 minutes after joint has been filled and tooled.
- D. **Backing:** Backing shall be installed to provide the indicated sealant depth. The installation tool shall be shaped to avoid puncturing the backing.
- E. **Bond-Breaker:** Bond-breaker shall be applied to fully cover the bottom of the joint without contaminating the sides where sealant adhesion is required.
- F. **Primer:** Primer shall be used on concrete masonry units, wood, or other porous surfaces in accordance with instructions furnished with the sealant. Primer shall be applied to the joint surfaces to be sealed. Surfaces adjacent to joints shall not be primed.
- G. **Applications:** A full bead of sealant shall be applied into the joint under sufficient pressure, with the nozzle drawn across sealant, to completely fill the void space and to ensure complete wetting of contact area to obtain uniform adhesion. During application, the tip of the nozzle shall be kept at the bottom of the joint thereby forcing the sealant to fill from the bottom to the top. Sealants shall be tooled immediately after exposure with a caulking tool or soft bristled brush moistened with solvent. The finished sealant-filled joint shall be slightly concave unless otherwise indicated.
- H. **Acoustic Partition Joints:** Acoustic partition joints shall be made air and sound-tight with acoustic caulking material.
 - 1. Partitions shall be sealed where indicated on the Drawings. Gypsum panels may have joint treatment applied in the normal manner over sealed joints, or panels may be finished with base or trim as required.
 - 2. A 1/4-inch minimum round bead of sealant shall be applied around all cut-outs, such as at electrical boxes and air conditioning ducts, sufficient to seal the openings.

3.4 ACOUSTIC CAULKING

- A. **Preparation:** Joints and surfaces to be sealed shall be clean, dry, and free of loose materials.
- B. **Concealed Joints:** Concealed joints in acoustic partitions including perimeters and intersections of walls and penetrations through finish work and at conduit ends with boxes shall be sealed with acoustic caulking compound. Backs of electrical boxes shall be sealed with acoustic sheet caulking, covering all holes and knock-outs.

3.5 CLEANING

- A. After application of sealant and caulking materials, adjacent materials which have been soiled shall be cleaned and left in a neat, clean, undamaged, or unstained condition. On porous surfaces, excess sealant shall be removed per sealant or caulking manufacturer's printed instructions.

- END OF SECTION -

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SECTION 08 10 00 - STEEL DOORS AND FRAMES

PART 1 -- GENERAL

1.1 SUMMARY

- A. The CONTRACTOR shall provide one (1) new steel door, frame, and related items, complete and operable, as indicated in accordance with the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards

ANSI A115 Series	Door and Frame Preparation
ASTM A 653	Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 1008	Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
ASTM B 117	Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM D 1735	Standard Practice for Testing Water Resistance of Coatings Using Water Fog Apparatus
ASTM E 90	Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
UL	Underwriters' Laboratories, Inc.

B. Trade Standards

National Association of Architectural Metal Manufacturers (NAAMM).

C. Manufacturers' Standards

1. In addition to the standards listed above, steel doors and frames and installation shall be in accordance with the manufacturer's published recommendations and specifications.

1.3 CONTRACTOR SUBMITTALS

- A. Furnish submittals in accordance with the requirements of Section 01 33 00 – Contractor Submittals.

B. Shop Drawings

1. Show details of the products and systems and connections to adjoining materials.

2. Include schedules showing sizes, types, and locations of door louvers and glass and manufacturer's installation instructions.
3. Submit manufacturer's literature and any engineering calculations that may be required elsewhere in this Section.
4. Submit calculations by a registered civil or structural engineer showing that the doors, frames, and structural connections are designed to meet code requirements and loads.

C. Sound Doors and Frames

1. Submit Shop Drawings, manufacturer's literature, installation recommendations, and certification of Sound Transmission Class (STC) rating for sound door and frame assemblies.

PART 2 -- PRODUCTS

2.1 MATERIALS AND FABRICATION - GENERAL

A. Shop Fabrication and Assembly

1. Steel doors and frames shall be shop-fabricated and shop-assembled, where possible.
2. Provide temporary stiffeners, spacers, and other accessories as necessary to facilitate handling and accurate erection.
3. After fabrication, tool marks and other surface imperfections shall be filled and ground smooth.

B. Fire Rating and Labeling

1. Doors and frames indicated as fire-rated shall bear a UL label indicating the type of rating for which they are certified.
2. The design and construction of such products shall have specific UL approval according to current procedures for the fire rating, either 3-hour, 1.5-hour, 3/4-hour, or 20-minute, as indicated.

C. Materials for Doors and Frames

1. Exterior doors and frames shall be fabricated entirely of steel, galvanized to G60 in accordance with ASTM A 653.

D. Priming and Painting

1. Doors and frames shall be chemically treated to ensure maximum coating adhesion and shall have exposed surfaces painted with a rust-inhibitive primer after fabrication.

2. The prime coat shall be capable of passing a 120-hour salt spray test in accordance with ASTM B 117, and a 250-hour humidity test in accordance with ASTM D 1735.

E. Hardware

1. Doors and frames shall be reinforced and equipped with an interior panic push-bar for emergency egress out of the building.
2. The door shall be drilled or tapped for an outdoor keyhole to open the panic bar locking mechanism from the outside. Surface-mounted hardware shall meet ANSI A115 Series requirements.
3. No dead bolt required on the man door.
4. Hardware shall be as indicated in Section 08 70 00 – Finish Hardware and as otherwise indicated.

2.2 METAL FRAMES

A. Pressed Metal Frames

1. Pressed steel frames for doors shall be of the combination buckled frame and trim of type, and of sizes as indicated.
2. Metal shall not be lighter than 16-gauge steel.
3. Frames shall be of the fully welded unit type.
4. Special frames, oversized frames, and frames with transom shall be provided where indicated.

- B. Frame jamb depths, trim profile, stops, and backbends shall be as indicated.

2.3 FRAME ANCHORS

A. Floor Anchors

1. Floor anchors shall be welded inside each frame jamb head, and holes shall be provided for floor anchorage.
2. The minimum thickness of floor anchors shall be 14-gauge.

B. Anchors for Concrete Installations

1. Frames for installation in concrete walls shall be provided with adjustable jamb anchors of the T-strap, stirrups and strap, or wire type.
2. The number of anchors provided per frame jamb and head shall be as follows:
 - a. Frames up to 7.5 feet, in height: 3 anchors
 - b. Frame head anchors shall be not less than those required by the referenced

standards.

C. Anchors to Existing Construction

1. Frames to be anchored to previously placed concrete shall be provided with anchors of a suitable design to meet the job requirements or as indicated.

2.4 DUST COVER BOXES AND MORTAR GUARDS

- A. Provide dust cover boxes or mortar guards fabricated of not less than 24-gauge steel at hardware mortises on frames to be set in masonry, concrete, or plaster walls.

2.5 SILENCER HOLES

- A. Provide appropriate holes for silencers in the door frames which are not designated to receive weatherstripping, seals, or sound seals.

2.6 STEEL DOORS

A. Design and Construction

1. Steel doors shall be of hollow metal construction and shall be of a full-flush design with no visible seams.
2. Face sheets shall be fabricated of not less than cold-rolled, stretcher-leveled, 18-gauge steel.
3. Doors shall have flush seamless face sheets with continuously and fully welded seam edges.
4. Doors shall be rigid and neat in appearance, and shall be free from warpage or buckling.
5. Corner bends shall be true and straight and shall be of not less than the minimum radius for the gauge of metal used.
6. The door top and bottom shall be internally reinforced by steel members welded in place.
7. The tops of exterior doors shall be provided with flush, water- and weather-tight top enclosures.

B. Door Louver Panels

1. Provide each door with a 24-inch x 24-inch square intake louver panel on the bottom half of the door. Louver panel shall be equipped with both insect screen and a manual hand crank to allow for manual closure of the louver blades during winter operation.
2. Louver panels shall be of the same construction as the doors.

C. Door and Transom Cores

1. Doors and transom cores shall be water-resistant polyurethane with a minimum R-value of 11.
2. Fire-rated doors shall be solid or fiber mineral core doors as required to meet code and referenced standards requirements.

D. **Manufacturers, or Equal**

1. **Forderer Cornice Works**
2. **Krieger Steel Products Co.**
3. **Overly Manufacturing Co.**
4. **Trussbilt, Inc.**

PART 3 -- EXECUTION

3.1 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Doors and frames shall be shipped and stored with temporary stiffeners and spacers in place in order to prevent distortion.
- B. Doors and frames shall be delivered in original, unbroken packages, containers, or bundles bearing the name of the manufacturer.
- C. Doors and frames shall be carefully stored on wood blocking in an area that is protected from the elements.
- D. Storage shall be in a manner that will prevent damage or marring of finishes.

3.2 CONSTRUCTION

- A. General
- B. The WORK shall be in accordance with the manufacturer's published recommendations and as indicated.
- C. The WORK shall be coordinated with appropriate related subcontractors in order to assure a proper installation.
- D. Field conditions and dimensions shall be verified prior to fabrication.

3.3 FRAME INSTALLATION

- A. Frames shall be set plumb and square in a true plane, and be securely anchored to the adjoining construction.
- B. Provide steel shims, set tight and rigidly attached between frame anchors and structure.
- C. Finished metal frames shall be strong and rigid, neat in appearance, and square, true,

and free from defects, warp, or buckling.

- D. Molded members, trims, and stops, shall be clean cut, straight, and shall be of a uniform profile throughout their lengths.

E. Corner Joints

1. Corner joints shall have contact edges tightly closed with trim faces mitered, welded, and finished smooth.
2. The use of gussets will not be permitted.

3.4 DOOR INSTALLATION

- A. Doors shall be installed plumb, square, and level.
- B. Doors shall operate freely, but not loosely, and shall be free from rattling while in a closed position.
- C. Door clearances shall be plus 3/32-inch or minus 1/32-inch, and shall not exceed the limits in the manufacturer's printed recommendations.
- D. Any door that becomes warped more than 3/16-inch out-of-plane shall be replaced by the CONTRACTOR.
- E. Doors and finish hardware shall have hardware protected prior to painting.

3.5 FINISH HARDWARE

- A. Finish hardware shall be installed in accordance with hardware manufacturer's standard templates and printed instructions.
- B. Operable parts shall be adjusted for correct function and operation.

3.6 EXISTING CONSTRUCTION

- A. For frames that are dimpled for fasteners that are required for installation into previously placed (existing) concrete, masonry, or steel structures, the fasteners and fastener frame dimples shall be filled with auto putty or an equal filler material.
- B. Fasteners and fillers at dimple holes shall be ground smooth (non-visible) before painting.
- C. Fastener locations shall not be visible after the painting is finished.

- END OF SECTION -

SECTION 08 34 00 - OVERHEAD DOORS

PART 1 -- GENERAL

1.1 SUMMARY

- A. The CONTRACTOR shall provide one (1) single-panel hydraulic operated overhead door assembly with integrated man-door, door frame, and appurtenant WORK, complete and operable, in accordance with the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Federal Specifications

QQ-S-775E, Int. Amd. 1 Steel Sheets, Carbon, Zinc-Coated (Galvanized) by the Hot-dip Process

- B. ASTM International

ASTM A36 – Standard Specification for Carbon Structural Steel

ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

- C. Commercial Standards

AWS American Welding Society

NEMA National Electric Manufacturers' Association

NEC National Electric Code

NFPA National Fire Protection Association

- D. Trade Standards

Aluminum Association Anodizing Systems

- E. **Manufacturers' Standards:** In addition to the standards listed above, coiling doors and their installation shall be in accordance with the manufacturer's published recommendations and specifications.

1.3 CONTRACTOR SUBMITTALS

- A. Furnish submittals in accordance with Section 01 33 00 - Contractor Submittals.

- B. **Manufacturer's Information:** Manufacturer's literature, wiring diagrams, manufacturer's installation instructions, and any engineering calculations that may be required below. Calculations by a registered civil or structural engineer shall be submitted to show that the coiling door systems and structural connections are designed to meet code requirements and loads.

- C. **Shop Drawings:** Details of the products and systems and connections to adjoining materials. Schedules showing sizes, types, and locations of louvers and glass.
- D. **O & M Instructions:** Prior to Substantial Completion, furnish complete operation and maintenance instructions for the coiling door assemblies.

PART 2 -- PRODUCTS

2.1 OVERHEAD DOORS

- A. **General:** Single-panel doors shall be of the fully welded steel and insulated panel design, shall be hydraulically operated, and shall be sealed to be weather and dust-resistant. Doors shall contain an integrated framed egress man-door. Doors shall be provided complete with framing, hydraulic operating cylinders and power unit, brackets, head, hinges, bottom and side weather stripping, hardware, and other items necessary for installation and operation.
- B. **Wind Loading:** The doors shall be designed to withstand a wind load of 40 lb/sq ft. The load should be considered non-factored per IBC Code.
- C. **Panel and Framing Sections:** Framing shall be of a minimum ASTM A500 structural steel tubing and ASTM A36 structural steel bars designed to same loading requirements for live, dead and wind loads as the surrounding construction. Maximum spacing shall be 96 inches for vertical members and 48 inches for horizontal members. Panel frame shall be factory-welded at all joints and connections.
- D. **Hinges:** Hinges shall be greaseless permanent bronze teflon impregnated bushings with no required maintenance. Hinge pin yield strength shall be 100,000 psi.
- E. **Hydraulic Operation Features:** Hydraulic operation shall be by two hydraulic cylinders mechanically fastened to swinging door leaf and manufacturer's door frame. Cylinders shall operate to open and close the door and be designed to carry required loads during operation, open position, and closed position with internal cylinder stops and oil flow restrictors for the closing cycle. Cylinders must provide a minimum of 1,000 lbf of total closing force. Power unit shall be a minimum of 1 HP, 110 VAC single-phase with momentary toggle switch control requiring constant pressure to operate. Electric motor and pump are combined into one self-contained unit located adjacent to the door.
- F. **Primer and Priming:** Panel doors shall be provided with a baked acrylic coating. Other exposed and concealed metal parts and doors shall be shop-primed with primer that is compatible with the finish indicated. The inside working area of the guides shall not be painted.
- G. Manufacturers, or Equal
 - 1. PowerLift Doors
 - 2. or equal.

PART 3 -- EXECUTION

3.1 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. **Delivery of Materials:** Manufactured materials shall be delivered in original and unbroken packages, containers, or bundles bearing the name of the manufacturer.
- B. **Storage:** Materials shall be carefully stored in an area that is protected from the elements. Storage shall be in a manner that will prevent damage or marring of the door and finish.

3.2 GENERAL

- A. Installation shall be in accordance with the manufacturer's printed recommendations and instructions.

3.3 INSTALLATION

- A. Doors and frames shall be accurately cut, fitted, and installed level, square, plumb, and in alignment. Fasteners shall be of sufficient length and shall be sized for loads imposed. Doors and frames shall be provided with accurate cutouts and shall be reinforced for strength where necessary. Doors shall be adjusted to provide smooth, unbinding operation with hardware fully operable.

- END OF SECTION -

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SECTION 09 96 00 - PROTECTIVE COATINGS

PART 1 -- GENERAL

1.1 SUMMARY

- A. The CONTRACTOR shall provide protective coatings, complete and in place, in accordance with the Contract Documents.
- B. Definitions
 - 1. The term "paint," "coatings," or "finishes" as used herein, shall include surface treatments, emulsions, enamels, paints, epoxy resins, and other protective coatings, excepting galvanizing or anodizing, whether used as a pretreatment, primer, intermediate coat, or finish coat.
 - 2. The term "DFT" means minimum dry film thickness, without any negative tolerance.
- C. The following surfaces shall not be coated, unless specifically noted otherwise in the Contract Documents:
 - 1. Fibrous Reinforced Plastic (FRP) / fiberglass surfaces
 - 2. Stainless steel or aluminum surfaces
 - 3. Bronze, brass, or copper surfaces
 - 4. Concrete, unless required by items on the concrete coating schedule below or the Drawings
 - 5. Electrical conduit
 - 6. Machined surfaces
 - 7. Grease fittings
 - 8. Glass
 - 9. Equipment nameplates
 - 10. Platform gratings, stair treads, door thresholds, and other walk surfaces, unless specifically indicated to be coated.
- D. The coating system schedules summarize the surfaces to be coated, the required surface preparation, and the coating systems to be applied. Coating notes on the Drawings are used to show or extend the limits of coating schedules, to show exceptions to the schedules, or to clarify or show details for application of the coating systems.
- E. Where protective coatings are to be performed by a Subcontractor, the Subcontractor shall possess a valid state license as required for performance of the painting and coating WORK called for in this specification and shall provide at least five (5)

references which show that the Subcontractor has previous successful experience with the indicated or comparable coating systems. Include the name, address, and the telephone number for the owner of each installation for which the Subcontractor provided the protective coating.

1.2 REGULATORY REQUIREMENTS

A. **Environmental Protection.** In addition to requirements specified elsewhere for environmental protection, provide coating materials that conform to the restrictions of the local Air Pollution Control District and regional jurisdiction. Notify the OWNER of any coating system specified herein which fails to conform to such requirements.

1. Lead Content. Do not use coatings having a lead content over 0.06 percent by weight of nonvolatile content
2. Chromate Content. Do not use coatings containing zinc-chromate or strontium-chromate
3. Asbestos Content. Materials shall not contain asbestos
4. Mercury Content. Materials shall not contain mercury or mercury compounds.
5. Silica. Abrasive blast media shall not contain free crystalline silica.
6. Human Carcinogens. Materials shall not contain ACGIH 0100Doc and ACGIH 0100Doc confirmed human carcinogens (A1) or suspected human carcinogens (A2).

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Paint coatings removal and application shall be in accordance with the following standards, as applicable:

1. National Standard Format (NSF) and American National Standards Institute (ANSI), NSF/ANSI 61 (2012) Drinking Water System Components.
2. American Water Works Association AWWA D102 Coating Steel Water Storage Tanks
3. The Society for Protective Coatings (SSPC) and The National Association of Corrosion Engineers (NACE):
 - NACE TM-01-70 (1970) Visual Standard For Surfaces of New Steel Airblast Cleaned With Sand Abrasive
 - NACE TM-01-75 (1975) Visual Standard for Surfaces of New Steel Centrifugally Blast Cleaned with Steel Grit and Shot
 - SSPC SP 1 (1982; E 2004) Solvent Cleaning
 - SSPC SP 2 (1982; E 2004) Hand Tool Cleaning
 - SSPC SP 3 (1982; E 2004) Power Tool Cleaning

SSPC SP5/NACE No. 1	(2007) White Metal Blast Cleaning
SSPC SP6/NACE No.3	(2007) Commercial Blast Cleaning
SSPC SP7/NACE No.4	(2007) Brush-Off Blast Cleaning
SSPC SP10/NACE No.2	(2007) Near-White Blast Cleaning

1.4 CONTRACTOR SUBMITTALS

- A. Furnish submittals in accordance with Section 01 33 00 - Contractor Submittals.
- B. Submittals shall include the following information and be submitted at least 30 Days prior to commencing protective coating WORK:
 - 1. Materials List: Eight copies of a coating materials list showing the manufacturer and the product number, keyed to the coating systems herein. The list shall be submitted prior to or at the time of submitting samples.
 - 2. Manufacturer's Information: For each coating system to be used, the following data:
 - a. Manufacturer's data sheet for each product proposed, including statements on the suitability of the material for the intended use.
 - b. Technical and performance information that demonstrates compliance with the system performance and material requirements.
 - c. Paint manufacturer's instructions and recommendations on surface preparation and environmental conditions for application.
 - d. Colors available for each product (where applicable).
 - e. Compatibility of shop and field applied coatings (where applicable).
 - f. Material Safety Data Sheet for each product proposed.
- C. Samples
 - 1. Samples of paint, finishes, and other coating materials shall be submitted on 8-1/2" x 11" sheet metal pieces. Each sheet shall be completely coated over its entire surface with one protective coating material, type, and color.
 - 2. Two sets of color samples to match each color selected by the OWNER from the manufacturer's standard color sheets. If custom mixed colors are indicated, the color samples shall be made using color formulations prepared to match the color samples furnished by the OWNER. The color formula shall be shown on the back of each color sample.
 - 3. One 1-pound sample of each abrasive proposed to be used for surface preparation for submerged and severe service coating systems.

1.5 SPECIAL CORRECTION OF DEFECTS REQUIREMENTS

- A. **Inspection:** An inspection may be conducted by the OWNER during the tenth month following completion of coating WORK. When specified for specific systems, the CONTRACTOR and a representative of the coating material manufacturer shall attend this inspection. Defective WORK shall be repaired in accordance with these specifications and to the satisfaction of the OWNER. The OWNER may, by written notice to the CONTRACTOR, reschedule the inspection to another date within the one-year warranty period or may cancel the inspection altogether. The CONTRACTOR is not relieved of its responsibilities to correct defects, whether or not the inspection is conducted.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. **Suitability:** The CONTRACTOR shall use suitable coating materials as recommended by the manufacturer. Materials shall comply with Volatile Organic Compound (VOC) limits applicable at the Site.
- B. **Material Sources:** Where manufacturers and product numbers are listed, it is to show the type and quality of coatings that are required. If a named product does not comply with VOC limits in effect at the time of Bid opening, that product will not be accepted, and the CONTRACTOR shall propose a substitution product of equal quality that does comply. Proposed substitute materials will be considered as indicated below. Coating materials shall be materials that have a record of satisfactory performance in industrial plants, manufacturing facilities, and water and wastewater treatment plants.
- C. **Compatibility:** In any coating system only compatible materials from a single manufacturer shall be used in the WORK. Particular attention shall be directed to compatibility of primers and finish coats. If necessary, a barrier coat shall be applied between existing prime coat and subsequent field coats to ensure compatibility.
- D. **Containers:** Coating materials shall be sealed in containers that plainly show the designated name, formula or specification number, batch number, color, date of manufacture, and name of manufacturer, all of which shall be plainly legible at the time of use.
- E. **Colors:** Colors and shades of colors of coatings shall be as indicated or selected by the OWNER. Each coat shall be of a slightly different shade to facilitate inspection of surface coverage of each coat. Finish colors shall be as selected from the manufacturer's standard color samples by the OWNER or ENGINEER.
- F. Substitute or "Or-Equal" Products
1. To establish equality under Section 01 60 00 - Products, Materials, Equipment and Substitutions, the CONTRACTOR shall furnish satisfactory documentation from the manufacturer of the proposed substitute or "or-equal" product that the material meets the indicated requirements and is equivalent or better in the following properties:

- a. Quality
 - b. Durability
 - c. Resistance to abrasion and physical damage
 - d. Life expectancy
 - e. Ability to recoat in future
 - f. Solids content by volume
 - g. Dry film thickness per coat
 - h. Compatibility with other coatings
 - i. Suitability for the intended service
 - j. Resistance to chemical attack
 - k. Temperature limitations during application and in service
 - l. Type and quality of recommended undercoats and topcoats
 - m. Ease of application
 - n. Ease of repairing damaged areas
 - o. Stability of colors
2. Protective coating materials shall be standard products produced by recognized manufacturers who are regularly engaged in production of such materials for essentially identical service conditions. When requested, the CONTRACTOR shall provide the ENGINEER with the names of not less than 10 successful applications of the proposed manufacturer's products that comply with these requirements.
 3. If a proposed substitution requires changes in the WORK, the CONTRACTOR shall bear such costs involved as part of the WORK.

2.2 NON-SUBMERGED INDUSTRIAL COATING SYSTEMS

A. **System 10 - Alkyd Enamel**

1. Materials

Primer	manufacturer's recommendation
Finish Coat	
Type	high quality alkyd, medium long enamel

Demonstrated suitable for	ferrous, galvanized, and nonferrous surfaces in industrial exposure, producing high gloss surface that is resistant to mild corrosion and chemical fumes, has good color and gloss retention, good weathering, and sunlight resistance
VOC Content, max	428 grams per liter

2. Application and manufacturers

Surface Preparation	Prime Coat (DFT = 2 to 4 mils)	Finish Coat (DFT = 2 to 4 mils)	Total System DFT
SSPC SP-6	Ameron Amercoat 5105	Ameron Amercoat 5450	4 to 8 mils
	Tnemec Series N69	Tnemec Series 2H	
	Devoe Devguard 4120	Devoe Devguard 4308	

2.3 SUBMERGED AND SEVERE SERVICE COATING SYSTEMS

A. **System 50 - Amine Cure Epoxy**

1. Material

Type	high build, amine cure epoxy
VOC content, g/L max	220
Demonstrated suitable for	steel, long term immersion in water and wastewater, resistant to corrosion, chemical fumes, good color retention
Certification	NSF 61 if in contact with potable water

2. Application and manufacturers

Surface Preparation	Products (2 coats or more)	Total System DFT
SSPC SP10	Ameron Amercoat 395 FD	8 to 10 mils
	Carboline Carboguard 891	For non-submerged valves and other equipment, DFT = 6 to 8 mils
	Devoe Bar-Rust 233H	

B. System 52- Epoxy, Immersion - Water Structures

1. Materials: In accordance with AWWA D102 - Coating Steel-Water Storage Tanks, System ICS-2.

Type	2 component epoxy, polyamide or amine-cure type
Demonstrated suitable for	Steel, long term immersion in potable water
VOC content, g/L max	366
Certification required	NSF 61

2. Application and manufacturers

Surface Preparation	First Coat (2 - 4 mils)	Second Coat (3 - 5 mils)	Finish Coat (4 - 6 mils)	Total System DFT
SSPC SP10	Ameron Amercoat 395FD	Ameron Amercoat 395FD	Ameron Amercoat 395FD	9 - 15 mils
	Carboline Carboguard 891	Carboline Carboguard 891	Carboline Carboguard 891	
	Tnemec Pota-Pox N140F	Tnemec N140F	Tnemec N140F	

C. **System 70 - Acrylic, Concrete**

1. Materials

Filler-Sealer Type	epoxy masonry sealer, for concrete and CMU, for wet and dry conditions
Primer	as recommended by manufacturer
VOC Content, g/L, max	75
Finish Type	single component waterborne acrylic, industrial grade, high molecular weight
VOC Content, g/L, max	180
Demonstrated suitable for	concrete under mild to moderate exposure conditions, splash but not immersion

2. Application and manufacturers

Surface Preparation	Prime Coat (Filler-Sealer)	Finish Coat (DFT = 5 - 7 mils) (2 or more coats)	Total System DFT
SSPC SP13 (28 days old, protrusions removed, surface contamination removed)	Tnemec EnviroFill 130	Tnemec Tnemecryl Series 6	5 - 7 mils plus primer
	Ameron Amerlock 400BF and Nu-Klad 114A	Ameron Amercoat 220	
	Carboline Sanitile 600	Carboline Carbocrylic 3359DTM	

D. **System 71 – Polyurethane, Concrete Roofs and Decks, Waterproofing**

1. Material

Primer Type	2 component polyurethane
Demonstrated suitable for	Strong adhesion to clean, dry concrete
Base Coat	2 component elastomeric polyurethane
Demonstrated suitable for	Long lasting, wear-resistant waterproofing

Finish Coat	2 component aliphatic polyurethane
Demonstrated suitable for	Heavy duty protection of concrete roof decks in all climates, with UV resistance

2. Application and manufacturers

Surface Preparation	Primer	Base Coat	Finish Coat
SSPC SP13	Pacific Polymers Elasto-Poxy Primer WB	Pacific Polymers Elasto-Deck 5001 HT	Pacific Polymers Elasto-Glaze 6001 AL-HT
	BASF Conipur 78 Primer	BASF Conipur 265-Z	BASF Conipur 275

2.4 SPECIAL COATING SYSTEMS

- A. **System 100 - PVC Tape Pipe Wrap:** Prior to wrapping the pipe with PVC tape, the pipe and fittings first shall be primed using a primer recommended by the PVC tape manufacturer. After being primed, the pipe shall be wrapped with a 20-mil adhesive PVC tape, half-lapped, to a total thickness of 40 mils.

PART 3 -- EXECUTION

3.1 MANUFACTURER'S SERVICES

- A. The CONTRACTOR shall require the protective coating manufacturer to furnish a qualified technical representative to visit the Site for technical support as may be necessary to resolve field problems.
- B. For submerged and severe service coating systems, the CONTRACTOR shall require the paint manufacturer to furnish the following services:
 - 1. The manufacturer's representative shall provide at least 4 hours of on-Site instruction in the proper surface preparation, use, mixing, application, and curing of the coating systems.
 - 2. The manufacturer's representative shall observe the start of surface preparation, mixing, and application of the coating materials for each coating system.

3.2 WORKMANSHIP

- A. Skilled craftsmen and experienced supervision shall be used on coating WORK.
- B. Coating shall be done in a workmanlike manner so as to produce an even film of uniform thickness. Edges, corners, crevices, and joints shall receive special attention to insure thorough surface preparation. The finished surfaces shall be free from runs, drops, ridges, waves, laps, brush marks, and variations in color, texture, and finish. The hiding shall be so complete that the addition of another coat would not increase the hiding. Special attention shall be given so that edges, corners, crevices, welds, and similar areas receive a film thickness equivalent to adjacent areas, and installations shall be protected by the use of drop cloths or other precautionary measures.
- C. Damage to other surfaces resulting from the WORK shall be cleaned, repaired, and refinished to original condition.

3.3 STORAGE, MIXING, AND THINNING OF MATERIALS

- A. **Manufacturer's Recommendations:** Unless otherwise indicated, the coating manufacturer's printed recommendations and instructions for thinning, mixing, handling, applying, and protecting its coating materials, for preparation of surfaces for coating, and for other procedures relative to coating shall be strictly observed.
- B. Coating materials shall be used within the manufacturer's recommended shelf life.
- C. **Storage and Mixing:** Coating materials shall be stored under the conditions recommended by the Product Data Sheets, and shall be thoroughly stirred, strained, and

kept at a uniform consistency during application. Coatings from different manufacturers shall not be mixed together.

3.4 PREPARATION FOR COATING

- A. **General:** Surfaces to receive protective coatings shall be prepared as indicated prior to application of coatings. The CONTRACTOR shall examine surfaces to be coated and shall correct surface defects before application of any coating material. Marred or abraded spots on shop-primed and on factory-finished surfaces shall receive touch-up restoration prior to any field coating application. Surfaces to be coated shall be dry and free of visible dust.
- B. **Protection of Surfaces Not to be Coated:** Surfaces that are not to receive protective coatings shall be protected during surface preparation, cleaning, and coating operations.
- C. Hardware, lighting fixtures, switchplates, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not to be painted shall be removed, masked, or otherwise protected. Drop cloths shall be provided to prevent coating materials from falling on or marring adjacent surfaces. The working parts of mechanical and electrical equipment shall be protected from damage during surface preparation and coating operations. Openings in motors shall be masked to prevent entry of coating or other materials.
- D. Care shall be exercised not to damage adjacent WORK during blasting operations. Spraying shall be conducted under carefully controlled conditions. The CONTRACTOR shall be fully responsible for and shall promptly repair any and all damage to adjacent WORK or adjoining property occurring from blasting or coating operations.
- E. **Protection of Painted Surfaces:** Cleaning and coating shall be coordinated so that dust and other contaminants from the preparation process will not fall on wet, newly-coated surfaces.

3.5 SURFACE PREPARATION STANDARDS

- A. **Steel Structures Painting Council (SSPC) Standards.** The following referenced standards for surface preparation according to specifications of the Steel Structures Painting Council (SSPC) shall form a part of this specification:
 - 1. **SSPC SP1 - Solvent Cleaning:** Removal of oil, grease, soil, salts, and other soluble contaminants by cleaning with solvent, vapor, alkali, emulsion, or steam.
 - 2. **SSPC SP2 - Hand Tool Cleaning:** Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, by hand chipping, scraping, sanding, and wire brushing.
 - 3. **SSPC SP3 - Power Tool Cleaning:** Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, by power tool chipping, descaling, sanding, wire brushing, and grinding.
 - 4. **SSPC SP5 - White Metal Blast Cleaning:** Removal of all visible rust, oil, grease, soil, dust, mill scale, paint, oxides, corrosion products and foreign matter by blast cleaning.

5. **SSPC SP6 - Commercial Blast Cleaning:** Removal of all visible oil, grease, soil, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except that staining shall be limited to no more than 33 percent of each square inch of surface area.
6. **SSPC SP7 Brush-Off Blast Cleaning:** Removal of all visible oil, grease, soil, dust, loose mill scale, loose rust, and loose paint.
7. **SSPC SP10 Near-White Blast Cleaning:** Removal of all visible oil, grease, soil, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except that staining shall be limited to no more than 5 percent of each square inch of surface area.
8. **SSPC-SP13 Surface Preparation of Concrete:** Removal of protrusions, laitance and efflorescence, existing coatings, form-release agents, and surface contamination by detergent or steam cleaning, abrasive blasting, water jetting, or impact or power tool methods as appropriate for the condition of the surface and the requirements of the coating system.

3.6 FERROUS METAL SURFACE PREPARATION (UNGALVANIZED)

- A. **Surface salts** shall be removed by washing with fresh utility water and **Chlor*Rid** or *equal*, followed by rinsing with fresh utility water. Repeat the wash/rinse cycle until surface chloride salts are reduced to less than 7 micrograms per square centimeter.
- B. The minimum abrasive blasting surface preparation shall be as indicated in the coating system schedules included at the end of this Section. Where there is a conflict between these requirements and the coating manufacturer's printed recommendations for the intended service, the higher degree of cleaning shall apply.
- C. Workmanship for metal surface preparation shall be in conformance with the current SSPC Standards and this Section. Blast-cleaned surfaces shall match the standard samples available from the National Association of Corrosion Engineers, NACE Standard TM-01-70 - Visual Standard for Surfaces of New Steel Airblast Cleaned with Sand Abrasive and TM-01-75 - Visual Standard for Surfaces of New Steel Centrifugally Blast Cleaned with Steel Grit.
- D. Oil, grease, welding fluxes, and other surface contaminants shall be removed by solvent cleaning per SSPC SP1 - Solvent Cleaning prior to blast cleaning.
- E. Sharp edges shall be rounded or chamfered, and burrs and surface defects and weld splatter shall be ground smooth prior to blast cleaning.
- F. The type and size of abrasive shall be selected to produce a surface profile that meets the coating manufacturer's recommendation for the particular product and service conditions. Abrasives for submerged and severe service coating systems shall be clean, hard, sharp cutting crushed slag. Automated blasting systems shall not be used for surfaces that will be in submerged service. Metal shot or grit shall not be used for surfaces that will be in submerged service, even if subsequent abrasive blasting will use hard, sharp cutting crushed slag.

- G. Abrasive shall not be reused unless an automated blasting system is used for surfaces that will be in non-submerged service. For automated blasting systems, clean oil-free abrasives shall be maintained. The abrasive mix shall include at least 50 percent grit.
- H. The CONTRACTOR shall comply with the applicable federal, state, and local air pollution control regulations for blast cleaning.
- I. Compressed air for air blast cleaning shall be supplied at adequate pressure from well-maintained compressors equipped with oil and moisture separators that remove at least 95 percent of the contaminants.
- J. Surfaces shall be cleaned of dust and residual particles of the cleaning operation by dry air blast cleaning, vacuuming, or another approved method prior to painting.
- K. Enclosed areas and other areas where dust settling is a problem shall be vacuum-cleaned and wiped with a tack cloth.
- L. Damaged or defective coating shall be removed by the blast cleaning to meet the clean surface requirements before recoating.
- M. If the required abrasive blast cleaning will damage adjacent WORK, the area to be cleaned is less than 100 square feet, and the coated surface will not be submerged in service, then SSPC SP2 or SSPC SP3 may be used.
- N. Shop-applied coatings of unknown composition shall be completely removed before the indicated coatings are applied. Valves, castings, ductile or cast iron pipe, and fabricated pipe or equipment shall be examined for the presence of shop-applied temporary coatings. Temporary coatings shall be completely removed by solvent cleaning per SSPC SP1 before the abrasive blast cleaning has been started.
- O. Shop primed equipment shall be solvent-cleaned in the field before finish coats are applied.

3.7 FERROUS METAL SURFACE PREPARATION (GALVANIZED)

- A. Galvanized ferrous metal shall be alkaline cleaned per SSPC SP1 to remove oil, grease, and other contaminants detrimental to adhesion of the protective coating system, followed by brush off blast cleaning per SSPC SP7.
- B. Pretreatment coatings of surfaces shall be in accordance with the printed recommendations of the coating manufacturer.

3.8 SURFACE PREPARATION OF FERROUS SURFACES WITH EXISTING COATINGS, EXCLUDING STEEL RESERVOIR INTERIORS

- A. **General:** Grease, oil, heavy chalk, dirt, or other contaminants shall be removed by solvent or detergent cleaning prior to abrasive blast cleaning. The generic type of the existing coatings shall be determined by laboratory testing.
- B. **Abrasive Blast Cleaning:** The CONTRACTOR shall provide the degree of cleaning indicated in the coating system schedule for the entire surface to be coated. If the degree of cleaning is not indicated in the schedule, deteriorated coatings shall be

removed by abrasive blast cleaning to SSPC SP6. Areas of tightly adhering coatings shall be cleaned to SSPC SP7, with the remaining thickness of existing coating not to exceed 3-mils.

- C. **Incompatible Coatings:** If coatings to be applied are not compatible with existing coatings the CONTRACTOR shall apply intermediate coatings per the manufacturer's recommendation for the indicated coating system or shall completely remove the existing coating prior to abrasive blast cleaning. A small trial application shall be conducted for compatibility prior to painting large areas.
- D. **Unknown Coatings:** Coatings of unknown composition shall be completely removed prior to application of new coatings.
- E. **Water Abrasive or Wet Abrasive Blast Cleaning:** Where indicated or where Site conditions do not permit dry abrasive blasting for industrial coating systems due to dust or air pollution considerations, water abrasive blasting or wet abrasive blasting may be used. In both methods, paint-compatible corrosion inhibitors shall be used, and coating application shall begin as soon as the surfaces are dry. Water abrasive blasting shall be done using high pressure water with sand injection. In both methods, the equipment used shall be commercially produced equipment with a successful service record. Wet blasting methods shall not be used for submerged or severe service coating systems unless indicated.

3.9 CONCRETE AND CONCRETE BLOCK MASONRY SURFACE PREPARATION

- A. Surface preparation shall not begin until at least 30 Days after the concrete or masonry has been placed.
- B. Oil, grease, and form release and curing compounds shall be removed by detergent cleaning per SSPC SP1 before abrasive blast cleaning.
- C. Concrete, concrete block masonry surfaces, and deteriorated concrete surfaces to be coated shall be abrasive blast cleaned to remove existing coatings, laitance, deteriorated concrete, and to roughen the surface equivalent to the surface of the No. 80 grit flint sandpaper.
- D. If acid etching is required by the coating application instructions, the treatment shall be made after abrasive blasting. After etching, rinse surfaces with water and test the pH. The pH shall be between neutral and 8.
- E. Surfaces shall be clean and as recommended by the coating manufacturer before coating is started.
- F. Unless required for proper adhesion, surfaces shall be dry prior to coating. The presence of moisture shall be determined with a moisture detection device such as **Delmhorst Model DB**, or equal.

3.10 CONCRETE SURFACE PREPARATION FOR WATERPROOFING

- A. Concrete deck shall be dry, clean, and free of contaminants that may interfere with proper adhesion or curing. The concrete shall be water cured for a minimum of 28 Days, or be at 80 percent of design strength.

- A. Verify that the concrete deck is finished by a power or hand steel trowel followed by a soft hair broom, or equivalent.
- B. Before starting application, conduct a Mat Test as follows: place a 2-foot by 2-foot non-breathing rubber mat onto the concrete deck not in sunlight; tape the edges of the mat to the concrete. If no condensation is seen under the mat at 16 hours, the concrete is dry enough that application may begin.
- C. Visible hairline cracks and cold joints in the concrete shall be treated with a liquid flashing a minimum of 2-inches on each side of the crack or joint. Liquid flashing shall have a minimum dry thickness of 30-mils.

3.11 SHOP COATING REQUIREMENTS

- A. Unless otherwise indicated, items of equipment or parts of equipment which are not submerged in service shall be shop-primed and then finish-coated in the field after installation with the indicated or selected color. The methods, materials, application equipment, and other details of shop painting shall comply with this Section. If the shop primer requires top coating within a specific period of time, the equipment shall be finish-coated in the shop and then be touched up after installation.
- B. Items of equipment or parts and surfaces of equipment which are submerged or inside an enclosed hydraulic structure when in service, with the exception of pumps and valves, shall have surface preparation and coating performed in the field.
- C. The interior surfaces of steel water reservoirs, except for Part A surfaces, shall have surface preparation and coating WORK performed in the field.
- D. For certain pieces of equipment, it may be undesirable or impractical to apply finish coatings in the field. Such equipment may include engine generator sets, equipment such as electrical control panels, switchgear or main control boards, submerged parts of pumps, ferrous metal passages in valves, or other items where it is not possible to obtain the indicated quality in the field. Such equipment shall be primed and finish-coated in the shop and touched up in the field with the identical material after installation. The CONTRACTOR shall require the manufacturer of each such piece of equipment to certify as part of its Shop Drawings that the surface preparation is in accordance with these specifications. The coating material data sheet shall be submitted with the Shop Drawings for the equipment.
- E. For certain small pieces of equipment, the manufacturer may have a standard coating system that is suitable for the intended service conditions. In such cases, the final determination of suitability will be made during review of the Shop Drawing submittals. Equipment of this type generally includes only indoor equipment such as instruments, small compressors, and chemical metering pumps.
- F. Shop-painted surfaces shall be protected during shipment and handling by suitable provisions including padding, blocking, and the use of canvas or nylon slings. Primed surfaces shall not be exposed to the weather for more than 2 months before being topcoated, or less time if recommended by the coating manufacturer.
- G. Damage to shop-applied coatings shall be repaired in accordance with this Section and the coating manufacturer's printed instructions.

- H. The CONTRACTOR shall make certain that the shop primers and field topcoats are compatible and meet the requirements of this Section. Copies of applicable coating manufacturer's data sheets shall be submitted with equipment Shop Drawings.

3.12 APPLICATION OF COATINGS

- A. The application of protective coatings to steel substrates shall be in accordance with SSPC PA1 - Paint Application Specification No. 1.
- B. Cleaned surfaces and each coat shall be inspected prior to applying each succeeding coat. The CONTRACTOR shall schedule such inspection with the ENGINEER in advance.
- C. Blast cleaned ferrous metal surfaces shall be painted before any rusting or other deterioration of the surface occurs. Blast cleaning shall be limited to only those surfaces that can be coated in the same day.
- D. Coatings shall be applied in accordance with the manufacturer's instructions and recommendations and this Section, whichever has the most stringent requirements.
- E. Special attention shall be given to edges, angles, weld seams, flanges, nuts and bolts, and other places where insufficient film thicknesses are likely to occur. Use stripe painting with a brush in these areas.
- F. Special attention shall be given to materials that will be joined so closely that proper surface preparation and application are not possible. Such contact surfaces shall be coated prior to assembly or installation.
- G. Finish coats, including touch-up and damage repair coats shall be applied in a manner that will present a uniform texture and color matched appearance.
- H. Coatings shall not be applied under the following conditions:
 - 1. Temperatures exceeding the manufacturer's recommended maximum and minimum allowable.
 - 2. Concrete surfaces will be in direct sunlight during application or within 3 hours after application.
 - 3. Dust or smoke laden atmosphere.
 - 4. Damp or humid weather.
 - 5. Substrate or air temperature is less than 5 degrees F above the dew point.
 - 6. Air temperature is expected to drop below 40 degrees F or less than 5 degrees F above the dew point within 8 hours after application of coating.
 - 7. Wind conditions are not calm.
- I. Dew point shall be determined by use of a sling psychrometer in conjunction with U.S. Dept. of Commerce, Weather Bureau psychometric tables.

- J. Unburied steel piping shall be abrasive blast cleaned and primed before installation.
- K. Finish coats shall be applied after concrete, masonry, and equipment installation is complete, and the working areas are clean and dust free.

3.13 CURING OF COATINGS

- A. The CONTRACTOR shall maintain curing conditions in accordance with the conditions recommended by the coating material manufacturer or by this Section, whichever is the most stringent, prior to placing the completed coating system into service.
- B. In the case of enclosed areas, forced air ventilation, using heated air if necessary, may be required until the coatings have fully cured.
- C. **Forced Air Ventilation of Steel Reservoirs and Enclosed Hydraulic Structures:** Forced air ventilation is required for the application and curing of coatings on the interior surfaces of steel reservoirs and enclosed hydraulic structures, such as penstock pipelines. During application and curing periods, continuously exhaust air from a manhole in the lowest shell ring, or in the case of an enclosed hydraulic structure, from the lowest level of the structure using portable ducting. After interior coating operations have been completed, provide a final curing period for a minimum of 10 Days, during which the forced ventilation system shall operate continuously. For additional requirements, refer to the specific coating system requirements in Part 2 above.

3.14 IDENTIFICATION OF PIPING

- A. Identification of piping shall be in accordance with Section 40 23 01 - Piping Identification Systems.
- B. Every valve or connection, where it may be possible for a worker to be exposed to a hazardous substance, shall be labeled per OSHA Occupational Safety and Health Standards 29CFR1910.1200.

3.15 SHOP AND FIELD INSPECTION AND TESTING

- A. **General:** The CONTRACTOR shall give the ENGINEER a minimum of 3 Days advance notice of the start of any field surface preparation or coating application, and a minimum of 7 Days advance notice of the start of any surface preparation activity in the shop.
- B. Such WORK shall be performed only in the presence of the ENGINEER, unless the ENGINEER has granted prior approval to perform such WORK in its absence.
- C. Inspection by the ENGINEER, or the waiver of inspection of any particular portion of the WORK, shall not relieve the CONTRACTOR of its responsibility to perform the WORK in accordance with these Specifications.
- D. Scaffolding shall be erected and moved to locations where requested by the ENGINEER to facilitate inspection. Additional illumination shall be furnished on areas to be inspected.
- E. **Inspection Devices:** The CONTRACTOR shall furnish inspection devices in good working condition for the detection of holidays and measurement of dry film thicknesses

of coatings. Dry-film thickness gauges shall be made available for the ENGINEER's use while coating is being done, until final acceptance of such coatings. The CONTRACTOR shall furnish the services of a trained operator of the holiday detection devices until the final acceptance of such coatings. Holiday detection devices shall be operated only in the presence of the ENGINEER.

- F. **Holiday Testing:** The CONTRACTOR shall test for continuity all coated ferrous surfaces inside a steel reservoir, other surfaces that will be submerged in water or other liquids, surfaces that are enclosed in a vapor space in such structures, and surfaces coated with any of the submerged and severe service coating systems. Areas that contain discontinuities shall be marked and repaired or recoated in accordance with the coating manufacturer's printed instructions and then be retested.
1. Coatings with thickness exceeding 20-mils total DFT: Pulse-type holiday detector such as **Tinker & Rasor Model AP-W, D.E. Stearns Co. Model 14/20**, or equal shall be used. The unit shall be adjusted to operate at the voltage required to cause a spark jump across an air gap equal to twice the required coating thickness.
 2. Coatings with thickness of 20-mils or less total DFT: **Tinker & Rasor Model M1** non-destructive type holiday detector, **K-D Bird Dog**, or equal shall be used. The unit shall operate at less than 75 volts. For thicknesses between 10- and 20-mils, a non-sudsing type wetting agent, such as **Kodak Photo-Flo** or equal, shall be added to the water prior to wetting the detector sponge.
- G. **Film Thickness Testing:** On ferrous metals, the dry film coating thickness shall be measured in accordance with the SSPC Paint Application Specification No. 2 using a magnetic type dry film thickness gauge such as **Mikrotest Model FM, Elcometer Model 111/1EZ**, or equal. Each coat shall be tested for the correct thickness. No measurements shall be made until at least 8 hours after application of the coating. On non-ferrous metals and other substrates, the coating thicknesses shall be measured at the time of application using a wet film gauge.
- H. **Surface Preparation:** Evaluation of blast cleaned surface preparation will be based upon comparison of the blasted surfaces with the standard samples available from NACE, using NACE standards TM-01-70 and TM-01-75.

3.16 COATING SYSTEM SCHEDULE, FERROUS METAL - NOT GALVANIZED

Surface Type	Surface / Equipment / Area Description	Surface Preparation Requirements	System No.
FM-1	All surfaces indoors and outdoors, exposed or covered, except those included below.	Commercial blast cleaning SSPC SP6	(10) Alkyd Enamel or (14) Epoxy/ Polyurethane
FM-3	Surfaces of equipment and ferrous surfaces submerged or intermittently submerged in potable water, utility water, and wastewater including all surfaces lower than 2 feet above high water level in hydraulic structures, and all surfaces inside enclosed hydraulic structures and vents (excluding shop-coated valves, couplings, pumps).	White metal blast cleaning SSPC SP5	(50) Amine cure epoxy
FM-6	Buried small steel pipe.	Removal of dirt, grease, oil	(100) PVC tape
FM-7	Where indicated, ferrous surfaces in water passages of all valves 2-inch size and larger, exterior surfaces of submerged valves.	White metal blast cleaning SSPC SP5	(51) Polyamide epoxy or (50) Amine cure epoxy
FM-9	Ferrous surfaces of sleeve couplings.	Solvent cleaning SSPC SP1, followed by white metal blast cleaning SSPC-SP10	(53) Fusion bond epoxy

3.17 COATING SYSTEM SCHEDULE, FERROUS METAL - GALVANIZED

- A. Pretreatment coatings, barrier coatings, or washes shall be applied as recommended by the coating manufacturer. All non-galvanized surfaces shall be coated except for the following items which shall be coated only if required by other Sections:
1. Floor gratings and frames,
 2. Handrails,
 3. Stair treads,

4. Chain link fencing and appurtenances.

Surface Type	Surface / Equipment / Area Description	Surface Preparation Requirements	System No.
FMG-1	All exposed surfaces indoors and outdoors, except those included below.	Solvent cleaning SSPC SP1	(10) Alkyd enamel
FMG-3	Buried small steel pipe.	Removal of dirt, grease, oil	(100) PVC tape

Surface Type	Surface / Equipment / Area Description	Surface Preparation Requirements	System No.
C-1	All surfaces indoors and outdoors, where indicated.	Per paragraph 3.9	(70) Acrylic, concrete
C-2	Surfaces submerged in water or wastewater, including (a) between 2-feet above high water elevation and 2-feet below low water elevation in an open structure and (b) all surfaces above 2-feet below low water elevation in an enclosed structure.	Per paragraph 3.9	(72) Polyurethane, concrete
C-7	Concrete roofs and elevated decks	Per paragraph 3.10	(71) Polyurethane, water-proofing

- END OF SECTION -

SECTION 10 44 00 - FIRE EXTINGUISHERS

PART 1 -- GENERAL

1.1 SUMMARY

- A. The CONTRACTOR shall provide fire extinguishers and appurtenant WORK, complete and in place, in accordance with the Contract Documents.
- B. Fire extinguishers and mounting b shall be products of a single manufacturer.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Codes
 - 1. National Fire Protection Association publications (NFPA).
 - 2. International Fire Code (IFC) as published by the International Code Council

1.3 CONTRACTOR SUBMITTALS

- A. Furnish submittals in accordance with Section 01 30 00 - Contractor Submittals.
- B. **Shop Drawings:** Manufacturer's literature, installation instructions, and details shall be submitted.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Fire protection equipment and installation shall comply with the Code, NFPA Pamphlet No 10, and the manufacturer's published recommendations and specifications.

2.2 MATERIALS

- A. **Fire Extinguisher Designated FE-1:** FE-1 fire extinguishers shall be 10 pound minimum capacity, A.B.C. dry chemical type, with minimum UL rating of 4A-60BC.
- B. **Fire Extinguisher Designated FE-2:** FE-2 fire extinguishers shall be 20 pound minimum capacity, A.B.C. dry-chemical type with minimum UL rating of 20A-120BC.
- C. **Fire Extinguisher Designated FE-3:** FE-3 fire extinguishers shall be 10 pound minimum capacity, carbon dioxide type with minimum UL rating of 10BC.
- D. **Fire Extinguisher Designated FE-4:** FE-4 fire extinguishers shall be 5 pound minimum capacity, A, B, C dry-chemical type with minimum UL rating of 2A-10BC.
- E. **Fire Extinguisher Bracket:** Mounting brackets shall be specially designed for extinguisher.

- F. **Other Materials:** Other materials not specifically described but required for a complete and proper installation of fire fighting devices shall be as selected by the CONTRACTOR, subject to the review of the ENGINEER.

2.3 MANUFACTURERS

- A. Fire protection items shall be from the following manufacturers, or equal:
 - 1. **Larsen's Manufacturing Co.**
 - 2. **Potter-Roemer**
 - 3. **General Fire Extinguisher Co.**

PART 3 -- EXECUTION

3.1 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. **Delivery of Materials:** Manufactured materials shall be delivered in original unbroken packages, or containers bearing the manufacturer's label with manufacturer's name, product description, and rating.
- B. **Storage:** Materials shall be carefully stored in an area that is protected from deleterious elements as recommended by the material manufacturer. Storage shall be in a manner that will prevent damage to the material and its finish.

3.2 LOCATIONS AND INSTALLATION

- A. **Locations:** Fire prevention equipment locations and mounting heights shall be verified with the Fire Marshall before installation and shall be installed where directed. If locations are not directed by the Fire Marshall, the ENGINEER will direct locations.
- B. **Installation:** Installation shall be per NFPA Pamphlet No. 10 unless directed otherwise by the local Fire Marshall.
- C. **Brackets:** Fire extinguishers shall be provided with and installed on brackets or brackets within cabinets. The CONTRACTOR shall block and reinforce walls to support the fire extinguishers.

- END OF SECTION -

SECTION 23 05 00 – HEATING AND VENTILATION, GENERAL

PART 1 -- GENERAL

1.1 SUMMARY

- A. The CONTRACTOR shall provide heating and ventilating systems and associated equipment complete with supports, mounting frames, ventilators, ductwork, piping, louvers, panels, filters, grilles, electric drive units and controls, mechanical equipment, electrical work, appurtenances, testing, and balancing, as indicated in accordance with the Contract Documents.
- B. The equipment shall be installed ready for operation.
- C. Modify wiring of existing 2-speed exhaust fan controller as depicted.
- D. Provide cooling fan thermostat.
- E. Heat trace and weatherize new portions of penstock bifurcation piping, bypass and valves as indicated.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Codes, as referenced herein, are indicated in Section 01 42 10 – Reference Standards.
- B. The WORK and materials shall be in full accordance with the latest rules and regulations or publications of the State Fire Marshall, the local building code, and other local codes.
- C. Nothing in the Contract Documents shall be construed to permit WORK in violation of the above codes, rules, and regulations.
- D. In the absence of applicable codes, the installation and workmanship shall follow the standards set by the American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE).

1.3 CONTRACTOR SUBMITTALS

- A. Shop Drawings
 - 1. Submit complete shop drawings and certificates, test reports, affidavits of compliance, for all equipment, ductwork and piping systems, in accordance with the requirements in Section 01 33 00 – Contractor Submittals, and as indicated in the individual equipment, piping or ductwork Sections.
 - 2. Construction Drawings
 - a. The HVAC Drawings define the general layout, configuration, routing, size and the general intent of the design and are not fabrication drawings.
 - 3. The Shop Drawings shall include all necessary dimensions and details regarding equipment, pipe and ductwork joints, fittings, valves, appurtenances, design calculations, and material lists.

4. The submittals shall include detailed layout, spool, or fabrication drawings which shall show all fittings, and supports as necessary to accommodate the equipment as a complete and functional system.

B. Equipment Numbers

1. Equipment is identified by assigned numbers for reference and location purposes in the Contract Documents.
2. Indicate the appropriate equipment numbers on the Shop Drawings and other submittals.

1.4 WARRANTY

- A. Unit heaters, fans, and the like, that are provided by the CONTRACTOR shall carry the manufacturer's standard warranty.

- B. Warranties shall be furnished to the OWNER upon final acceptance of the completed systems by the OWNER.

C. Control System

1. The temperature and equipment control system shall be warranted free from defects in workmanship and material under normal use and service for a period of one year after acceptance by the ENGINEER.
2. Equipment that proves to be defective in workmanship or material during the warranty period shall be adjusted, repaired, or replaced by the automatic control manufacturer as part of the Contract.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Quality

1. Mechanisms and other parts shall be amply proportioned for the stresses which may occur during operation and for any other stresses which may occur during fabrication and erection.
2. Individual parts furnished which are alike in all units shall be alike in workmanship, design, and materials, and shall be of the manufacturer's top-line, industrial-commercial grade.

B. Supports

1. Equipment and appurtenances shall be firmly anchored or connected to supporting members.
2. Equipment shall be supported on restrained spring-type vibration isolators.

3. Supports as required for the proper installation of the equipment, but not forming an integral part of the building structure, shall be provided unless otherwise indicated.

C. Noise and Vibration Control

1. The system shall be free of objectionable vibrations and noise.

2.2 MOTORS

- A. Motors provided with the equipment shall conform to the latest IEEE and NEMA requirements for mechanical and electrical characteristics, including service factors.
- B. Motors shall be in conformance with the requirements of Section 26 01 00 – General Electrical Materials and Methods.
- C. Each motor shall bear the manufacturer’s nameplate with complete motor data.
- D. Each motor shall be of ample size and construction to continuously carry the loads which might be imposed by the equipment throughout the full range of operation of the equipment.
- E. The maximum motor loading shall be less than or equal to the nameplate horsepower rating, exclusive of the service factor.

2.3 ELECTRICAL WORK

A. General

1. Modify existing controls and control panel relating to the HVAC systems, including starters, thermostats, motorized dampers, louver operators and other equipment as indicated.
2. Provide control wiring as indicated in this Section and in conformance with the requirements of Division 26 – Electrical.
3. Provide circuit breakers to feed existing starter/controls, as indicated.

B. Install cooling fan thermostat and wire to controls as indicated.

C. Starters, whether as an integral or separate part of the equipment, shall be in accordance with the requirements of the Contract Drawings and Section 26 01 00.

D. Enclosures shall be of the same NEMA class as the electrical equipment in the same area.

2.4 FIRE ALARM AND DETECTION SYSTEM

A. The CONTRACTOR shall design and provide a complete fire alarm system as specified in Section Blind Slough HEP 28 31 00 - Fire Detection and Alarms.

B. Wire an alarm contact, as indicated, from the Fire Alarm Control Panel (FACP) in series with the ventilation thermostat to allow for the FACP to stop HVAC fan operation.

2.5 HANGERS AND SUPPORTS

- A. Provide all necessary hangers, supports, concrete inserts, anchors and guides for material and equipment to be installed.
- B. No perforated strap hangers and no wire supports will be accepted.
- C. Insulation Allowance
 - 1. Hangers supporting insulated pipe shall be sized to fit the pipe plus the insulation.
 - 2. The insulation at support points shall be provided with a metal shield in order to prevent damage to the insulation.
- D. Anchors and guides shall be constructed of steel, in accordance with approved Shop Drawings, and as indicated.
- E. Pipe hangers used to support uninsulated copper piping shall be copper-plated.
- F. Anchors
 - 1. Anchorages shall be obtained by welding lugs onto the pipe and providing abutting surfaces against the lugs to restrict longitudinal movement.
 - 2. Anchors shall be designed such that the pipe may be removed by removing bolts; no welding of pipe to the anchor will be accepted.
 - 3. bolting materials shall be cadmium-plated.

2.6 ELECTRIC HEAT TRACING

- A. **General:**
 - 1. self-regulating
 - 2. 150 degrees F maintenance temperature
 - 3. 120-volt
 - 4. 8 watts per ft. output
 - 5. twin 16-AWG copper buss wires within insulated jacket
- B. After the pipe has been heat traced, insulate and apply exterior jacketing in accordance with the requirements of Section 40 42 00 – Pipe, Ductwork and Equipment Insulation.
- C. Heat trace shall be powered from a dedicated 120VAC circuit breaker, to allow for manual turn-on in the winter and turn-off in the summer.
- D. Provide a thermostat with indicator light.
- E. Heating tracing shall include sections of new outdoor pipe as indicated.

F. **Manufacturers**, or Equal

1. **Chromalox Type SRL-4-1**

PART 3 -- EXECUTION

3.1 GENERAL

A. Openings - Existing Construction

1. Provide openings required in the existing construction for piping and equipment that are not specifically indicated.
2. Openings shall be cut in a neat and orderly manner with as little damage to existing structures as possible.
3. The patching of openings that have been cut shall match the existing construction.
4. Provide hangers and supporting members installed in the existing masonry or structural steel as required for proper completion of the WORK.

3.2 TEMPERATURE AND EQUIPMENT CONTROL

- A. After completion of the installation, use trained personnel to adjust thermostats and sensors in the motors and other provided equipment, and place them in complete operating condition subject to the approval of the ENGINEER.
- B. Instruct the operating personnel in the operation of the control system.

- END OF SECTION -

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SECTION 23 05 07 – ELECTRIC UNIT HEATERS

PART 1 -- GENERAL

1.1 SUMMARY

- A. The CONTRACTOR shall provide one (1) electric unit heater (EUH), and appurtenances, complete and operable, as indicated in accordance with the Contract Documents.
- B. Where 2 or more heaters or appurtenances of the same type or size are required, they shall be furnished by the same manufacturer.

1.2 CONTRACTOR SUBMITTALS

- A. Submittals shall be furnished in accordance with the requirements of Section 01 33 00 – Contractor Submittals.
- B. The submittals shall include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.

1.3 QUALITY

A. Codes and Permits

- 1. The WORK shall be in strict accordance with the State Mechanical Code, the State of Alaska, City of Petersburg and any other authorities having jurisdiction.
- 2. The CONTRACTOR shall have the required certification and be thoroughly familiar with the local codes.
- 3. The CONTRACTOR shall obtain and pay for necessary local and state permits.

B. Diligent Care

- 1. Care shall be taken at all times to protect floors, stairways, and walls during the make-up, erection of piping and placing of equipment.
- 2. The CONTRACTOR shall remove all stains and repair all damage before final acceptance of the WORK.

C. Materials

- 1. The materials used in connection with the electric heating system work shall:
 - a. be new;
 - b. be free from flaws and defects;
 - c. be fully equal to the quality specified; and,
 - d. conform to the requirements of applicable specifications and standards.

2. If during the construction of the Project the ENGINEER finds materials that have identifying marks removed, or lacking such marks completely, such items may be rejected until the CONTRACTOR has shown proof that said items conform to the indicated requirements, where the adequacy and extent of such proof shall be determined by the ENGINEER.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. The electrical system and components for electric heating systems shall be in conformance with the requirements of Section 23 05 00 – Heating & Ventilating General.

2.2 CORROSION-RESISTANT ELECTRIC UNIT HEATERS

A. General

1. Provide corrosion-resistant electric unit heaters as indicated.
2. The units shall be provided with their own wall mounting brackets.
3. The heaters shall be provided with built-in thermostat for temperature control.
4. The heaters shall be UL-listed for corrosive areas and shall meet the requirements of the National Electric Code.
5. The heaters shall be of the forced fan type, and of the power and voltage ratings as indicated in the mechanical equipment schedule for the electrical distribution system as indicated.

B. Construction

1. The heating elements shall be of finned tubular construction and composed of Type 316 stainless steel.
2. Provide stainless steel fittings to form a watertight seal between the elements and the junction box.

C. Motors

1. Motors shall be:
 - a. UL-listed;
 - b. totally enclosed;
 - c. epoxy painted; and,
 - d. provided with permanently lubricated ball bearings

2. Motors shall be designed to resist moisture and corrosion, shall be fitted with an epoxy-coated aluminum fan blade, and shall be factory-wired to a properly rated NEMA enclosure.

D. Shroud

1. The heating elements and motor shall be enclosed within a sturdy, heavy-gauge, stainless steel shroud.
2. The shroud shall be provided with a louvered outlet grille and a rear grille, each painted with one coat of zinc chromate primer and 2 coats of corrosion-resistant epoxy painting.

E. Electrical

1. Provide a properly rated NEMA enclosure to house element terminals and the following standard built-in controls:
 - a. over-temperature cutout with automatic reset;
 - b. fan delay relay;
 - c. required contactors; and
 - d. terminal blocks for field wiring.
2. Provide a separate motor contactor along with a 120V control transformer.
3. The heaters shall be rated at nominal 12.5 kW, 480 volts AC, 3-phase.

F. Provide a universal mounting bracket constructed of 14-gauge stainless steel, and suitable for wall mounting.

G. The following optional controls shall be built-in and factory-prewired in the enclosure:

1. thermostat with external adjustable knob;
2. selector switch, 3-position;
3. pilot light to indicate when heating elements are energized;
4. secondary manual reset thermal cutout;
5. anodized aluminum or epoxy-painted steel case material; and,

H. Corrosion-Resistant Electric Unit Heaters Manufacturer, or Equal:

1. **Chromalox, HD3D series**

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. The electric heating equipment shall be installed by a qualified installer in strict accordance with the Manufacturer's recommendations.

- END OF SECTION -

SECTION 26 01 00 – GENERAL ELECTRICAL MATERIALS AND METHODS

PART 1 -- GENERAL

1.1 SCOPE OF WORK

- A. Install and wire Owner furnished turbine-generator, metal-enclosed front access only switchgear, SCADA and surveillance rack, hydraulic power unit, lube oil power unit, grounding transformer, unit controls and protection, and intake control panel, as indicated on the engineering plans and reference drawings.
- b. Provide and install electrical equipment and materials specified and indicated on the engineering plans.

1.2 REFERENCES STANDARDS

- A. The following is a list of standards which may be referenced in this section:
 - 1. Alaska Administrative Code Title 8, Chapter 70
 - 2. Alaska Statutes, Title 18, Chapter 60, Article 6 – Electrical Safety
 - 3. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 - b. AB 1, Molded Case Circuit Breakers and Molded Case Switches.
 - c. ICS 2, Industrial Control Devices and Systems: Controllers, Contactors, and Overload Relays Not More than 2000 volts ac or 750 Volts DC.
 - d. PB 1, Panelboards.
 - e. ST 20, Dry-Type Transformers for General Applications.
 - f. WD 1, General Requirements for Wiring Devices.
 - 4. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC)
 - 5. Institute of Electrical and Electronics Engineers: C2, National Electrical Safety Code (NESC).
 - 6. Underwriters Laboratories, Inc. (UL):
 - a. 67, Standard for Safety Panelboards.
 - b. 98, Standard for Safety Enclosed and Dead-Front Switches.
 - c. 486E, Standard for Safety for Equipment Wiring Terminals for use with Aluminum and/or Copper Conductors.

- d. 489, Standard for Safety Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures.
- e. 508, Standard for Safety for Industrial Control Equipment.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 -Contractor Submittals.

A. Shop Drawings and Manufacturer's Data:

- 1. Outlet and device boxes.
- 2. Junction and pull boxes.
- 3. Outlets and Wiring devices.
- 4. Circuit breakers.
- 5. Panelboards.
- 6. Cable and wire.
- 7. Cable terminations and crimp/clamp lugs.

1.4 QUALITY ASSURANCE

- A. UL Compliance: Materials manufactured within scope of Underwriters Laboratories shall conform to UL Standards and have an applied UL listing mark.

PART 2 -- PRODUCTS

2.1 OUTLET AND DEVICE BOXES

- A. Sheet Steel: One-piece drawn type, zinc- or cadmium-plated.
- B. Cast Metal:
 - 1. Box: Cast ferrous metal.
 - 2. Cover: Gasketed, weatherproof, cast ferrous metal, with stainless steel screws.
 - 3. Hubs: Threaded.
 - 4. Lugs: Cast Mounting.
- C. Nonmetallic:

1. Box: PVC.
2. Cover: PVC, weatherproof, with stainless steel screws.
3. Manufacturer and Product: Carlon Type FS or FD, with Type E98 or E96 covers.

2.2 JUNCTION AND PULL BOXES

- A. Outlet Boxes Used as Junction or Pull Box: As specified under Article OUTLET AND DEVICE BOXES.
- B. Conduit Bodies Used as Junction Boxes: As specified under Article FITTINGS in Section 26 05 43 - Raceways.
- C. Steel Box:
 1. NEMA 250, Types: 12 and 4X.
 2. Box: 12-gauge steel, with white enamel painted interior and gray primed exterior, over phosphated surfaces. Provide gray finish as approved by OWNER.
 3. Cover: Hinged with clamps.
 4. Hardware and Machine Screws: ASTM A167, Type 316 stainless steel.
 5. Indoor J-boxes to be NEMA 12 or as indicated on the drawings.
 6. Outdoor J-boxes to be NEMA 4X or as indicated on the drawings.

2.3 WIRING DEVICES

- A. Switches:
 1. NEMA WD1 and FS W-S-896F/GEN.
 2. Industrial grade, totally enclosed, AC type, with quiet tumbler switches and screw terminals.
 3. Rivetless one-piece brass or copper alloy contact arm with silver alloy contacts.
 4. Capable of controlling 100 percent tungsten filament and fluorescent lamp loads.
 5. Rating: 20 amps, 120/277 volts.
 6. Automatic grounding clip and integral grounding terminal on mounting strap.
- B. Receptacle, Single and Duplex:
 1. NEMA WD 1 and FS W-C-596.

2. Specification grade, two-pole, three-wire grounding type with screw type wire terminals suitable for No. 10 AWG.
3. Contact Arrangement: Contact to be made on two sides of each inserted blade without detent.
4. Rating: 125 volts, NEMA WD 1, Configuration 5-20R, 20 amps.
5. One-piece mounting strap with integral ground contact (rivetless construction).

C. Receptacle, Ground Fault Circuit Interrupter:

1. Duplex, listed Class A to UL Standard 943, tripping at 5 mA.
2. Rating: 125 volts, NEMA WD1, Configuration 5-20R, 20 amps.
3. Size: For 2-inch by 4-inch outlet boxes.
4. Standard Model: NEMA WD1, with screw terminals and provisions for testing.
5. Feed-Through Model: NEMA WD1, with feed-through screw terminals and provisions for testing.

2.4 FUSED SWITCH, INDIVIDUAL, 0 TO 600 VOLTS

- A. Quick-make, quick-break, motor rated, load-break, heavy-duty type with external markings clearly indicating ON/OFF positions.
- B. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
- C. Fuse mountings shall reject Class H fuses and accept only current-limiting fuses specified.
- D. Enclosure: NEMA 250, Type as indicated in Part 3 of this Specification, unless otherwise shown.
- E. Interlock: Enclosure and switch to prevent opening cover with switch in ON position.

2.5 NONFUSED SWITCH, INDIVIDUAL, 0 TO 600 VOLTS

- A. NEMA KS 1.
- B. Quick-make, quick-break, motor rated, load-break, heavy-duty (HD) type with external markings clearly indicating ON/OFF positions.
- C. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
- D. Enclosure: NEMA 250, Type as indicated in Part 3 of this Specification unless otherwise shown.
- E. Interlock: Enclosure and switch to prevent opening cover with switch in the ON position.

2.6 TERMINAL BLOCK (0 TO 600 VOLTS)

- A. UL 486F/GEN 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. Short-circuiting type for current transformer leads.
- I. Marking system, allowing use of preprinted or field-marked tags.

2.7 DRY TYPE TRANSFORMER (0- TO 600-VOLT PRIMARY)

- A. UL 1561, NEMA ST 20, unless otherwise indicated.
- B. Self-cooled, two-winding, copper.
- C. Insulation Class and Temperature Rise: Manufacturer's standard.
- D. Core and Coil:
 - 1. Encapsulated for single-phase units 1/2 to 25 kVA and for three-phase units 3 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.
- E. Units larger than 5 kVA suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
- F. Enclosure:
 - 1. Single-Phase, 3 to 25 kVA: NEMA 250, Type 3R, non-ventilated.

2. Single-Phase, 37-1/2 kVA and Above: NEMA 250, Type 2, ventilated.
 3. Three-Phase, 3 to 15 kVA: NEMA 250, Type 3R, non-ventilated.
 4. Three-Phase, 30 kVA and Above: NEMA 250, Type 2, ventilated.
 5. Outdoor Transformers: NEMA 250, Type 3R.
- G. Wall Bracket: For single-phase units, 15 to 37-1/2 kVA, and for three-phase units, 15 to 30 kVA.
- H. Voltage Taps:
1. Single-Phase, 3 to 10 kVA: Four of 2.5 percent, full capacity; two above and two below normal voltage rating.
 2. Single-Phase, 15 kVA and Above: Four of 2.5 percent, full capacity; two above and two below normal voltage rating.
 3. Three-Phase, 3 to 15 kVA: Four of 2.5 percent, full capacity; two above and two below normal voltage rating.
 4. Three-Phase, 30 kVA and Above: Four of 2.5 percent, full capacity; two above and two below normal voltage rating.
- I. Impedance: 4.5 percent minimum on units 75 kVA and larger.
- J. Maximum Sound Level: NEMA ST20:
1. 40 decibels for 0 to 9 kVA.
 2. 45 decibels for 10 to 50 kVA.
 3. 50 decibels for 51 to 150 kVA.
 4. 55 decibels for 151 to 300 kVA.
 5. 60 decibels for 301 to 500 kVA.
- K. 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.

2.8 PANELBOARDS AND CIRCUIT BREAKERS

- a. All panelboards shall be rated for 600V application and configured for service entrance with removable bond between ground and neutral buses.
- b. Manufacturers
 - 1) Eaton/Cutler-Hammer.
 - 2) General Electric.
 - 3) Siemens.
 - 4) Circuit breakers and panelboard shall be of the same manufacturer.
- c. Circuit Breakers
 - 1) Molded Case Circuit Breakers: NEMA AB 1, FS W-C-375; Provide bolt-on type circuit breakers with integral thermal and instantaneous magnetic trip in each pole (common trip type). Provide circuit breakers, UL listed as Type HACR, for air conditioning equipment branch circuits. Provide circuit breakers, UL listed as Type SWD, for lighting circuits. Provide UL Class A ground fault interrupter circuit breakers where specified on panelboard schedules and/or the Drawings.]
 - 2) Trip Unit:
 - 3) Instantaneous magnetic trips shall be accessible and adjustable from the front of the breaker on frame size 100 amperes.
 - 4) Trip units shall be interchangeable and adjustable for trip pick up and delay settings on frame size 225 amperes.
 - 5) Breakers sized 400 amperes and higher shall be equipped with solid state trip units with long-time, short-time, instantaneous, and ground fault (LSIG) tripping characteristics.
 - 6) Breakers shall be rigidly mounted, separately removable and independent of trim plates for their support. Breakers shall be bolt on type.
 - 7) Breakers shall be industrial grade with a minimum pole width of 1-inch (25.4 mm) and a minimum height of 5-1/2-inches (139.7 mm). Miniature circuit breakers or breakers having a pole width of 1/2-inch are not acceptable.
 - 8) The minimum symmetrical interrupting rating for molded-case circuit breakers shall be 14kIA AC at 480VAC and 10kIA DC at 125VDC, or as specified on the panelboard schedule and/or Drawings. Series rated breakers are not acceptable.
- d. Bus Hardware

- 1) Panelboards shall be completely factory assembled and equipped with a main circuit breaker and the type, size and number of branch circuit breakers, arranged and numbered as shown on the attached panel schedule(s). Panelboards shall be fully rated. Series rated panelboards are not acceptable.
- 2) All multi-pole breakers shall be common trip. Branch circuits shall be arranged using double row construction. Bus sequence shall be ABC top to bottom, left to right for both top and bottom fed panels. Provisions or space for future breakers shall be located at the bottom of the panel and be fully bussed, complete with the necessary mounting hardware. Use at least 100 ampere breaker-connecting bus straps and mounting hardware.
- 3) Where SPARE is indicated on the panel schedule(s), the specified circuit breaker and 100 ampere (minimum) branch-circuit busing and mounting hardware shall be installed.
- 4) Where SPACE is indicated on the panel schedule(s), 100 ampere (minimum) branch-circuit busing and mounting hardware shall be installed, ready for future installation of circuit breakers, furnished by others. A minimum of 20 percent spare pole spaces, grouped in multiple of three, shall be provided in each panelboard, for future installation by the University. Provide single pole filler plates in the spaces, as required.
- 5) A nameplate shall be provided, and located near the top of the front trim on the exterior surface, listing panel type and ratings, as required by UL. Each circuit shall be permanently numbered to agree with the panel schedule, using plastic or metal buttons mounted adjacent to the breaker and secured by rivets or grommets with an engraved or depressed number. Adhesive numbering tape, painted numbers, or use of more than one number per breaker is not acceptable.
- 6) Main vertical bus bars shall be copper and plated per UL requirements. Bus bars shall be supported by glass-filled polyester-type insulators. Bolts used to connect current-carrying parts together, shall be accessible for tightening from the front of the panel. Bus bars shall be factory drilled and tapped with spacing arranged to permit breaker interchange, from the front, while the panel is energized.
- 7) Neutral bus shall be copper, 200 percent rated and insulated from the cabinet and other parts. It shall be rigidly mounted in the panel and shall be provided with a solderless cable connector for each circuit breaker and each space in the panelboard and the main connecting lug(s).
- 8) A copper equipment ground bus, of sufficient width and length, shall be solidly bolted and grounded to the enclosure at the bottom and shall leave clear space for the bottom cable entries. The bus shall have sufficient termination points in number to

agree with branch circuits and spaces. A solderless connector, for No. 2 to No. 4/0 cable size, shall be bolted to the ground bus.

- 9) Copper bus bars shall be of sufficient size to provide a current density of not more than 1000 amperes per square inch of cross section, and not more than 200 amperes per square inch at bolted connections.
 - 10) Minimum Short Circuit Rating for Bus Bracing: The bus shall be braced for the minimum symmetrical short circuit rating of the panel, as shown on the panel schedule.
 - 11) Provide main bus pressure connectors (main lugs) and separately supported sub-feed pressure connectors (lug landings) where noted. Provide additional bottom raceway space to accommodate pressure connectors and lug landings. In no instance shall the gutter space be less than required by NFPA-70.
 - 12) Pre-installed locking devices shall be provided for locking the main circuit breaker and each branch circuit breaker in the OPEN position, by means of a padlock. Locking devices shall not be removable from the front of the panel with the trim in place. Attachment of the locking device to the panel with adhesives is not acceptable.
- e. Include drawings numbers for the panelboard schedules. Schedules shall provide the following information:
- 1) Panelboard Number Name or Label.
 - 2) Panelboard type.
 - 3) Number of phases.
 - 4) Main bus ampacity.
 - 5) Main circuit breaker trip rating.
 - 6) Branch circuit breaker arrangement.
 - 7) Branch circuit breaker trip sizes.
 - 8) Flush or surface mounting.
 - 9) Enclosure type.
 - 10) Service entrance rating requirement (indicate 'Y', if required).
 - 11) Power Metering Requirement (indicate 'Y', if required).
 - 12) Circuit load.

PART 3 -- EXECUTION

3.1 GENERAL

- A. Install equipment in accordance with manufacturer's recommendations.

- B. Use appropriate conduit and conductor entry fittings with enclosures to maintain the specified enclosure environmental capability after installation.
- C. Equipment locations, if shown on Drawings, are approximate. Final locations shall be determined in accordance with field conditions and subject to OWNER's approval.

3.2 OUTLET AND DEVICE BOXES

- A. Install suitable for conditions encountered at each outlet or device in wiring or raceway system, sized to meet NFPA 70 requirements.

- B. Sizes:

1. Depth: Minimum 2 inches, unless otherwise required by structural conditions. Box extensions not permitted.
2. Hollow Masonry Construction: Install with sufficient depth such that conduit knockouts or hubs are in masonry void space.
3. Ceiling Outlet: Minimum 4-inch octagonal sheet steel device box, unless otherwise required for installed fixture.
4. Switch and Receptacle: Minimum 2-inch by 4-inch sheet steel device box.

- C. Locations:

1. Drawing locations are approximate.
2. To avoid interference with mechanical equipment or structural features, relocate outlets as directed by OWNER.
3. Light Switch: Install on lock side of doors.
4. Light Fixture: Install in symmetrical pattern according to room layout, unless otherwise shown.

- D. Mounting Height:

1. If shown on Drawings dimensions given are to centerline of box.
2. Where specified heights do not suit structural features or finish, mount as directed by OWNER.
3. Light Switch: 48 inches above floor.
4. Thermostat: 54 inches above floor.
5. Convenience Receptacles.
 - a. General Interior Areas: 15 inches above floor.

- b. Outdoor, All Areas: 24 inches above finished grade, or as directed by OWNER.
- 6. Switch, Motor Starting: 48 inches above floor, unless otherwise indicated on Drawings.
- E. Install plumb and level.
- F. Flush Mounted:
 - 1. Install with concealed conduit.
 - 2. Install proper type extension rings or plaster covers to make edges of boxes flush with finished surface.
 - 3. Holes in surrounding surface shall be no larger than required to receive box.
- G. Support boxes independently of conduit by attachment to building structure or structural member.
- H. Install bar hangers in frame construction or fasten boxes directly as follows:
 - 1. Concrete or Brick: Bolts and expansion shields.
 - 2. Hollow Masonry Units: Toggle bolts.
 - 3. Steelwork: Machine screws.
- I. Threaded studs driven in by powder charge and provided with lock washers and nuts are acceptable in lieu of expansion shields.
- J. Provide plaster rings where necessary.
- K. Boxes embedded in concrete or masonry need not be additionally supported.
- L. Install galvanized mounting hardware in industrial areas.
- M. Install separate junction boxes for flush or recessed lighting fixtures where required by fixture terminal temperature.
- N. Boxes Supporting Fixtures: Provide means of attachment with adequate strength to support fixture.
- O. Open no more knockouts in sheet steel device boxes than are required; seal unused openings.
- P. Box Type (Steel Raceway System):
 - 1. Exterior Locations:
 - a. Exposed Raceways: Cast metal.

- b. Concealed Raceways: Cast metal.
- c. Concrete Encased Raceways: Cast metal.
- 2. Interior Locations:
 - a. Exposed Rigid Conduit or IMC: Cast metal.
 - b. Exposed EMT: Sheet steel.
 - c. Concealed Raceways: Sheet steel.
 - d. Concrete Encased Raceways: Cast metal.
 - e. Lighting Circuits, Ceiling: Sheet steel.
- 3. Cast-In-Place Concrete Slabs: Sheet steel.
- Q. Box Type, Corrosive Locations (PVC-Coated Rigid Galvanized Steel Raceway System): PVC-coated cast metal.

3.3 JUNCTION AND PULL BOXES

- A. Install where shown and where necessary to terminate, tap-off, or redirect multiple conduit runs.
- B. Install pull boxes where necessary in raceway system to facilitate conductor installation.
- C. Install in conduit runs at least every 150 feet or after the equivalent of three right-angle bends.
- D. Use conduit bodies as junction and pull boxes where no splices are required and their use is allowed by applicable codes.
- E. Installed boxes shall be accessible.
- F. Do not install on finished surfaces.
- G. Install plumb and level.
- H. Support boxes independently of conduit by attachment to building structure or structural member.
- I. Install bar hangers in frame construction or fasten boxes directly as follows:
 - 1. Wood: Wood screws.
 - 2. Concrete or Brick: Bolts and expansion shields.
 - 3. Hollow Masonry Units: Toggle bolts.

4. Steelwork: Machine screws.
- J. Threaded studs driven in by powder charge and provided with lock washers and nuts are acceptable in lieu of expansion shields.
- K. 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 OWNER's written acceptance prior to installation in paved areas, roadways, or walkways
 4. Use boxes and covers suitable to support anticipated weights
- L. Flush Mounted:
1. Install with concealed conduit
 2. Holes in surrounding surface shall be no larger than required to receive box
 3. Make edges of boxes flush with final surface
- M. Mounting Hardware:
1. Noncorrosive Dry Areas: Galvanized.
 2. Noncorrosive Wet Areas: Stainless steel.
 3. Corrosive Areas: Stainless steel.
- N. Location/Type, unless otherwise indicated on engineering drawings:
1. Finished, Indoor, Dry: NEMA 250, Type 1.
 2. Unfinished, Indoor, Dry: NEMA 250, Type 12.
 3. Unfinished, Indoor and Outdoor, Wet: NEMA 250, Type 4.
 4. Steel Raceway System: Cast metal.
 5. Unfinished, Indoor and Outdoor, Wet and Corrosive: NEMA 250, Type 4X.
 6. Nonmetallic Raceway System: Nonmetallic.
 7. Unfinished, Indoor and Outdoor, Wet, Dust, or Oil: NEMA 250, Type 13.
 8. Underground Conduit: Concrete.

9. Outdoor Locations Where Indicated Weatherproof (WP): NEMA 250, Type 3R.

10. Areas Not Otherwise Classified: NEMA 250, Type 12.

3.4 WIRING DEVICES

A. Switches:

1. Mounting Height: See Article OUTLET AND DEVICE BOXES.
2. Install with switch operation in vertical position.
3. Install single-pole, two-way switches such that toggle is in up position when switch is on.

B. Receptacles:

1. Install with grounding slot down and house in NEMA 3R rated enclosure.
2. Weatherproof Receptacles:
 - a. Install in cast metal box.
 - b. Install such that hinge for protective cover is above receptacle opening.

C. Switch, Motor Rated:

1. Install with switch operation in vertical position such that toggle is in up position when ON.
2. Install within sight of motor when used as a disconnect switch.
3. Mounting Height: See Article OUTLET AND DEVICE BOXES.
4. Enclosure Type: See Article OUTLET AND DEVICE BOXES.

3.5 DEVICE PLATES

- A. Securely fasten to wiring device; ensure a tight fit to box.
- B. Flush Mounted: Install with all four edges in continuous contact with finished wall surfaces without use of mats or similar materials. Plaster fillings will not be acceptable.
- C. Surface Mounted: Plate shall not extend beyond sides of box, unless plates have no sharp corners or edges.
- D. Install with alignment tolerance to box of 1/16-inch.
- E. Types (Unless Otherwise Shown):

1. Office: Plastic
2. Exterior: Weatherproof
3. Interior:
 - a. Flush Mounted Boxes: Plastic.
 - b. Surface Mounted, Metal Boxes:
 - 1) General Purpose Areas: Sheet Steel.
 - 2) Other Areas: Cast.
 - c. Surface Mounted, Aluminum Boxes:
 - 1) General Purpose Areas: Stamped.
 - 2) Other Areas: Cast.
 - d. Surface Mounted, Sheet Steel Boxes: Raised sheet steel.
 - e. Surface Mounted, Nonmetallic Boxes: Manufacturer's standard.

- END OF SECTION -

SECTION 26 01 26 - ELECTRICAL TESTING

PART 1 -- GENERAL

1.1 REQUIREMENTS

- A. Provide the services of independent testing firm for inspection, calibration, and testing of all installed equipment to establish equipment conforms to requirements specified in these specifications and is ready for commissioning. The testing firm shall be an independent business entity not affiliated with the CONTRACTOR and shall be certified as a Nationally Recognized Testing Laboratory (NRTL) by OSHA or other under approved accreditation or by achieving sufficient experience. PMP&L shall have sole right to accept or reject offered alternate accreditation or experience.
- B. Relay protection programming, testing and checkout shall be performed by persons who specialize in such work, and shall be approved by Owner to perform such tasks under this scope of work. Relay testing personnel may be different than those who perform standard NETA electrical testing.
- C. Organize the tests such that all aspects of installed equipment are covered, including the interface to existing equipment.
- D. Submit reports of all tests performed, including test procedures, measurements taken, settings entered, conclusions and recommendations. Provide photos of test setup, test instruments used, and instrument calibration stickers.

1.2 REFERENCES

- A. Testing shall be performed in accordance with the applicable test criteria and requirements included in the following list of standards:
 - 1. American National Standards Institute (ANSI):
 - a. C2, National Electrical Safety Code.
 - 1. Institute of Electrical and Electronics Engineers (IEEE).
 - 2. National Electrical Manufacturers Association (NEMA).
 - 3. International Electrical Testing Association (NETA):
 - a. Acceptance Testing Specifications (ATS) for Electrical Power Distribution Equipment and Systems.
 - 4. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).
 - b. 70E, Standard for Electrical Safety in the Workplace.

- B. Protective Relay Testing shall be in accordance with the applicable test criteria and requirements of the following:
 - 1. IEEE Std C37.233-2009, IEEE Guide for Power System Protection Testing
 - 2. IEEE C37.242-2013, IEEE Guide for Synchronization, Calibration, Testing, and Installation of Phasor Measurement Units (PMUs) for Power System Protection and Control.
 - 3. IEEE Std C57.13.1-2006 (R2012), IEEE Guide for Field Testing of Relaying Current Transformers [Power Transformers (Distribution and Regulating)].

1.3 SUBMITTALS

- A. The following shall be submitted in accordance with Section 01 33 00:
- B. Submit 30 days prior to performing inspections or tests:
 - 1. Qualifications of testing firm and individuals performing field and relay testing.
 - 2. Schedule for performing inspection and tests.
 - 3. List of references to be used for each test.
 - 4. Test procedures to be used for all equipment and subsystems.
 - 5. Equipment and materials inspection form(s) to be used.
 - 6. Individual device test forms to be used.
 - 7. Individual system test forms to be used.
- C. Test Report: Submit within 7-days after completion of test. Report shall include:
 - 1. Executive Summary.
 - 2. Test criteria or standards used.
 - 3. Test instruments used, including calibration records.
 - 4. Test sheets with tester's and witness' initials organized to cover the following subsystems:
 - a. Medium voltage switchgear.
 - b. Power cable, MV and 600V.
 - c. Transformers.
 - d. Switches.

- e. Wiring and conduit system.
 - f. Control systems and control panels, local and remote.
 - g. Instrument transformers.
 - h. Protective Relays – settings and connections.
 - i. Motor Controls.
 - j. Equipment Interconnections and labeling.
 - k. SCADA system.
 - l. Fiber optic cable.
 - m. Video surveillance system.
 - n. Ground grid system.
5. Observation, summary, and recommendations.

1.4 QUALIFICATIONS

A. GENERAL ELECTRICAL TESTING

- a. Test personnel shall be engineers and technicians regularly engaged in testing and inspecting of electrical equipment, installations, and systems.
- b. Test personnel shall be certified by NETA or other demonstrated training and/or experienced in the area of electrical training. Provide proof of qualification. Testing personnel without NETA certification, or other similar certifying entity, may be acceptable but subject to approval by Owner.
- c. Test equipment shall have an operating accuracy equal to, or greater than, requirements established by NETA ATS.
- d. Test instrument calibration shall be in accordance with NETA ATS.

B. RELAY TESTING AND CHECKOUT

- a. Relay programming/setting and testing shall be performed by personnel trained and qualified to perform such work. Personnel performing relay checkout and testing shall have a minimum of five years' experience performing similar testing.
- b. Personnel programming and testing SEL relays shall have specific experience performing such tasks.
- c. Relay testing shall use secondary current and voltage injection method.
- d. Relay settings to be provided by Owner.

1.5 SEQUENCING AND SCHEDULING

- A. Perform inspection and electrical tests after equipment has been fully installed and cleaned and inspected.
- B. Perform tests with apparatus de-energized whenever feasible.
- C. Inspection and electrical tests on energized equipment are to be:
 - 1. Scheduled with OWNER prior to de-energization.
 - 2. Minimized to avoid extended period of interruption to operating plant equipment.
- D. Notify OWNER at least 48 hours prior to performing tests on energized electrical equipment.

1.6 STANDARD VALUES

- A. Test values to be used shall be in accordance with referenced standard documents unless they are specifically noted herein.
- B. Values obtained from tests shall be reported for acceptability. Report all deficiencies or deviations from standard values.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION

3.1 GENERAL

- A. Tests and inspection shall establish that:
 - 1. Electrical equipment is operational within industry and manufacturer's tolerances.
 - 2. Wiring is correctly labeled, and terminations are correct.
 - 3. Equipment is suitable for energization.
 - 4. Installation conforms to requirements of Contract Documents and referenced industry standards.
 - 5. Manufacturers' settings have been correctly entered and equipment operation verified.
 - 6. Electrical inspections, as may be required, have been performed by the local authority having jurisdiction, and who have released the equipment for energization.
 - 7. Equipment is ready for commissioning tests in accordance with Division 1.
- B. Perform general electrical inspection and testing in accordance with NETA Acceptance Testing Specifications, industry standards, local authority having jurisdiction, and manufacturer's recommendations.

- C. Verify, test, and calibrate protective relays, circuit breakers, fuses, and other applicable devices in accordance with values established by the short circuit and coordination study performed by equipment suppliers.
- D. Adjust mechanisms and moving parts for free mechanical movement.
- E. Adjust adjustable relays and sensors to correspond to operating conditions, or as recommended by manufacturer.
- F. Verify nameplate data for conformance to Contract Documents.
- G. Realign equipment not properly aligned and correct un-levelness.
- H. Properly anchor electrical equipment found to be inadequately anchored.
- I. Tighten accessible bolted connections, including wiring connections, with calibrated torque wrench to manufacturer's recommendations, or as otherwise specified.
- J. Clean contaminated surfaces with cleaning solvents as recommended by manufacturer.
- K. Inspect raceways for proper routing and support. Verify each raceway is properly identified with label.
- L. Verify cables and wiring are properly identified with circuit labels and conductor identifications.
- M. 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.
- N. Electrical Enclosures and Panels:
 - 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 door and panel sections having dented surfaces.
 - 5. Repair or replace 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 due to extensive damage, refinish the entire assembly.

3.2 WIRING AND CABLE TESTING

A. Visual and Mechanical Inspections:

1. Physical damage to jacket and insulation.
2. Cable bends not in conformance with manufacturer's minimum allowable bending radius where applicable.
3. Proper support.
4. Color coding conformance with specifications.
5. Proper shield grounding.
6. Proper circuit identification.
7. Correct phasing and polarities.
8. Correct point-to-point terminations.
9. Proper lug type for conductor material.
10. Proper lug installation.
11. Proper clearances.
12. Bolt torque level in accordance with NETA ATS, Table 100.12, unless otherwise specified by manufacturer.

B. Insulation Resistance Tests:

1. Perform insulation resistance test using DC voltages per NETA ATS Table 100.1.
2. Test each conductor with respect to ground and to adjacent conductors per IEEE 118 procedures.
3. Investigate values less than shown in Table 100.1.
4. Continuity test by ohmmeter method to ensure proper cable connections.

C. Current and Voltage Application Tests:

1. Inject AC or DC test current, as applicable, to each current loop and confirm proper currents are measured at target devices.

2. Apply AC or DC test voltage, as applicable, and confirm proper voltage is received by target devices.

D. Operational Tests:

1. Initiate control devices.
2. Check proper operation of control system.
3. Check alarms and shutdown circuits.

E. Medium Voltage Cable High Potential Test:

1. Perform high potential test per NETA ATS Table 100.6.
2. Each conductor section tested with:
 - a. Splices and terminations in-place but disconnected from equipment.
 - b. Remaining conductors and shields grounded in accordance with IEEE 400.
3. Measure only the leakage current associated with conductor.
4. Maximum test voltage shall not exceed limits for terminators specified in manufacturer's specifications.
5. Apply test voltage in a minimum of five equal increments until maximum acceptable test voltage is reached.
 - a. Increments not to exceed ac voltage rating of conductor.
 - b. Record DC leakage current at each step after a constant stabilization time consistent with system charging current.
6. Raise conductor to specified maximum test voltage and hold for 15 minutes, or as specified by conductor manufacturer. Record DC leakage current at 30 seconds and 1 minute and at 1-minute intervals, thereafter.
7. Immediately following test, ground conductor for adequate time period to drain insulation stored charge.
8. Test results evaluated on a pass/fail basis.

3.3 PROTECTIVE RELAYS

A. Visual and Mechanical Inspection:

1. Visually check each relay for:
 - a. Tight cover gasket and proper seal.
 - b. Unbroken cover or enclosures.

- c. Condition of wire terminations.
 - 2. Verify that each relay:
 - a. Complies with Contract Documents and application.
 - b. Is set in accordance with recommended settings.
- B. Electrical Tests:
 - 1. Check settings for:
 - a. Pickup parameters on each operating element.
 - b. Timing at three points on time-current curve.
 - c. Pickup target and seal-in units.
 - d. Special tests as required to check operation of restraint, directional, and other elements in accordance with manufacturer's instruction manual.
 - 2. Phase angle and magnitude contribution tests on differential and directional relays after energization to vectorially verify proper polarity and connections.
 - 3. Check outputs from multi-function programmable relays for:
 - a. Accuracy of displayed data and parameters.
 - b. Proper relay target operation.
 - c. Correct output contacts as assigned.
 - d. Correct metering and status data output.
 - e. Alarms.
 - f. Response to transfer trip signals.
 - g. Test spare output relay contacts to assure they function properly.

3.4 VOLTAGE AND CURRENT TRANSFORMERS

- A. Visual and Mechanical Inspection:
 - 1. Visually Check Current and Voltage Transformers For:
 - a. Cracked insulation.
 - b. Broken leads or defective wiring.
 - c. Proper polarity connection and wiring continuity.

- d. Adequate clearances between primary and secondary circuit wiring.
2. Verify Mechanically That:
 - 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 voltage transformers.

B. Primary Injection of Currents and Voltages

1. Apply voltages and current at the primary sides of current and voltage transformers to ensure circuits are correctly phased at both primary and secondary windings for proper operation of protective relays, synchronizing circuits and meters.

3.5 CONTROL PANELS AND DEVICES

A. Visual and Mechanical Inspection:

1. Verify that power supply and equipment grounding conductors are correctly provided in accordance with NEC.
2. Verify by point-to-point check that field wiring is correctly terminated with devices, sensors, switches, relays, interlocks, communication lines, and other interfacing devices in accordance with the approved shop drawings.
3. Verify that low voltage signal wiring is correctly terminated and shields grounded.
4. Verify conductor labels and terminal identifications in accordance with shop drawings provided by manufacturers and suppliers.
5. Verify nameplate data.

B. Electrical Tests:

1. Verify and calibrate instrumentation input and output loops.
2. Verify emergency shutdown functions.
3. Verify inputs are received from field transducers and sensors and correct values are displayed on the control panel meters.
4. Verify operation of control circuits by observing target field devices.

3.6 FIELD SENSORS AND TRANSDUCERS

A. Visual and Mechanical Inspection:

1. Verify devices against nameplate data.
2. Verify correct locations, polarity and orientation.
3. Verify integrity of installation.

B. Electrical Tests:

1. Verify sensors are correctly connected to power source.
2. Calibrate for linearity and output range.
3. Signal isolation with adjacent circuits.
4. Proper grounding of conductor shields.

3.7 GROUNDING SYSTEM

A. Visual and Mechanical Inspection:

1. Equipment and circuit grounds in motor control center, panelboards, and switchgear assemblies for proper connection, continuity and tightness.
2. Ground bus connections in motor control center, panelboards, and switchgear assemblies for proper termination and tightness.
3. Effective transformer 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. Verify interconnections to grounding grid system.
2. Measure and report ground resistance as specified in Section 26 05 26.

3.8 OWNER SUPPLIED EQUIPMENT

A. Visual and Mechanical Inspection:

1. Proper installation per drawings and manufacturer recommendations.
2. Control Wiring:
 - a. Compare wiring to local and remote control, and protective devices with elementary diagrams.
 - b. Verify supply power phasing and rotation.

c. Check for proper conductor identification.

B. Operational Testing:

1. Operate equipment by initiating controls from control station.
2. Check for correct rotation.

3.9 SCADA AND COMMUNICATION EQUIPMENT

A. Communication Cables and Wiring

1. Verify fiber optic cables are properly installed and routed to correct equipment.
2. Verify that equipment rack is correctly installed and anchored to floor.

B. SCADA and HMI Terminals

1. Verify that SCADA system is properly programmed.
2. Verify protective relays and PLCs are properly communicating with SCADA system.

C. Intake Control System

1. Verify that fiber optic cables between powerhouse and intake are properly installed and exchanges of field data and control commands are properly executed and updated in real time.
2. Verify accuracy of water level measurements as received by the control panel.
3. Verify alarms and equipment operating status is correctly received and updated at powerhouse control panel.

3.10 VIDEO SURVEILLANCE SYSEM

- A. Verify field wiring and power status for all cameras.
- B. Orient cameras as directed by OWNER and provide calibration for optimum operation in accordance with manufacturer's instruction.
- C. Verify video operation and remote camera movements (pan, tilt, and zoom) as controlled from remote sites.

3.11 MEDIUM VOLTAGE SWITCHGEAR

A. Visual and Mechanical Inspection

1. Compare equipment nameplate data with drawings and specifications.
2. Inspect physical and mechanical condition.

3. Verify all maintenance devices and tools specified by manufacturers are available.
4. Verify the assembly and removable elements are clean.
5. Perform mechanical operation tests on operating breaker racking and tripping/closing mechanisms.
6. Inspect internal parts, including contacts, interrupters, bushing current transformers, and gaskets.
7. Inspect bolted electrical connections to verify tightness in accordance with manufacturer's published data or NETA recommendation.
8. Ensure SWGR is grounded per the drawings.

B. Electrical Tests

1. Perform resistance measurements through bolted connections in accordance with NETA ATS.
2. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with breaker closed and across each pole in accordance with NETA ATS.
3. Perform contact and pole resistance test.
4. Perform insulation resistance tests on all control interconnection cabling/wiring with respect to ground with solid state devices removed from the circuit. Use the following voltages and duration:
 - a. 300-Volt rated Wiring: 500VDC for 1 minute
 - b. 600-Volt rated Wiring: 1,000VDC for 1 minute
5. Perform minimum pickup voltage tests on trip and close coils per manufacturer's data.
6. Verify correct operation of any auxiliary features.
7. Trip breaker by operation of any protective device.

3.12 DISCONNECT SWITCHES

A. Visual and Mechanical Inspection

1. Compare equipment nameplate data with drawings and specifications.
2. Inspect physical and mechanical condition.
3. Verify all maintenance devices and tools specified by manufacturers are available.

4. Verify the unit is clean.
5. Inspect anchorage, alignment, ground and required clearances.
6. Verify correct blade alignment, blade penetration, travel stops, arc interrupter operation and mechanical operation.
7. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
8. Perform mechanical operation tests on operating mechanism.
9. Inspect bolted electrical connections to verify tightness in accordance with manufacturer's published data or NETA recommendation.
10. Perform thermographic survey on electrical connections in accordance with NETA ATS.
11. Verify sequencing and operation interlocking system.

B. Electrical Tests

1. Perform resistance measurements through bolted connections in accordance with NETA ATS.
2. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with breaker closed and across each pole in accordance with NETA ATS.
3. Perform contact and pole resistance test across each switch blade and fuse holder.
4. Perform insulation resistance tests on all control wiring with respect to ground with solid state devices removed from the circuit. Use the following voltages and duration:
 - a. 300-Volt rated Wiring: 500VDC for 1 minute.
 - b. 600-Volt rated Wiring: 1,000VDC for 1 minute.
5. Perform minimum pickup voltage tests on trip and close coils per manufacturer's data.
6. Verify correct operation of any auxiliary features.

3.13 MISCELLANEOUS CIRCUITS AND DEVICES

- A. CONTRACTOR shall ensure that all other equipment supplied and installed under this Contract are properly installed, interconnected, calibrated, and ready for operation whether or not specifically identified herein.

B. Perform electrical testing as identified in other Division 26 sections.

- END OF SECTION -

SECTION 26 02 00 - OWNER-FURNISHED ELECTRICAL EQUIPMENT

PART 1 -- GENERAL

1.1 SECTION INCLUDES

- A. Installation of OWNER-Furnished Equipment.

1.2 QUALITY ASSURANCE

- A. Verify that all materials were shipped complete per manufacturer’s bill of material.
- B. Visually inspect all material for physical damage.
- C. Cooperate with manufacturer’s field service engineers for installation and testing.

1.3 CONSTRUCTION COORDINATION AND RESPONSIBILITY

- A. Verify and tag all wiring and termination points to ensure correct field wiring of materials provided by OWNER.
- B. Submit detailed step-by-step installation plan for approval.
- C. Mark up all drawings and diagrams to show all changes made during installation. Submit as part of the project closeout documentation.

1.4 RELATED SPECIFICATIONS

- A. Section 48 01 00 Installation of Turbine Generator Equipment.

PART 2 -- PRODUCTS

2.1 OWNER-FURNISHED ELECTRICAL MATERIALS

- A. See Section 01 11 00 – Summary of Work for the complete list of OWNER-furnished CONTRACTOR-installed (OFCI) equipment. Equipment anchors or accessories required for proper grounding, installation and wiring of these materials, including foundations and footings, shall be provided by CONTRACTOR.

- B. Major OFCI equipment includes the following. Equipment data is preliminary.

1. Generator Switchgear

No. of Units	2-Bkr cubicles and 1-cable pulling/PT compartment, front access only SWGR
Description	Metal-Enclosed, 5.0 kV, 1200A Bus and Breaker
Weight and Dimensions	Shipped as one assembly Qty.= 1, TBD lbs., 92” W x 61.5” D x 91.75” H Qty.= 2, TBD lbs., circuit breakers Assembly consisting of three sections, one cable/PT compartment (center) and two breaker cubicles. Breakers shipped separately.

Manufacturer	APT SWGR, Breaker Susol VCB
Model or Type	Vacuum, UVL Tulip Type Contactor
Remarks	Installed in powerhouse.

2. Turbine-Generator Protection/Control Panel

No. of Units	Assembly (3-sections) shipped whole
Description	Turbine-generator protection/control panel complete with protective relays, kWh meter, switches, HMI, PLC, and switchboard meters.
Weight and Dimensions	TBD lbs, 112" W x 20"D x 86"H
Manufacturer	
Model or Type	N/A
Remarks	Anchored and bolted to concrete floor. Provide all interconnecting wiring and fiber optic cables

3. Communication Rack

No. of Units	1 (rack)
Description	Communication and Surveillance Rack
Weight and Dimensions	TBD lbs, 39.26" W x 23.5"D x 70.25"H
Manufacturer	
Model or Type	N/A
Remarks	Anchored and bolted to concrete floor. Provide all interconnecting wiring and fiber optic cables

4. Generator Terminal Cabinet – attached to generator

No. of Units	1 (1 cubicle)
Description	Turbine-generator control, including PLC, synch switch, switchboard meters, and control switches.
Weight and Dimensions	See generator manufacturer data and drawings
Manufacturer	
Model or Type	N/A
Remarks	

5. Neutral Grounding Transformer

No. of Units	1 (cabinet, wall mount)
Description	36"x36"x16" cabinet with heat dissipating resistor mounted on top
Weight and Dimensions	30"W x 12"D x 60"H
Manufacturer	OS Engineering
Model or Type	N/A
Remarks	Mount using Unistrut channel next to generator and brace accordingly.

6. Intake Remote Control Panel

No. of Units	1
Description	Intake equipment control panel PLC, remote to master unit PLC in powerhouse.
Weight and Dimensions	30"W x 12"D x 60"H
Manufacturer	
Model or Type	N/A
Remarks	Wall mounted in Intake Building. Provide all interconnecting wiring and fiber optic patch cables. Reuse existing fiber between powerhouse and intake building.

7. HPU

No. of Units	1 Assembly
Description	Hydraulic Power Unit
Weight and Dimensions	TBD lbs., 20"W x 24"D x 84"H
Manufacturer	
Model or Type	
Remarks	Install in powerhouse. Provide all interconnecting wiring.

8. LPU

No. of Units	1 Assembly
Description	Lube Oil Hydraulic Power Unit
Weight and Dimensions	TBD lbs., 20"W x 24"D x 84"H
Manufacturer	
Model or Type	
Remarks	Install in powerhouse. Provide all interconnecting wiring.

9. Flow Meter

No. of Units	1 – High Pressure Flange Mount
Description	20" Krohne Optiflux 2000 IP68 with remote mount for IFC 300W transmitter (mount in powerhouse)
Weight and Dimensions	
Manufacturer	Krohne
Model or Type	Magnetic Flow Meter
Remarks	Provide all interconnecting wiring.

10. Fiber Optic Cable Spool – Armored

No. of Units	1-5000ft Spool
Description	Armored Fiber Optic Cable, 12-strands, SM

Weight and Dimensions	
Manufacturer	
Model or Type	
Remarks	

11. TIV Pressure Sensors

No. of Units	2
Description	
Weight and Dimensions	
Manufacturer	
Model or Type	
Remarks	Provide all interconnecting wiring.

12. Powerhouse Bypass Valve motor operator (V-202)

No. of Units	1
Description	Electric motor operator (quarter turn) 480 v 3 phase
Weight and Dimensions	TBD
Manufacturer	AUMA
Model or Type	SAR 10.2
Remarks	Provide all interconnecting wiring.

13. Turbine

No. of Units	1
Description	Pelton 2-jet Turbine with servos for needle valves and deflectors and associated instrumentation
Weight and Dimensions	TBD
Manufacturer	Gilkes
Model or Type	
Remarks	Provide all interconnecting wiring.

14. Generator

No. of Units	1
Description	Synchronous generator salient pole with brushless excitation and flywheel with associated instrumentation
Weight and Dimensions	TBD
Manufacturer	Marelli
Model or Type	
Remarks	Provide all interconnecting wiring.

PART 3 -- EXECUTION

3.1 INSTALLATION REQUIREMENTS

- A. Receive and inspect all Owner supplied equipment and materials. Notify Owner immediately of any equipment which has been damaged or is in poor condition. Test equipment as soon as possible to verify condition.
- B. Fully assemble, adjust, and install in strict accordance with the engineering drawings, reference drawings, manufacturers' instruction, and approved shop drawings.
- C. Provide equipment foundations and steel support structures properly designed for the OWNER-furnished equipment, as required.
- D. Check tightness of all equipment terminal power and control connections.
- E. Check contact alignments and movement of circuit breakers and disconnect switches.
- F. Check operation of space heater and auxiliary circuits.
- G. Megger circuits to determine that no accidental grounds occurred during shipment and installation.
- H. Check continuity of ground connections to ground grid.
- I. Measure and record fiber optic transmission loss from the powerhouse to the intake building.
- J. Verify phasing and polarity of three-phase circuits from source to end and make corrections as needed.
- K. Verify polarity of DC control circuits from source to end and make corrections as needed.
- L. Wipe insulators clean with soft, dry cloth so that all traces of foreign matter are removed. Do not use abrasive material on insulators.
- M. Touch up damaged areas with paint approved by OWNER.
- N. Conduct field operational test in accordance with Section 26 01 26, with assistance from the Manufacturer's Field Representative.
- O. Attach ground connections per equipment requirement.

3.2 WIRING REQUIREMENTS

- A. Provide all wires, cables, and conduits for OWNER-furnished equipment.
- B. Cooperate with equipment suppliers for field checking, scheduling, troubleshooting, adjustments and testing of all OWNER-furnished equipment.

- END OF SECTION -

SECTION 26 05 19 – CABLE AND CONDUCTORS

PART 1 -- GENERAL

1.1 REFERENCES

The following is a list of standards which may be referenced in this section:

1. American National Standards Institute (ANSI): 386, Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V
2. American Society for Testing and Materials (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. B263, Standard Test Method for Determination of Cross-Sectional Area of Stranded Conductors.
3. Association of Edison Illuminating Companies (AEIC):
 - a. CS 5, Crosslinked Polyethylene Insulated Shielded Power Cables Rated 5 Through 35 kV.
 - b. CS 6, Ethylene-Propylene-Rubber-Insulated Shielded Power Cables Rated 5 Through 69 kV.
 - c. CS 8, Specification for Extruded Dielectric Shielded Power Cables Rated 5 through 46 kV.
4. Insulated Cable Engineer's Association, Inc. (ICEA):
 - a. S-68-516, Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
 - b. S-73-532, Standard for Control, Thermocouple Extension, and Instrumentation Cables.
 - c. S-95-658, Standard for Non-shielded Power Cables Rated 2,000 Volts or Less for the Distribution of Electrical Energy.
 - d. S-97-682, Standard for Utility Shielded Power Cables Rated 5,000 – 46,000 Volts.
 - e. T-29-520, Procedure for Conducting Vertical Cable Tray Flame Test with a Theoretical Heat Input of 210,000 Btu/hour.

- f. T-31-610, Guide for Conducting a Sealed Water Penetration Resistance Test for Sealed Conductor.
5. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
- a. 48, Standard Test Procedures and Requirements for Alternating-Current Cable Terminations.
 - b. 404, Standard for Cable Joints for Use with Extruded Dielectric Cable Rated 5,000V through 138,000V and Cable Joints for Use with Laminated Dielectric Cable Rated 2,500V through 500,000V.
6. National Electrical Manufacturers' Association (NEMA):
- a. CC 1, Electric Power Connectors for Substations.
 - b. WC 3, Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
 - c. WC 5, Thermoplastic Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
 - d. WC 7, Crosslinked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
 - e. WC 8, Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
 - f. WC26, Wire and Cable Packaging.
 - g. WC 55, Instrumentation Cables and Thermocouple Wire.
7. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
8. Underwriters Laboratories, Inc. (UL):
- a. 13, Standard for Safety Power-Limited Circuit Cables.
 - b. 44, Standard for Safety Thermoset-Insulated Wires and Cables.
 - c. 486A, Standard for Safety; Wire Connectors and Soldering Lugs for Use with Copper Conductors.
 - d. 510, Standard for Safety Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape.
 - e. 910, Standard for Safety Test Method for Flame Propagation and Smoke Density Values for Electrical and Optical-Fiber Cables Used in Spaces Transporting Environmental Air.
 - f. 1072, Standard for Safety Medium-Voltage Power Cables.
 - g. 1277, Standard for Safety Electrical Power and Control Tray Cables with Optional Optical-Fiber Members.

- h. 1581, Standard for Safety Reference Standard for Electrical Wires, Cables, and Flexible Cords.

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00:

A. Shop Drawings:

- 1. Wire and cable descriptive product information.
- 2. Wire and cable accessories descriptive product information.

1.3 UL COMPLIANCE

- A. Materials manufactured within scope of Underwriters Laboratories shall conform to UL Standards and have an applied UL listing mark.

PART 2 -- PRODUCTS

2.1 CONDUCTORS 600 VOLTS AND BELOW

A. Conductor Type and Insulation:

Size	Strands	Conductor Insulation
12	1	XHHW
10	1	XHHW
4	19	XLPE
1/0	19	XLPE
2/0	19	XLPE
4/0	19	XLPE
350	37	XLPE
500	37	XLPE

B. Conductor Applications:

- 1. 120- and 277-Volt Lighting, No. 10 AWG and Smaller: Solid copper.
- 2. 120-Volt Receptacle Circuits, No. 10 AWG and Smaller: Solid copper.
- 3. All Other Circuits: Stranded copper.

C. Service Environment and Operating Requirements:

- 1. The cable shall be suitable for aerial, direct burial and conduit installations in wet and dry locations.

2. The cable be designed and constructed such that it will operate satisfactorily under maximum conductor temperature as follows:

Normal Service	90°C
Emergency Overhead	130°C
Short Circuit	250°C

D. Insulation

1. XLPE conductors shall be covered with a layer of thermoset cross-linked polyethylene insulating material in accordance with ANSI/ICEA S-105-692, Part 3.
2. THHN conductors shall be covered with a thermoplastic high heat resistant insulating material in accordance with NEC Article 3-10.
3. The minimum thickness of the insulation for each conductor shall not be less than the value specified in WC-5, Part 3.

2.2 5 KV, 1/C ETHYLENE PROPYLENE RUBBER (EPR) INSULATED, SHIELDED CABLE

- A. Single conductors shall be copper unless noted on the Drawing and shall be EPR Class III Construction, nominal operation 105 degrees C.
- B. Cable shall meet the requirements of the following industry standards: ICEA S-94-649-2004 – Standard for Concentric, Neutral Cables Rated 5,000–46,000 Volts
- C. NEMA WC 26-2008 (EEMAC 201-2008) – Binational Wire and Cable Packaging Standard
- D. Conductor: Copper, concentric-lay, class B, compressed, soft drawn, annealed prior to stranding, meeting ASTM B3, B8, B49, and ICEA S-97-682, Section 2.2
 - a. 350 kcmil: diameter nominal 0.661 in, 37 strand.
 - b. #6 AWG: diameter nominal 0.178 in, 7 strand.
- E. Extruded Insulation Shield, minimum 24 mil and maximum 60 mil.
- F. Shield, per ICEA S-97-682, Part 3 for tape metallic shield.
- G. Terminations: Cable terminations shall use 3M Cold Shrink QT-II kit 7620-T series, rated 5kV, and minimum BIL 95 kV, for single conductor tape shield conductor.
- H. Service Environment and Operating Requirements:
 1. The cable shall be suitable for aerial, direct burial and conduit installations in wet and dry locations.
 2. The cable be designed and constructed such that it will operate and installed satisfactorily under the temperatures as follows:

Maximum Normal Service	105°C
Emergency Overload	130°C
Short Circuit	250°C
Minimum Installation Temperature	-40°C

I. Conductor Applications

1. Switchgear to switchyard connection, 350 kcml, 5 kV, shielded, single conductor.
2. Station service transformer to switchgear, #6 AWG, 5 kV shielded, single conductor.
3. Switchgear to generator, three conductor, 5 kV, 350 kcml, armored. See below

J. Approved Manufacturers

- a. Southwire
- b. Approved alternative manufacturer.

2.3 THREE-CONDUCTOR, 5 KV, COPPER, ARMOR CABLE

A. Cable used from connecting the generator stator leads to the switchgear shall be a 3/C CU 5KV 115 NL-EPR 133% TS AIA PVC MV-105, Type MV-105, Three Conductor Copper, 115 Mils No Lead Ethylene Propylene Rubber (NL-EPR) 133% Insulation Level, Tape Shield, Aluminum Interlocked Armor (AIA), Polyvinyl Chloride (PVC) Jacket.

B. The cable supplied shall meet the following:

- a. Conductor: Class B compressed stranded bare copper per ASTM B3 and ASTM B8.
- b. Conductor Shield: Semi-conducting cross-linked copolymer.
- c. Insulation: 115 Mils No Lead Ethylene Propylene Rubber (NL-EPR) 133% Insulation Level.
- d. Insulation Shield: Stripable semi-conducting cross-linked copolymer.
- e. Copper Tape Shield: Helically wrapped 5 mil copper tape with 25% overlap.
- f. Grounding Conductor: 1 Class B compressed stranded bare copper ground per ASTM B3 and ASTM B8.
- g. Filler: Wax paper filler.
- h. Binder: Polypropylene tape.
- i. Armor: Aluminum Interlocked Armor (AIA).
- j. Overall Jacket: Polyvinyl Chloride (PVC).

C. Terminations: Cable terminations shall use 3M Cold Shrink QT-III kit 7600-T-3G series, rated 5kV, and minimum BIL 95 kV, for three-conductor tape shield cable.

D. Approved manufacturers:

- a. Southwire;
- b. Approved alternate manufacturer.

2.4 600-VOLT RATED MULTI-CONDUCTOR CABLE

E. General Purpose multi-conductor Cable shall be rated for 600 Volts and as follows:

Conductors	Size	Conductor Insulation
4/C	12	XLPE or EPR
7/C	12	XLPE or EPR
12/C	12	XLPE or EPR
4/C	10	XLPE or EPR
7/C	10	XLPE or EPR
12/C	10	XLPE or EPR

F. Jacket: Multi-conductor cables shall be wrapped with a separator tape and covered with a thermoplastic chlorinated polyethylene jacket (CPE).

G. Stranding: Class B or Class C concentric stranded, soft or annealed tinned copper in accordance with ASTM B-8 and B-33.

H. Insulation: XLPE or EPR and shall meet the flame test requirements of ICEA S-95-658.

I. Color Coding:

J. The cable shall be suitable for indoor and outdoor use in wet or dry locations in conduit, cable trays, cable trench and direct burial.

2.4 LOW VOLTAGE INSTRUMENTATION CABLE

A. General:

1. Type PLTC, 300-Volt rated, meeting requirements of UL 13, UL Listed Power Limited Circuit Cable 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. Minimum Temperature Rating: 105 degrees C.
4. Passes vertical tray flame test.
5. Outer Jacket: PVC, flame-retardant, sunlight- and oil-resistant.
6. Instrumentation cable rated at 300 V shall not be routed in the same raceway with higher voltage circuits.

B. Twisted, Shielded Pair Instrumentation Cable: Single pair, designed for noise rejection for process control, computer, or data log applications meeting NEMA WC 55.

1. Size: No. 18 AWG.

2. Outer Jacket: 35-mil nominal.
 3. Individual Pair Shield: 1.35-mil, double-faced aluminum/synthetic polymer, overlapped to provide 100 percent coverage.
 4. Conductors:
 - a. Bare soft annealed copper, Class B, seven-strand concentric, ASTM B8.
 - b. Tinned copper drain wire.
 - c. Insulation: PVC
 - d. Color Code: Pair conductors black and white.
- C. Fire Alarm Cable: Shielded power limited fire protective signaling circuit cable meeting requirements of NFPA 70, Article 760 power limited circuits:
1. Cable: Pass UL 70,000 Btu flame test and listed by California State Fire Marshall.
 2. Outer jacket: Red in color, identified along its entire length as fire protective signaling circuit cable.
 3. Conductors:
 - a. Solid, tinned, or bare copper.
 - b. Insulation: 15 mil PVC.

2.5 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.

B. Identification Devices:

1. Wire labels shall be sliptube over the lug.
2. Sleeve: Permanent, PVC, yellow or white, with legible machine-printed black markings.
3. 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.
- 4. Marker Plate: Nylon, with legible designations permanently hot stamped on plate.
- 5. Tie-On Cable Marker Tags:
 - a. Chemical resistant white tag.
- 6. Grounding Conductor: Permanent green heat-shrink sleeve, 2-inch minimum.

C. Connectors and Terminations:

- 1. Nylon, Self-Insulated Crimp Connectors.
- 2. Nylon, Self-Insulated, Crimp Locking-Fork, Torque-Type Terminator.
- 3. 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.

D. Cable Lugs:

- 1. In accordance with NEMA CC 1
- 2. Rated 600 volts of same material as conductor metal.
- 3. Insulated, Locking-Fork, Compression Lugs:
 - a. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
 - b. Seamless.
- 4. Uninsulated Crimp Connectors and Terminators:
 - a. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.

2.6 ACCESSORIES FOR CONDUCTORS ABOVE 600 VOLTS

A. Molded Splice Kits (used only when approved by Owner):

- 1. Components necessary to provide insulation, metallic shielding and grounding systems, and overall jacket.
- 2. Capable of making splices that have a current rating equal to, or greater than the cable ampacity, conforming to IEEE 404.
- 3. 25 kV class, with compression connector, EPDM molded semiconductive insert, peroxide-cured EPDM insulation, and EPDM molded semiconductive outer shield.

4. Premolded splice shall be re-jacketed with a heat shrinkable adhesive-lined sleeve to provide a waterproof seal.

B. Bus/Terminal Connection Insulation:

1. Raychem HVBT High Voltage Busbar Insulation heat shrink Tape, or approved equal, shall be used as adhesive-coating tape to provide insulation enhancement and protection against accidentally induced flashovers for all medium voltage bolted or exposed current carrying metal. Tape used shall be 2" wide, 1/2 overwrap.
2. Tape and sheet products to have coating to prevent adhesion to metal surfaces.
3. Insulating materials to be removable or cut off without leaving a residue..

C. Cable Lugs:

1. In accordance with NEMA CC1.
2. Rated of same material, or compatible with, as the conductor metal.
3. Fastener hardware for all terminations greater than 600 VAC to use non-magnetic stainless-steel material, employing a bolt, flat washer, Belleville washer, and nut sized to fit the lug and spade holes. Provide all fasteners as required.

2.7 PULLING COMPOUND

- A. Nontoxic, noncorrosive, noncombustible, nonflammable, wax-based lubricant; UL listed.
- B. Suitable for rubber, neoprene, PVC, polyethylene, hypalon, CPE, and lead-covered wire and cable.
- C. Suitable for zinc-coated steel, aluminum, PVC, bituminized fiber, and fiberglass raceways.

PART 3 -- EXECUTION

3.1 GENERAL

- A. Conductor storage, handling, and 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 all conductors and cables, unless otherwise indicated.
- E. Tighten screws and terminal bolts in accordance with UL 486A for copper conductors.

- F. Cable Lugs: Provide with correct number of holes, bolt size, and center-to-center spacing sized for the conductor, 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 18 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, all 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 AC and DC cables 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.

3.2 POWER CONDUCTOR COLOR CODING

- A. Conductors 600 Volts and Below:
 - 1. No. 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 an area 1-1/2 to 2 inches wide.
 - 2. No. 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

System	Conductor	Color
208Y/120 Volts Three-Phase, Four-Wire	Grounded Neutral Phase A Phase B Phase C	White Black Red 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 an identifiable colored strip, other than green, in accordance with NFPA 70.
- B. Conductors Above 600 Volts: Apply general purpose, flame retardant tape at each end, and at accessible locations wrapped at least six full overlapping turns, covering an area 1.5 to 2-inches wide.
1. Colors:
 - a. Grounded Neutral: White.
 - b. Phase A: Brown.
 - c. Phase B: Orange.
 - d. Phase C: Yellow.

3.3 CIRCUIT IDENTIFICATION

- A. Circuits Appearing in Circuit Schedule: Identify power, instrumentation, and control conductor circuits, using circuit schedule designations, at each termination and in accessible locations such as manholes, handholes, panels, switchboards, motor control centers, pull boxes, and terminal boxes.
- B. 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.
 3. Submit proposed circuit names for OWNER approval.
- C. Method:
1. Conductors No. 3 AWG and Smaller: Identify with sleeves or heat bond markers.
 2. Cables and Conductors No. 2 AWG and Larger:

- a. Identify with marker plates; or
 - b. Tie-on cable marker tags
 - c. Attach with nylon tie cord
3. Taped-on markers or tags relying on adhesives not permitted

3.4 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 No. 6 AWG and larger.
- C. Connections and Terminations:
 1. Install wire nuts only on solid 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 No. 12 AWG and smaller.
 4. Install uninsulated crimp connectors and terminators for instrumentation, control, and power circuit conductors No. 4 AWG through No. 2/0 AWG.
 5. Install uninsulated, bolted, two-way connectors and terminators for power circuit conductors No. 3/0 AWG and larger.
 6. Install uninsulated terminators bolted together on motor circuit conductors No. 10 AWG and larger.
 7. Tape insulate all uninsulated connections.
 8. Place no more than one conductor in any single-barrel pressure connection.
 9. Install crimp connectors with tools approved by connector manufacturer.
 10. Install terminals and connectors acceptable for type of material used.
 11. Compression Lugs:
 - a. Attach with a tool specifically designed for purpose.
 - b. Tool shall provide complete, controlled crimp and shall not release until crimp is complete.
 - c. Do not use plier type crimpers.

D. Do not use soldered mechanical joints.

E. Splices and Terminations:

1. Indoors: Use general purpose, flame retardant tape.
2. Outdoors: Use flame retardant, cold- and weather-resistant tape.
3. Cap spare conductors and conductors with UL listed end caps.

F. 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.

G. Control and Instrumentation Wiring:

1. Where terminals provided will accept such lugs, terminate control and instrumentation wiring, except solid thermocouple leads, with insulated, locking-ring 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. Cable Protection:
 - a. Under Infinite Access Floors: May be installed without bundling.
 - b. All Other Areas: Install individual wires, pairs, or triads in flex conduit under the 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 the shield.

H. 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.

3.5 CONDUCTORS ABOVE 600 VOLTS

A. Do not splice unless specifically indicated or approved by the OWNER.

B. Make joints and terminations with splice and termination kits, in accordance with kit manufacturer's instructions.

- C. Install splices or terminations as continuous operation in accessible vault or locations under clean, dry conditions. Work shall be performed by technician qualified by training on medium voltage cable installation.
- D. Single Conductor Cable Terminations: Provide heat shrinkable stress control and outer nontracking insulation tubings, high relative permittivity stress relief mastic for insulation shield cutback treatment, and a heat-activated sealant for environmental sealing , plus a ground braid and clamp.
- E. Install terminals or connectors acceptable for type of conductor material used.
- F. Provide outdoor rain skirts for all riser pole and outdoor switchgear terminations.
- G. Provide shield termination and grounding for all terminations.
- H. Provide necessary mounting hardware, covers, and connectors.
- I. Where elbow connectors are specified, install in accordance with manufacturer's instructions.
- J. Connections and Terminations:
 - 1. Install uninsulated crimp connectors and terminators for instrumentation, control, and power circuit conductors No. 4 AWG through No. 2/0 AWG.
 - 2. Install uninsulated, bolted, two-way connectors and terminators for power circuit conductors No. 4/0 AWG and larger.
 - 3. Install uninsulated, bolted, two-way connectors for motor circuit conductors No. 12 and larger.
 - 4. Insulate bus connections with heat shrinking tubing, tape, and sheets.

- END OF SECTION -

SECTION 26 05 26 – GROUNDING

PART 1 -- GENERAL

1.1 SECTION INCLUDES

- A. Requirements for Equipment Grounding.
- B. Requirements for Ground Grid.

1.2 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. B2, Medium Hard Drawn Copper Wire
 - 2. B3, Soft or Annealed Copper Wire
 - 3. B8, Concentric-Lay-Stranded Copper Conductors, Hard, Medium Hard, or Soft
 - 4. B33
- B. American National Standards Institute (ANSI): C2, National Electrical Safety Code (NEC).
- C. National Electrical Code (NEC), current revision as of contract date.
- D. IEEE Standard 80 Guide for Safety in AC Substation Grounding.
- E. IEEE Standard 81 Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potential of a Ground System.
- F. IEEE Standard 665-1995 Guide for Generating Station Grounding.

1.3 GROUNDING SYSTEM DESIGN

- A. Powerhouse grounding will be reused and enhanced as indicated on the drawings. Primarily, grounding will be extended as necessary to ground equipment. Station service power grounded shall be per NEC.

1.4 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00:

- A. Shop Drawings:
 - 1. Product Data:
 - a. Exothermic weld connectors.
 - b. Mechanical connectors.

- c. Compression connectors.
 - d. Ground enhancement material.
2. Grounding system layout showing ground cable routing and interconnections to ground rods.
- B. Ground resistance measurements and report.

PART 2 -- PRODUCTS

2.1 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 Volts unless otherwise required by applicable Code.

- B. Bare Copper Conductors:

Solid Conductors: ASTM B 3.

Stranded Conductors: ASTM B 8.

Tinned Conductors: ASTM B 33.

Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.

Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.

Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

- C. Bare Grounding Conductor and Conductor Protector for Wood Poles:

1. No. 4 AWG minimum, soft-drawn copper.

2. Conductor Protector: Half-round PVC or wood molding; if wood, use pressure-treated fir, cypress, or cedar.

- D. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

- E. Ground Cable: Soft drawn bare stranded copper cable, No. 4/0 AWG minimum.

2.2 GROUND ROD

- A. Copper-clad steel, 5/8-inch in diameter, 10 ft. minimum.

2.3 CONNECTORS

- A. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, pressure type with at least two bolts. Clamp type sized for pipe.
- B. Welded Connectors: Exothermic welding kits of types recommended by kit manufacturer for materials being joined and installation conditions:
 - 1. Outdoor Weld: Suitable for exposure to elements or direct burial.
 - 2. Indoor Weld: Utilize low-smoke, low-emission process.
 - 3. Manufacturers:
 - a. Erico Products, Inc.
 - b. Thermoweld.
- C. Compression Type:
 - 1. Compress-deforming type connectors shall not be used in grounding applications.

2.4 GROUND PLATE

- A. Provide insulated grounding bar, TMGB Pattern Busbar, 4"W x 0.25"H x 20"L, Copper, Chatsworth P/N 40153-020 or equal.
- B. Locate the ground plate above switchgear on west interior powerhouse wall. Bond plate two switchgear ground bus with two 4/0 conductors.
- C. Dedicated ground conductors from electrical power equipment, including generator, switchyard, station service transformer, grounding transformer, to be bonded to insulated ground plate. Bond cable tray and other electrical bus and enclosures to ground plate per NEC.

2.5 GROUND ENHANCEMENT MATERIAL

- D. No grounding enhancement material will be required.

PART 3 -- EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare copper conductor, No. 4/0 AWG minimum.
 - 1. Bury at least 18 inches below grade, unless otherwise shown on the Drawing.

Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.

- C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- D. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Install bus on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.
 - 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down to specified height above floor; connect to horizontal bus.
- E. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
 - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 - 4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING UNDERGROUND SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.
- C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.
- D. Pad-Mounted Transformers: Install two ground rods and ground ring around the pad where indicated. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding

electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than **6 inches** from the foundation.

3.3 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 - 1. Feeders and branch circuits.
 - 2. Lighting circuits.
 - 3. Receptacle circuits.
 - 4. Single-phase motor and appliance branch circuits.
 - 5. Three-phase motor and appliance branch circuits.
 - 6. Flexible raceway runs.
 - 7. Armored and metal-clad cable runs.
 - 8. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.
- B. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

3.4 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.
- C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.

2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

D. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

E. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

F. Grounding for Steel Building Structure: Install as shown.

3.5 CONNECTIONS

A. General:

1. Above grade Connections: Install exothermic weld, mechanical, or compression-type connectors; or brazing.
2. Below grade Connections: Exothermic weld.
3. Remove paint, dirt, or other surface coverings at connection points to allow good metal-to-metal contact.

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 instruction.

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.

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.

3.7 DEADFRONT ENCLOSURE (DOGHOUSE)

- A. Install in accordance with OWNER standard.
- B. Ground Rod Floor Protrusion: 4 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 No. 6 AWG copper conductor.

3.6 GROUND RESISTANCE MEASUREMENTS

A. Tests and Inspections:

1. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
2. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
3. Perform tests by fall-of-potential method according to IEEE-81.

- B. Prepare test and inspection reports. Report shall include photos of the test setup, equipment calibration stickers, and location and arrangement of the probes and test equipment.

- END OF SECTION -

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SECTION 26 05 40 – SWITCHYARD CONSTRUCTION

PART 1 -- GENERAL

1.1 SECTION INCLUDES

- A. Removing existing doghouses, foundations, cabling, and conduit as outlined on the engineering plans.
- B. Installing Owner supplied 25kV vacuum switch and control box.
- C. Complete modification of 25kV, 2" aluminum bus as indicated on the earlier prepared engineering design reference drawings (D Hittle and Associates).
- D. Modify/extend conduits as indicated on the engineering plans.
- E. Provide additional grounding as indicated on the engineering plans
- F. Remove and replace switchyard surface rock.

1.2 REFERENCES

- A. RUS Bulletin 1724E-300 – Design Guide for Rural Substations (2001)
- B. IEEE Standard 605-2008: IEEE Guide for Bus Design in Air Insulated Substations.
- C. American National Standards Institute (ANSI): C2, National Electrical Safety Code (NESC).
- D. National Electrical Code (NEC), current revision as of contract date.
- E. IEEE Standard 80 Guide for Safety in AC Substation Grounding.
- F. IEEE Standard 81 Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potential of a Ground System.
- G. IEEE Standard 665-1995 Guide for Generating Station Grounding.

1.3 GROUNDING SYSTEM DESIGN

- A. Powerhouse grounding will be reused and enhanced as indicated on the drawings. Primarily, grounding will be extended as necessary to ground equipment. Station service power grounded shall be per NEC.

1.4 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00:

- A. Material Product Data:

1. Exothermic weld connectors catalog cut sheets and part number.
2. Mechanical connectors catalog cut sheets and part number.
3. Compression connectors catalog cut sheets and part number.
4. Bus insulator supports catalog cut sheets and part number.
5. Medium voltage cable terminations cut sheets, part number, and installation instructions.
6. Sample switchyard surface rock and data sheets.
7. Aluminum bus, 2", specifications and manufacturer.
8. Grounding conductor, rods, and connector manufacturer information.
9. Fasteners manufacturer information.

B. Ground resistance measurements and report

PART 2 -- PRODUCTS

2.1 ALUMINUM BUS AND MISCELLANEOUS MATERIAL

- A. Owner will supply 2" aluminum bus in a quantity which may be sufficient to complete installation as indicated on the reference bus drawings. Owner supplied aluminum bus is located at the switchyard and to be quantified during bidding stage. Contractor to verify quantity and condition of the bus during bidding. Contractor to supplement or replace as needed.
- B. Bus material to be schedule 40, 2", aluminum 6061-T6.
- C. Connectors to be as listed on the earlier prepared engineering design reference drawings
- D. Provide all other material necessary to complete the bus modifications.

2.2 BUS INSULATOR SUPPORTS

- A. Surface rock to be obtained locally.
- B. Approved Manufacturers:
 - a. Gamma Insulators
 - b. Lapp Insulators
 - c. Locke Insulators
 - d. Newell Porcelain Company
 - e. PPC Insulators (Seves)
 - f. Victor Insulators, Inc.

2.3 SWITCHYARD SURFACE ROCK

- A. Switchyard surface material shall consist of 3" Thomas Bay, 1" fractured, no fines, washed river rock from Rock and Road Construction, with contact number 907-772-3308.
- B. Substitute material would be acceptable provided it is very similar to that specified above. Sample rock. One cubic foot worth, of any substitute material must be submitted for review and approval.

2.4 FASTENERS

- A. Switchyard fasteners used for electrical bus, cable termination, or support shall be stainless steel.

PART 3 -- EXECUTION

3.1 OWNER SUPPLIED ITEMS

- A. Receive and verify operating condition of 25kV vacuum switch. See switch manufacturer drawings provided as reference. Notify Owner immediately if switch is damaged or in some manner not functional.
- B. Receive six surge arresters to be installed with the vacuum switch per the manufacturer drawings. Notify Owner immediately if material is damaged or unusable.
- C. Receive and verify condition of 2" aluminum bus material. Notify Owner immediately if material is damaged or unusable.

3.2 VACUUM SWITCH INSTALLATION

- A. Install vacuum switch and control box as indicated on the D Hittle and Associates reference drawings.
- B. Provide conduit and cabling as indicated.
- C. Wire controls to switchgear in powerhouse and test.

3.3 RISER, 2.4kV, TERMINATION

- A. See cable schedule and Section 26 05 19 for MV cable requirements.
- B. Pull 5 kV, shielded cable from switchyard to powerhouse switchgear.
- C. Terminate 5-kV cable with MV cold shrink terminations.
- D. Connect terminate cable to aluminum bus terminals as indicated.
- E. Ground terminations and shield of cable terminations as instructed by termination manufacturer's installation instructions.

F. Hi-pot cable and termination by applying 5kVDC voltage for one minute.

3.4 SWITCHYARD RESURFACE.

- A. Upon completion of all underground work, including conduit, cabling, and grounding, remove all remaining switchyard surface rock down to native soil. Grade surface to be level.
- D. From fence to three feet outside the north and east switchyard fencing, remove all vegetation and rock. Level this area to maintain a level or gentle grade outside the fenced area.
- E. Install 3" of approved clean surface rock throughout the interior switchyard, up to the fence.
- F. Apply 3" of clean surface rock three feet outside the north and east fence.
- G. Outside the west and south fence area, remove all vegetation three feet from the fence. No rock require in this area.
- H. No herbicide shall be applied or used in the switchyard.

- END OF SECTION -

SECTION 26 05 43 – ELECTRICAL RACEWAYS SYSTEMS

PART 1 -- GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American National Standards Institute (ANSI):
 - a. C80.1, Rigid Steel Conduit-Zinc Coated
 - b. C80.3, Electrical Metallic Tubing-Zinc Coated
 - c. C80.6, Intermediate Metal Conduit (IMC)-Zinc Coated
2. National Electrical CONTRACTOR's Association, Inc. (NECA): 5055, Standard of Installation.
3. National Electrical Manufacturers Association (NEMA):
 - a. RN 1, Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
 - b. TC 2, Electrical Polyvinyl Chloride Plastic Tubing (PVC) and Conduit.
 - c. TC 3, PVC Fittings for Use with Rigid PVC Conduit and Tubing.
 - d. TC 6, PVC and ABS Plastic Utilities Duct for Underground Installation.
 - e. VE 1, Metallic Cable Tray Systems.
4. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
5. Underwriters Laboratories, Inc. (UL):
 - a. 1, Standard for Safety Flexible Metal Conduit
 - b. 6, Standard for Safety Rigid Metal Conduit
 - c. 360, Standard for Safety Liquid-Tight Flexible Steel Conduit
 - d. 514B, Standard for Safety Fittings for Cable and Conduit
 - e. 514C, Standard for Safety Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
 - f. 651, Standard for Safety Schedule 40 and 80 Rigid PVC Conduit
 - g. 651A, Standard for Safety Type EB and A Rigid PVC Conduit and HDPE Conduit

- h. 797, Standard for Safety Electrical Metallic Tubing
- i. 870, Standard for Safety Wireways, Auxiliary Gutters, and Associated Fittings
- j. 1660, Standard for Safety Liquid-Tight Flexible Nonmetallic Conduit
- k. 2024, Standard for Safety for Optical Fiber and Communication Cable Raceway

1.2 SUBMITTALS

The following shall be submitted in accordance with SECTION 01 33 00:

A. Shop Drawings:

1. Manufacturer's Literature:

- a. Conduits and cable trays of all types to be used
- b. Junction and pull boxes
- c. Terminal junction boxes
- d. Fittings and wiring hardware
- e. Underground vaults

2. Cable Tray System (see minimum bill of material list on plans):

- a. Dimensional drawings, installation details, and descriptive information
- b. Calculation of design load per NEMA load/span designation
- c. Layout drawings and list of accessories being provided

3. Conduit and Vault Layouts:

- a. Plans and sections showing arrangement and location of conduits
- b. Plans and sections showing vault installation and locations

1.3 UL COMPLIANCE

- A. Materials manufactured within scope of Underwriters Laboratories shall conform to UL Standards and have an applied UL listing mark.

PART 2 -- PRODUCTS

2.1 CONDUIT AND TUBING

- A. Rigid Galvanized Steel Conduit (RGS):

1. Hot-dip galvanized and chromated protective layer.
2. Meet requirements of NEMA C80.1 and UL 6.
3. Used for all exposed applications, unless otherwise stated on the engineering plans.

B. PVC Schedules 40 and 80 Conduit:

1. UL-listed for concrete encasement, underground direct burial, concealed or direct sunlight exposure, and 90°C insulated conductors.
2. Meet requirements of NEMA TC 2 and UL 631.
3. Schedule 40 used in embedded applications and schedule 80 for direct buried, unless otherwise indicated on the plans.

C. Flexible Metal, Liquid-Tight Conduit:

1. UL 360 listed for 105 degrees C insulated conductors.
2. Material: Galvanized steel, with an extruded PVC jacket.
3. Use in applications where motor vibration requires flexibility, and only for lengths of 8 feet or less.

D. Flexible, Nonmetallic, Liquid-tight Conduit:

1. Material: PVC core with fused flexible PVC jacket
2. UL 1660 listed for:
 - a. Dry Conditions: 80 degrees C insulated conductors.
 - b. Wet Conditions: 60 degrees C insulated conductors.
3. Use in applications where motor vibration requires flexibility, and only for lengths of 8 feet or less.

E. High Density Polyethylene Conduit

1. OWNER Material Standard No. 250027.2, "High Density Polyethylene Conduit"
2. May be used as substitute for PVC schedule 80 for direct buried applications.

2.2 FITTINGS

A. Rigid Galvanized Steel 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.
- 3. Grounding Bushing:
 - a. Material: Malleable iron with integral insulated throat rated for 150 degrees C, with solderless lugs.
- 4. Conduit Hub:
 - a. Material: Malleable iron with insulated throat with bonding screw.
 - b. UL listed for use in wet locations.
- 5. Conduit Bodies:
 - a. Sized as required by NFPA 70.
- 6. Couplings: As supplied by conduit manufacturer.
- 7. Unions:
 - a. Concrete tight, hot-dip galvanized, malleable iron
- 8. Cable Sealing Fittings:
 - a. To form watertight nonslip cord or cable connection to conduit.
 - b. For Conductors with OD of 1/2-inch or less: Neoprene bushing at connector entry.
- B. PVC Conduit and Tubing:
 - 1. Meet requirements of NEMA TC-3.
 - 2. Type: PVC, slip-on.
- C. 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.
- D. Flexible Metal, Nonliquid-Tight Conduit:
 - 1. Meet requirements of UL 514B.

2. Body: Galvanized: steel.
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.

E. Flexible, Nonmetallic, Liquid-tight Conduit:

1. Meet requirements of UL 514B.
2. Type: High strength plastic body, complete with lock nut, O-ring, threaded ferrule, sealing ring, and compression nut.
3. Body/compression nut (gland) design to assure high mechanical pullout strength and watertight seal.

F. Watertight Entrance Seal Device:

1. New Construction:
 - a. Material: Oversized sleeve, malleable iron body with sealing ring, pressure ring, grommet seal, and pressure clamp.
2. Cored-Hole Application:
 - a. Material: Assembled dual pressure disks, neoprene sealing ring, and membrane clamp.

2.3 CABLE TRAYS

- A. Meet requirements of NEMA VE 1.
- B. Type: Ladder, of welded construction.
- C. Material: Copper-free aluminum alloy 6063-T6 finish.
- D. Dimensions: 3-inch NEMA nominal inside fill depth and fittings. Width, rung spacing, and bending radius to suit application or as shown on the drawings.
- E. Fittings of same cross-sectional tray area, and hardware of same material as cable tray.
- F. Tray Grounding: Conform to NFPA 70 and NEMA VE 1.
- G. Provide next higher NEMA VE 1 class designation than required for support of designed span length.
- H. Design Loads: Use working load adequate for actual cables installed plus 20 percent additional weight allowance for future cables with safety factor of 1.5 in accordance with NEMA VE 1, Table 3-1. Submit calculations as required by PART 1.

- I. Expansion Joints: NEMA VE 1 for 50 degrees F maximum temperature variation.
- J. Furnish Cable Tray with no sharp edges, burrs, or weld projections.

EXECUTION

3.1 GENERAL

- A. Conduit and tubing sizes shall be based on the use of copper conductors. Conduits not specified in this section shall not be used. Conduits indicated on engineering plans shall be followed.
- B. Crushed or deformed raceways not permitted.
- C. Maintain raceway entirely free of obstructions and moisture.
- D. Immediately after installation, plug or cap raceway ends with watertight and dust-tight seals until time for pulling in conductors.
- E. Sealing Fittings: Provide drain seal in vertical raceways where condensate may collect above sealing fitting.
- F. Avoid moisture traps where possible. When unavoidable in exposed conduit runs, provide junction box and drain fitting at conduit low point.
- G. Group raceways installed in same area.
- H. Proximity to Heated Piping: Install raceways minimum 12 inches from parallel runs.
- I. Follow structural surface contours when installing exposed raceways. Avoid obstruction of passageways.
- J. Run exposed raceways parallel or perpendicular to walls, structural members, or intersections of vertical planes. Installation shall be plumb, square, and true.
- K. Block Walls: Do not install raceways in same horizontal course with reinforcing steel.
- L. Install watertight fittings in outdoor, underground, or wet locations.
- M. 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.
- N. Metal conduit to be reamed, burrs removed, and cleaned before installation of conductors, wires, or cables.
- O. Do not install raceways in concrete equipment pads, foundations, or beams.

- P. Horizontal raceways installed under floor slabs shall lie completely under slab, with no part embedded within slab.
- Q. Install concealed, embedded, and buried raceways so that they emerge at right angles to surface and have no curved portion exposed.
- R. Install conduits for fiber optic cables, telephone cables, and Category 5 data cables in strict conformance with the requirements of EIA/TIA 596-A.
- S. Conduit larger than 1-inch shall not be embedded in concrete slabs, walls, foundations, columns or beams, unless approved by OWNER.
- T. Conduits routed to the cable tray shall be attached to the powerhouse wall first before they are horizontally extended to the cable tray.

3.2 CONDUIT APPLICATION

- A. Diameter: Minimum 3/4 inch.
- B. Exterior, Exposed:
 - 1. Rigid galvanized steel (RGS).
 - 2. Motors and transformers: See "Connections".
- C. Interior, Exposed:
 - 1. Rigid galvanized steel.
 - 2. Motors and transformers: See "Connections".
- D. Interior, Concealed (Not Embedded in Concrete):
 - 1. Rigid galvanized steel.
- E. Above ground, Embedded in Concrete Walls, Ceilings, or Floors:
 - 1. Rigid galvanized steel.
- F. Direct Earth Burial:
 - 1. PVC schedule 80, for voltage below 600 V.
 - 2. Rigid galvanized steel, wrapped for corrosion protection, for voltage above 600 V.
- G. Concrete-Encased Raceways:
 - 1. Not required for this contract.

3.3 CONNECTIONS

- A. For motors, wall- or ceiling-mounted fans and unit heaters, dry type transformers, electrically operated valves, instrumentation, and other equipment 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.
 - 4. Dry Areas: Flexible, metallic liquid-tight.
 - 5. Length: 18-inch minimum, 60-inch maximum, sufficient to allow movement or adjustment of equipment.
- B. Outdoor Areas, Process Areas Exposed to Moisture, and Areas required to be oil-tight and dust-tight: Flexible metal, liquid-tight conduit.
- C. Transition From Underground or Concrete Embedded to Exposed: Rigid galvanized steel conduit wrapped six inches above and below surface with corrosion protection material.
- D. Under Equipment Mounting Pads: Rigid galvanized steel conduit.

3.4 PENETRATIONS

- A. Make at right angles, unless otherwise shown.
- B. Notching or penetration of structural members, including footings and beams, not permitted.
- C. Fire-Rated Walls, Floors, or Ceilings: Firestop openings around penetrations to maintain fire-resistance rating using fire penetration seal as approved by OWNER.
- D. Apply single layer of wraparound duct band to all metallic conduit protruding through concrete floor slabs to a point 2 inches above and 2 inches below concrete surface.
- E. Provide toe plates in front of conduits protruding through concrete floor to protect from accidental kicks or damages.
- F. Concrete Walls, Floors, or Ceilings (Aboveground): Provide nonshrink grout dry-pack, or use watertight seal device.
- G. Entering Structures:
 - 1. General: Seal raceway at the first box or outlet with oakum or expandable plastic compound to prevent the 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 the 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. Heating, Ventilating, and Air Conditioning Equipment:
- a. Penetrate equipment in area established by manufacturer.
 - b. Terminate conduit with flexible metal conduit at junction box or conduit attached to exterior surface of equipment prior to penetrating equipment.
 - c. Seal penetration with approved sealant.
4. Existing or Precast Wall (Underground): Core drill wall and install a watertight entrance seal device.
5. Nonwaterproofed Wall or Floor (Underground, without Concrete Encasement):
- a. Provide Schedule 40 pipe sleeve, or watertight entrance seal device.
 - b. Fill space between raceway and sleeve with expandable plastic compound or oakum and lead joint, on each side.
6. Vaults and Hand Holes:
- 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.

3.5 SUPPORT

- A. Support from structural members only, at intervals not exceeding NFPA 70 requirements, and in any case not exceeding 10 feet. Do not support from piping, pipe supports, or other raceways.
- B. Multiple Adjacent Raceways: Provide ceiling trapeze.

- C. Nails or wooden plugs inserted in concrete or masonry for attaching raceway not permitted. Do not weld raceways or pipe straps to steel structures. Do not use wire in lieu of straps or hangers.

3.6 BENDS

- A. Install concealed raceways with a minimum of bends in the shortest practical distance.
- B. Make bends and offsets of longest practical radius. Bending radius in conduits for fiber optic cables shall be not less than 20 times cable diameter or 15 inches, minimum, whichever is larger.
- 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-Degree 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.

3.7 EXPANSION / DEFLECTION FITTINGS

- A. Provide on all raceways at all 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.

3.8 PVC CONDUIT

- A. Solvent Welding:
 - 1. Provide manufacturer recommended solvent; apply to all joints.
 - 2. Install such 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 the unbelled end of the joint prior to joining.

3.9 CABLE TRAYS

- A. Install in accordance with Application Information Section of NEMA VE 1.
- B. Provide accessories as necessary for a complete system.
- C. Install such that joints are not made at support brackets.
- D. Install horizontal section support brackets between support point and quarter point of tray span.
- E. Provide wall support for all horizontal cable tray.
- F. Install support within 2 feet on each side of expansion joints and within 2 feet of fitting extremity.
- G. Provide expansion joints in accordance with NEMA VE 1 for 50 degrees F maximum temperature variation.
- H. Install horizontal tray level, plumb, straight, and true to line or grade within a tolerance of 1/8 inch in 10 feet and within a cumulative maximum of 1/2 inch.
- I. Install vertical tray plumb within a tolerance of 1/8 inch in 10 feet.
- J. Install without exposed raw edges.
- K. Maintain 12-inch vertical separation between multi-tiered trays having a common support, and at all crossover locations.
- L. Provide bonding jumper at each expansion joint and adjustable connection.
- M. Provide a divider to separate AC wiring and DC control and low signal wiring.
- N. Ground Conductor: Provide properly sized clamps for each section, elbow, tee, cross, and reducer.

3.10 CONDUIT TERMINATION AT ENCLOSURE

- A. Cast Metal Enclosure: Provide manufacturer's premolded insulating sleeve inside metallic conduit terminating in threaded hubs.
- B. Nonmetallic, Cabinets, and Enclosures: Terminate conduit in threaded conduit hubs, maintaining enclosure integrity.

C. Sheet Metal Boxes, Cabinets, Control Panels, and Enclosures:

1. Rigid Galvanized Conduit:

- a. Provide one lock nut each on inside and outside of enclosure.
- b. Install grounding bushing.
- c. Provide bonding jumper from grounding bushing to equipment ground bus or ground pad; if neither ground bus nor pad exists, connect jumper to lag bolt attached to metal enclosure.
- d. Install insulated bushing on ends of conduit where grounding is not required.
- e. Provide insulated throat when conduit terminates in sheet metal boxes having threaded hubs.
- f. Utilize sealing locknuts or threaded hubs on outside of NEMA 3R and NEMA 12 enclosures.
- g. Terminate conduits at threaded conduit hubs at NEMA 4 and 4X boxes and enclosures.

2. Flexible Metal Conduit: Provide two screw type, insulated, malleable iron connectors.

3. Flexible, Nonmetallic Conduit: Provide nonmetallic, liquid-tight strain relief connectors.

4. PVC-Coated Rigid Galvanized Steel Conduit: Provide PVC-coated, liquid-tight, metallic connector.

5. PVC Schedule 40 Conduit: Provide PVC terminal adapter with lock nut.

D. Motor Control Center, Switchboard, Switchgear, and Free-Standing Enclosures:

1. Terminate metal conduit entering bottom with grounding bushing; provide a grounding jumper extending to equipment ground bus or grounding pad.

2. Terminate PVC conduit entering bottom with bell end fittings.

3.11 CONDUIT IDENTIFICATION TAGS

A. Conduit Identification Tags:

1. Identify all conduits with unique conduit designations. Conduit designations shall be as shown in Cable and Conduit Schedule or designations approved by OWNER.

2. Install at each terminus, near midpoint, and at minimum intervals of every 50 feet of exposed Raceway, whether in ceiling space or surface mounted.

3. Provide non-corrosive wire for attachment.

3.12 PROTECTION OF INSTALLED WORK

- A. Protect products from moisture, corrosion, and physical damage during construction.
- B. Provide manufactured watertight and dust-tight seals over all conduit openings during construction.
- C. Touch up painted conduit threads after assembly to cover nicks or scars.

- END OF SECTION -

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SECTION 26 05 53 - UNDERGROUND ELECTRIC SERVICES

PART 1 -- GENERAL

1.1 SECTION INCLUDES

- A. Requirements for underground power cable installations for:
 - 1. Powerhouse switchyard 25kV cable dead-front termination enclosure (doghouse).
 - 2. Buried conduits between powerhouse, switchyard, and station service transformer.

1.2 REFERENCES

- A. National Electrical Safety Code (NESC).
- B. National Electrical Code (NEC).

1.3 SUBMITTAL

- A. Submit in accordance with Section 01 33 00 – Contractor Submittals.
 - 1. Manufacturer's data, including outlines, specifications.
 - 2. Underground cable routing showing cable and vault locations.
 - 3. Cable terminators and junctions.

PART 2 -- PRODUCTS

2.1 PRECAST MANHOLES AND VAULTS

- A. Provide per Section 26 01 00 – Basic Electrical Materials and Methods and as follows:
 - a. 25-kV deadfront Junction cable pedestal (doghouse), CJP-30-50 Power Design Inc (PDI), with three-way load break junction and bushings. See reference drawing by PDI 3337-R1.

2.2 LOAD BREAK JUNCTION AND ELBOW TERMINATION

- A. Provide as follows: OWNER standard materials.
- B. Provide all accessories per listed OWNER standards.

2.3 SPLICES

- A. Provide per Owner Standards, as follows:
- B. Provide all accessories per OWNER Standards.

PART 3 -- EXECUTION

3.1 GENERAL

- A. Meet OWNER's guidelines for underground work.

3.2 TRENCHING

- A. Provide all trenching, backfilling and restoration work. Submit details for approval prior to trenching.
- B. The minimum cover required for secondary (0 - 600V) shall be 24". The minimum cover required for primary (5kV or above) shall be 36" not more than 48".
- C. Minimum depth may be reduced where unusual soil conditions dictate. Contact the OWNER for specific requirements for these cases.
- D. The minimum separation between electric and water penstock shall be 36".
- E. The bottom of the trench shall be undisturbed, tamped, or relatively smooth earth.
- F. Where the excavation is in rock, lay conduits on a protective layer of clean tamped backfill. Backfill within 6" of the electrical conduit shall be free of solid material greater than 4" maximum or sharp edges likely to damage it. The balance of backfill shall be free of solid material greater than 8" in maximum dimension. All backfill shall be free of materials that may damage the conduit system (large rock or paving material, cinders, large or sharply angular substance, or corrosive material).
- G. Backfill within 24 hours after OWNER inspection and/or conductors are installed. Sand shall be required if select backfill material is not available. Select backfill or sand shall provide a 3" bedding below conductors and a minimum cover of 3".

3.3 VAULT/DOGHOUSE INSTALLATION

- A. Number of Vaults: If additional vaults are needed as dictated by the site condition, provide them at no additional cost to OWNER. In no case shall the number of vaults be less than shown on the Drawing. Final vault locations are subject to approval.
- B. All vaults shall be designed and installed in a manner such that water from the vault will drain into an acceptable outlet. Vault drains shall not connect to storm drains, nor shall storm drains empty into a vault.
- C. Set transformer vaults so that their lids are 2 inches above final grade.
- D. Protect all insulated cables entering the handhole at minimum by a piece of plastic duct. This duct shall be permanently sealed around its exterior and interior with cement grout.
- E. Install conduit perpendicular to the vault walls which they are entering and in a manner that ensures that all conductors can be trained to lay in the same direction (clockwise or counter-clockwise) and also in such a way as not to interfere with other conduit entrances.

- F. Conduit shall not enter at same corners of a vault.
- G. Cement grout is required to seal all holes and around all conduits.
- H. Vaults and covers shall be located and oriented so that proper door clearance from buildings/obstructions may be maintained.
- I. Bell ends are required on all conduits.
- J. Pulling irons, one at each corner shall be provided.
- K. Identification
 - 1. To identify their function, the word ELECTRIC, or COMMUNICATION, shall be neatly and permanently marked in plain uppercase letters on the covers of subsurface electrical vaults. Letters shall be a minimum of 2" and a maximum of 4" in height.
 - 2. Letters shall be inscribed in the concrete cover or embossed on the metal door (where applicable). The identifying word shall be squarely in alignment with a vault edge for a neat appearance and shall be placed in a consistent location from one cover to the next.

3.4 VALUT/DOGHOUSE GROUNDING

- A. See Drawings for installation details.
- B. Only one ground rod is required at each vault when there is more than one vault in succession.
- C. Two ground rods with 4/0 stranded bare copper wire are required at the first and last vaults.

- END OF SECTION -

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SECTION 26 10 10 - STATION BATTERIES AND CHARGERS

PART 1 - - GENERAL

1.1 SUBMITTALS

- A. Submit the following in accordance with Section 01 33 00 - Submittals and 01 33 26 - Electrical Drawings and Data.
- B. Battery Bank Data:
 - 1. Manufacturer's technical data
 - 2. Maintenance details
 - 3. Installation and wiring instruction
 - 4. Operating instructions
- C. Battery Charger Data:
 - 1. Manufacturer's technical data
 - 2. Installation and wiring instruction
 - 3. Operating instructions
- D. Emergency Eye Wash Station
 - 1. Manufacturer's technical data
 - 2. Maintenance details
 - 3. Installation instruction
 - 4. Operating instructions

PART 2 PRODUCTS

2.1 BATTERY BANKS

- A. Furnish one station service battery bank: consisting of ten 12V batteries comprised of 6 cells each, with a nominal cell voltage of 2.25V and a nominal bank voltage of 135V.
- B. The battery banks shall consist of flooded, lead-calcium, vent regulated cells, in fire-retardant (UL 94 V0) clear plastic jars with flame-retardant covers (UL 94 V0)
- C. Load Cycle Capability (135V battery): Beginning with a state of full charge at 32°F, the battery alone shall be capable of supplying a continuous load of 18 amperes for a period of 8 hours, without dropping below 1.75 volts per cell.
- D. The battery bank shall meet the following requirements:
 - 1. Battery Room Temperature: 0° C to 40° C
 - 2. Battery Plates: Fauré type using lead-calcium alloy

3. Battery Posts: Solid lead battery posts in the area of the bolt connections, i.e. no horizontal copper inserts in the posts are allowed.
 4. Provide cross-drilled holes in each battery post to facilitate the addition of bolt-on jumpers after batteries and lead straps are assembled in the rack. As an alternate, a two-hole post (with or without copper inserts) will be acceptable provided two independent sets of inter-cell connectors are provided for connection of the cells (i.e., each set of inter-cell connectors can be independently removed from the cell).
 5. Inter-rack Jumpers: Minimum #4/0 Copper
 6. Main Battery Terminals: For #4/0 AWG
- E. Provide the following accessories:
1. Type 316 Stainless Steel connecting hardware consisting of one bolt (of sufficient length to expose two full threads when properly torqued), one nut, one lock washer, and two washers (1/8-inch thick with a 7/8-inch diameter) for each battery post.
 2. One complete set of Flame Arresters, vent-mounted, center tube for specific gravity readings, and dust covers.
 3. One portable hydrometer syringe.
 4. One vent-mounted thermometer.
 5. Cell lifting strap.
 6. One set of plastic cell numbers and positive and negative symbols.
 7. One-pound NO-OXIDE type grease for terminals.
 1. Touch-up paint for battery rack.

2.2 BATTERY RACK

- A. Provide two tier battery racks as follows:
1. Provisions for clamping the battery cells in position.
 2. Provide non-conducting members directly supporting the cells to isolate the battery cells from the steel framing channel.
 3. Finished with not less than two coats of ANSI 70 light gray acid resisting enamel.
 4. Allow for a two-tier mounting arrangement, with a row of 5 batteries mounted above a row of 5 batteries, in one rack.
 5. Bolt rack to the floor and provide lateral support bracing connected to the powerhouse wall.
 6. Plexiglass top and front cover, bolted to frame and floor, to prevent accidental touching of the batteries and battery connections. Top and side covers shall extend on either side, a minimum of six inches past any battery case.

2.3 BATTERY CHARGER

- A. Provide fully automatic battery charger, capable of maintaining the battery charge with the chargers floating on the battery bus, and at the same time supplying the continuous load on the DC bus.
1. Size: Capable of supplying full DC load as well as the battery charging load per Design-Builder's design. Chargers shall re-charge a fully discharged battery in no more than 8 hours.
 2. Input: 480V, three-phase.
 3. Rated Output: 30A, 139.8V during equalization.
 4. Battery eliminator type, capable of supplying DC load without the battery connected and with maximum 30 mV ripple.
 5. Output Regulation: ± 1 percent for 0 to 100 percent output with input variation of ± 10 percent.
 6. Constant Voltage Charger Output: Properly filtered to allow maximum 150 mV ripple, with or without the battery connected (Battery "Eliminator" model).
 7. Floating Charge Voltage: Automatically and accurately adjusted, with stable operation to maintain this voltage.
 8. Equalizing Charge Voltage: Adjustable to 2.33 Volts per cell.
 9. Floating and Equalizing Voltage Control, and Current Limiting Device: By a long-life transistorized voltage sensing control system, unaffected by switching or other surges on the AC or DC leads.
 10. Protect all exposed wiring against possible shorts between terminals and/or cabinet.
 11. Provide the following features on the charger:
 - a. AC and DC circuit breakers, fully rated for the voltage type and ampere rating of the charger, i.e. DC-rated breaker on the output and AC-rated breaker on the input. Minimum acceptable interrupting capacities are 20 kA at 250 VDC and 20 kA at 600 VAC.
 - b. Disconnecting device in supply circuit.
 - c. DC voltmeter and DC ammeter with 1 percent accuracy.
 - d. Automatic current limiting, adjustable from 40-100 percent of rated output.
 - e. Dry contacts (135-Vdc contacts) for DC no-charge alarm, DC ground detection alarm (135V charger only), DC voltage high-low alarms, and AC failure alarm.
 - f. On-Off indicating lights.
 - g. Convection cooled, floor or wall-mounting steel cabinet. No rear access for wiring or maintenance.
 - h. Manually set 0-72 hour adjustable equalizing charge synchronous timer to increase charger output to the adjustable preset equalizing voltage until the time is run out, at which time the output shall be automatically readjusted to the full float voltage. The timer shall have a "HOLD" position

which can be manually set to allow the charger to remain in the equalize mode until it is removed from the HOLD position.

2.4 BATTERY ACID SPILL CONTAINMENT SYSTEM

- A. Furnish system compliant with current regulation requirements of the Uniform and/or International Fire Codes (UFC/IFC).
- B. Furnish non-corrosive containment barriers that are 4 inches high, liquid-tight and extend at least 1 inch beyond the battery rack in all directions.
- C. Furnish a flexible internal liner that fits properly inside the containment system.
- D. Furnish flame-retardant absorbent pillows that will contain and neutralize the spilled electrolyte to a pH of 7.0-9.0 and contain color indicators to differentiate between acidic and non-acidic exposures.
- E. Furnish complete system hardware and floor anchors.

2.5 MISCELLANEOUS INFORMATION

- A. Provide complete set of data and product catalogs covering the equipment. If standard drawings and/or standard published descriptive data are submitted, clearly indicate any modifications required and intended by the Design-Builder to meet the requirements of this Specification.
- B. Provide guaranteed performance curves substantiating the ability of proposed battery to equal or exceed the design requirements in performance under the service conditions and loading specified herein. Supply Battery Discharge Curves showing amperes (or ampere-hours) per positive plate for a 12-hour period.
- C. Provide make and model of AC and DC circuit breakers provided for the battery chargers.
- D. Provide a statement of the manufacturer's guarantees, including a 20-year life expectancy, and Agreement on the application of pro-rated credit for any Warranty Cell replacement, which shall be as follows: Pro-rated credit shall be calculated on a straight-line basis against the original discounted purchase price; and the current List Price of the replacement battery shall be discounted by the same percentage, or greater, as the original bid discount.
- E. Furnish the following as part of the O&M Manuals:
 - 1. A complete set of charger drawings in AutoCAD format. These drawings shall completely describe the installation details and wiring diagrams. Typical diagrams showing many options available within the main frame are not acceptable.
 - 2. Complete descriptions of the installation, calibration, operation and maintenance of the battery charging system including all schematics, printed circuit board layouts, etc., to enable Borough of Petersburg's technicians to troubleshoot to the component level.

2.6 EMERGENCY EYE WASH STATION

- A. Provide self-contained, gravity-operated, simple and quick-to-use portable unit complete with drain hose, mounting bracket, bacteriostatic additive, and test log card.
 - 1. Spray action with continuous flow of wash solution for 15 minutes at rate greater than 0.4 gpm
 - 2. Sixteen-gallon capacity, constructed of FDA polyethylene
 - 3. Wall-mounted with included mounting bracket(s)
 - 4. SEI-certified and shall meet ANSI Z358.1-1991
- B. Model No. 90320 by Sellstrom Manufacturing or approved equal.

PART 3 EXECUTION

3.1 SITE INSTALLATION SUPPORT

- A. Install two-tier battery rack with batteries, with spill containment.
- B. Install battery charger on wall as indicated.
- C. Wire battery bank and battery charger to 125VDC distribution panel.
- D. Complete installation and testing of batteries per manufacturer's instructions.

- END OF SECTION -

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SECTION 26 50 00 - LIGHTING

PART 1 -- GENERAL

1.1 SECTION INCLUDES

- A. Interior and exterior luminaires.

1.2 REFERENCES

- B. The following is a list of standards which may be referenced in this section:
 - 1. Certified Ballast Manufacturer (CBM).
 - 2. Illuminating Engineering Society of North America (IESNA).
 - 3. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
 - 4. Underwriters Laboratories, Inc. (UL):
 - a. 595, Standard for Safety Marine-Type Electric Lighting Fixtures.
 - b. 924, Standard for Safety Emergency Lighting and Power Equipment.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 00 – Contractor Submittals.
- B. Submit the following:
 - 1. Luminaires:
 - a. Catalog data sheets and pictures.
 - b. Luminaire finish and metal gauge.
 - c. Lens material, pattern, and thickness.
 - d. Candle power chart 0 to 90 degrees.
 - e. Lumen output chart.
 - f. Mounting or suspension details.
 - 2. Lamps:
 - a. Voltages.
 - b. Colors.
 - c. Approximate life (in hours).

- d. Approximate initial lumens.
- e. Lumen maintenance curve.
- f. Lamp type and base.

1.4 QUALITY ASSURANCE

A. UL Compliance:

- 1. Materials manufactured within scope of Underwriters Laboratories shall conform to UL Standards and have an applied UL listing mark.

PART 2 -- PRODUCTS

2.1 LUMINAIRES, EMERGENCY LIGHTS, AND EXIT SIGNS

- A. See Light Fixture Schedule on the Drawing.
- B. Include factory furnished installation accessories.
- C. Emergency/Exit Lights: per IFC 1006 and 1011.

2.2 LAMPS

- A. See Light Fixture Schedule.

2.3 LIGHTING CONTROL

- A. Light Switches
 - 1. Provide where indicated on the Drawing.
- B. Three-Way Switches
 - 1. Provide where indicated on the Drawing.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. Install and adjust fixtures, lamps, ballasts, fuses, receptacles, and photoelectric units in accordance with manufacturer's recommendations.
- B. Provide proper hangers, pendants, and canopies as necessary for complete installation at locations indicated on Drawings.
- C. Install plumb and level. Mounting heights shall be as shown.
- D. Install each luminaire outlet box with galvanized stud.

3.2 EMERGENCY LIGHTING UNIT AND EXIT SIGNS

- A. Install in accordance with manufacturer's recommendations.
- B. Provide permanent circuit connections with conduit and wire.
- C. Connect to branch circuit feeding normal lighting in area ahead of all local switches.

3.4 CLEANING

- A. Remove labels and markings, except UL listing mark.
- B. Wipe luminaires inside and out to remove construction dust.
- C. Touch up all painted surfaces of luminaires and poles with matching paint ordered from manufacturer.

- END OF SECTION -

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SECTION 28 05 50 - FIBER OPTIC CABLE

PART 1 -- GENERAL

1.1 SCOPE OF WORK

- A. Pull and fasten into position Owner supplied armored single mode fiber optic cable between intake control building and powerhouse, providing necessary clamping hardware. A 5000-foot reel of fiber optic cable is located at the intake.
- B. Fiber optic cable to be pulled and installed permanently per the drawings, primarily laid on the ground with sections buried as identified on the drawings.
- C. Temporarily route the last 150 to 200 feet of fiber optic cable around powerhouse out of the way of penstock construction, to be used in a temporary configuration.
- D. Temporarily connect new fiber optic cable from intake, and fiber from downtown, into Contractor supplied PLC to provide dam breach signals, breach alarm to the hatchery, and network connection to the intake during construction.
- E. Permanently reconfigure and reroute fiber optic cable into final position and test, providing patch panels and miscellaneous material.
- F. Terminate fiber optic cable from downtown, and from intake building, to fiber optic patch panels as indicated on the drawings.
- G. Provide fiber patch cords as required to connect end devices to the fiber optic patch panel.

1.2 REFERENCES

- A. Institute of Electrical and Electronic Engineers, Inc.
1222 Standard for All-Dielectric Self-Supporting Fiber Optic Cable.
C2 National Electrical Safety Code (NESC).
- B. Electronic Industries Alliance
EIA/TIA-455-170 (1989) FOTP-170 Cable Cutoff Wavelength of Single-Mode Fiber by Transmitted Power.
- C. National Fire Protection Association.
70 National Electrical Code (NEC).
- D. Telecommunications Industry Association
TIA-455-104-A (1993; R 2005) Standard for FOTP-104 Fiber Optic Cable Cyclic Flexing Test.

TIA-455-13-A (1996; R 2002) FOTP-13 Visual and Mechanical Inspection of Fiber Optic Components, Devices, and Assemblies.

TIA-455-46A (1990) FOTP-46 Spectral Attenuation Measurement for Long-Length, Graded-Index Optical Fibers.

TIA-455-78 (2002B) FOTP-78 Optical Fibers - Part 1-40: Measurement Methods and Test Procedures – Attenuation.

TIA/EIA-455-171-A (2001) FOTP-171 Attenuation by Substitution Measurement for Short-Length Multimode Graded-Index and Single-Mode Optical Fiber Cable Assemblies.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 00 – Contractor Submittals.
- B. Submit the following:
 - 1. List of equipment and materials.
 - 2. Manufacturer's descriptive and technical data, performance charts and curves, catalog cuts for material supplied.
 - 3. Installation instructions.
 - 4. Splicing instructions (if required).
 - 5. Fiber connectors catalog part number and manufacturer specifications.

1.4 QUALIFICATIONS

- A. Installation technicians shall have received formal specialty training and shall be regularly engaged in installation and testing of optical fibers and accessories. Proof of training and/or work experience shall be submitted to demonstrate relevant qualifications for work specified herein.

PART 2 -- PRODUCTS

2.1 OPTICAL FIBER AND CABLE

- A. Optical Fiber (Owner furnished)
 - 1. Type: Single mode. dispersion-unshifted, zero water peak optical fiber, EIA Class 1Va.
 - 2. Color Coding: Each fiber shall be color coded. Coloring ink shall be heat stable and chemically compatible with the fiber coating and buffer tube filling compound. Shall not affect the transmission characteristics of the optical fibers.
 - 3. Each fiber shall have acrylic coating to preserve the fiber's tensile strength.

4. Optical fiber shall contain no factory splices.
5. Maximum Attenuation: 0.35dB/km at 1,310 nm
 0.25 dB/km at 1,550 nm
6. Attenuation Uniformity: Less than 0.1 dB.
7. Number of Fibers: 12 strands, minimum

B. Cable Construction

1. General: Existing fiber from downtown cable is all dielectric self-supporting (ADSS) type composed of central dielectric support member surrounded by loose buffer tubes or filler tubes, covered with inner and outer medium density polyethylene (MDPE) jackets separated by a woven aramid yarn sheath for strength and protection. The loose buffer tube design shall isolate the optical fibers from cable tension. Owner furnished fiber from intake building to powerhouse is armored, 12-strand loose fiber.
2. Buffer Tubes: Fibers placed in gel-free buffer tubes containing water blocking absorbent yarn. Buffer tubes shall be color coded. Buffer tubes shall be filled with water blocking compound.
3. Filler Rods: Unpigmented solid HDPE rod with the same outer diameters as the buffer.
4. Water-blocking: All voids within the cable core shall be filled with water –blocking material to prevent water ingress and migration.
5. Rip Cord: Cable shall be equipped with ripcord.
6. Tensile Strength:
Maximum Allowable Sagging Tension: 1300 lbs
Maximum Rated Cable Load: 1,700 lbs
7. Sag and Tension: NESC Medium Loading with 1% initial sag.
8. Temperature Ranges:
Installation: -30° C to +70°C.
Operation: -40 C to +70°C.
Storage/Shipping: -50°C to +70°C
9. Packaging: 10,000 feet on non-returnable reels.

2.2 FIBER OPTIC CONNECTORS

- A. Field installable, self-aligning and centering type to match field equipment.
- B. Match the fiber core and cladding diameters.

C. Insertion Loss: 0.3 dB nominal and less than 0.5 dB max.

2.3 PATCH PANEL AND PATCH CORDS

A. Existing and Owner furnished patch panels will be used.

B. Patch Cords: Provide factory connector-terminated flexible optical fiber cable with connectors of the same type as used elsewhere in the system. Optical fiber shall be the same type as used elsewhere in the system.

C. Preferred Connector: SC single-mode fiber connectors, or as required by the supplied equipment.

2.4 FIBER SPLICE KIT (Owner with Owner approval)

A. Preferred Model: Preformed Line Products.

1. Splice Enclosure: Coyote RUNT Closure Part #8006671.

2. Splice Tray Kits: Coyote RUNT Part #80806033.

PART 3 -- EXECUTION

3.1 GENERAL

A. Prior to pulling Owner furnished cable, test fiber optic cable (all strands) while on reel and provide test report to Owner. Notify Owner if cable testing indicates the cable does not meet factory specifications.

B. Take proper care of fiber optic reel and cable, to protect from damage during pulling and securing. Cable shall be pulled via the route and profile indicated on the engineering plans. Cable shall primarily be laid on the ground. Cut vegetation as necessary to allow cable to lay on the ground. In areas of flat soft soil, bury cable six inches below surface.

C. The fiber optic cable from the intake to the powerhouse shall be installed in one continuous run without splices. Installation shall be performed or supervised only by trained technician in fiber cable installation. Fiber optic cable from downtown to the powerhouse shall be reused and terminated to a splice box located in the powerhouse and from patched to final equipment destination. Fiber optic cable from the intake shall also be terminated to a different patch panel within the powerhouse.

D. Splices will be permitted by OWNER only on a case by case situation and as follows:

1. Make splices using the method recommended by the cable manufacturer. House splices in a splice enclosure and encapsulate with an epoxy, ultraviolet light cured splice encapsulant or otherwise protected against infiltration of moisture or contaminants.

2. Fusion splices shall have nominal splice loss of 0.1dB or less for each single mode cable fusion splice.

3. Field splices shall be located in the communication vault. Provide sufficient cable in each splicing location to properly rack and splice the cables, and to provide extra cable for additional splices. Protect cable ends with end caps except during actual splicing. During splicing, protect the unspliced portions of the cable and its fibers from intrusion of moisture and foreign matter.

3.2 FIELD TESTING

A. Optical Time Domain Reflectometer Test

1. Perform optical time domain reflectometer test per TIA-455-78.
2. If the losses are greater than 0.1 dB per fusion splice, the splice is not acceptable and shall be replaced until acceptable values are obtained.
3. Submit report documenting the results of tests.

B. Power Attenuation Test

1. Perform power attenuation tests of all fibers at 1310 nm and 1550 nm from each end.
2. If the circuit loss exceeds the following criterion the circuit is unsatisfactory:

Maximum Circuit Attenuation = 0.35dB/km at 1,310 nm (or 0.25 dB/km at 1,550 nm)
+ 0.1dB/splice + 0.5 dB/connector
3. If the circuit is unsatisfactory notify OWNER and provide solutions for the problem.

C. Operations Test

1. Perform field operations test to ensure optical fiber systems are interfaced and work correctly with Owner-furnished equipment. Correct all problems attributable to the fiber communication link to achieve satisfactory transmission of control and video signals.
2. Submit report documenting the results of tests.

- END OF SECTION -

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SECTION 28 23 00 - VIDEO SURVEILLANCE SYSTEM

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Video Surveillance system is Owner furnished, except for cabling and mounting brackets, to be supplied under this section.
- B. Video surveillance system is as follows: A standalone video system, with power-over-ethernet internet-protocol (POE IP) cameras and network video recorder (NVR) as indicated. The video system shall use fixed cameras at the powerhouse with NVR and accessible through the internet requiring secure login credentials.
 - 1. Existing camera at the dam shall be reused or replaced as necessary to achieve the functionality listed herein, and connected to the NVR.
 - 2. The intake camera shall be a pan-tilt-zoom (PTZ) type and operated remotely. The video surveillance equipment shall be rack mounted and located in the existing intake control building.
 - 3. Additional new cameras, Owner furnished, shall be installed at the powerhouse.
 - 4. Network video recorder is to be located in the SCADA and Surveillance rack in the powerhouse.

1.02 SUBMITTALS

- A. Submit the following in accordance with Section 01 33 00 – Contractor Submittals.
- B. Video Surveillance Data by Owner Supplier to be provided to Contractor:
 - 1. Manufacturer's technical data
 - 2. Camera and housing outlines
 - 3. Video terminal details
 - 4. Installation and wiring instruction
 - 5. Programming and operating instructions
- C. Programming and operating instructions
 - 1. NVR catalog cut sheet
 - 2. NVR O&M manual

PART 2 PRODUCTS

2.01 VIDEO SURVEILLANCE SYSTEM AND CAMERAS (Owner Furnished)

- A. Video surveillance system shall be provided to deliver live streaming images of the Blind Slough Hydro facility, with the number of cameras shown on the plans. The cameras shall be of a fixed type.
- B. Live video shall be available over a network connection to the NVR base unit, requiring password login using a standard computer browser. Recorded video shall also be available through the NVR using the same login credentials.
- C. Video cameras shall be dome cameras and shall provide color images using CMOS-based image sensor and provide clear images under the existing site condition without extra lighting. Images may switch to black-and-white when available light is low. Image size shall be 1080P Recording in H.264 encoding, 1080p Resolution up to 30fps, Trendnet TV-NVR408 NVR or approved equal, suitable for Indoor/Outdoor application. Playback shall be at controlled speed or frame-by-frame. Connection of cameras to NVR shall be digital using a power-over-ethernet connection.
- D. System shall be complete with network interface switch, power supplies, Ethernet connectors, mounting accessories, camera dome housing. NVR system shall include self-contained network interface and IP address for connection to the local SCADA network. System shall be capable of storing at least three weeks' worth of live video for all cameras provided simultaneously. Access of recorded video shall be through the local interface or over the network through a password accessible account.
- E. Cameras shall be Trendnet TV-IP317PI dome camera or approved equal.
- F. The video surveillance system shall meet the following requirements:
 - 1. NVR Channels: 8
 - 2. NVR Type: Hardware, 4-TB Storage, Rack Mounted
 - 3. Compression: H.264
 - 4. Max Resolution: 1080p
 - 5. Recording Framerate: 30
 - 6. PTZ Controls: Yes
 - 7. Remote Access: Yes
 - 8. Backup Media: USB, Network
 - 9. Expandable: Yes
 - 10. IP Compatible: Yes
 - 11. Audio Channels 8
 - 12. Operating System Embedded Linux
 - 13. Number of Cameras: As indicated on drawings

2.02 VIDEO TERMINAL (Owner Furnished)

- A. Monitoring terminal shall be complete with video processor with keyboard, color monitor, and mouse.
- B. Monitoring terminal shall be a product of the video camera manufacturer. A liquid crystal display shall be provided that is a minimum of 24-inch in size. Location of the video display terminal shall be located in the supervisor's office.

2.03 POWER SUPPLY (Owner Furnished)

- A. A POE DC power supply powering the video cameras shall be included with the NVR as required, located no further than 250 feet from each camera. Power for the intake camera may use the existing power supply.

2.04 Accessory Material (Contractor Furnished)

- A. Provide necessary camera mounting brackets, CAT6 cable with connectors, and conduit.

PART 3 EXECUTION

3.01 SITE INSTALLATION SUPPORT

- A. Install fixed type cameras and NVR, and connect to the internet with a fixed IP address requiring login credentials.
- B. Reuse existing Intake PTZ camera and connect to the NVR, using existing fiber between the Intake building and Powerhouse.
- C. Contractor shall provide technical support for programming, installation and commissioning of the video system per the manufactures instruction manuals.
- D. Contractor shall adjust each camera position to the desired view angle acceptable to the Owner and secure them into position.
- E. Contractor shall demonstrate the video surveillance system and features to the Owner, demonstrating remote access capability.

- END OF SECTION -

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**SECTION 28 31 00
FIRE DETECTION AND ALARMS**

PART 1 - GENERAL 1.01 SECTION INCLUDES

- A. Multi-zone fire alarm systems.
- B. Fire detecting and imitating devices
- C. Signaling devices.

1.02 REFERENCED STANDARDS

- A. NFPA 72A Protective signaling Systems
- B. NFPA 72E Automatic Fire Detectors
- C. NFPA 70 National Electrical Code, Article 760

1.03 QUALITY ASSURANCE

- A. UL Listed for intended application.

1.04 SUBMITTALS

- A. The following shall be submitted in accordance with Section 01 33 00.
- B. Submit the following:
 - 1. Equipment brochures and product data.
 - 2. Electrical connection and schematic diagrams.
 - 3. Sensor layouts.
 - 4. Control panel external wiring diagram.
 - 5. Warranties and certification.
 - 6. Operations and maintenance data.

1.05 OPERATION REQUIREMENTS

- A. The following describes general operating requirements for the fire alarm system.
 - 1. Normal Mode: When conditions are normal (no alarm and no trouble detected) only green power-on LED shall be on.
 - 2. Supervisory Alarm Mode: The supervisory mode shall be activated if an abnormal condition is detected in the alarm circuit (i.e., open circuit). Light emitting diodes (LEDs) shall illuminate and audible alarm sound. Supervisory alarm mode shall continue until the abnormal condition is cleared and the reset switch is operated. Contact shall be provided for interface by external devices.
 - 3. Alarm Mode: The alarm mode shall be activated if any of the initiating devices operates. LEDs indicating the initiating zones shall illuminate and the alarm relay operate. Alarm mode shall continue until the initiating device is reset and the front panel reset switch is operated. Contacts shall be provided for external control interface.
 - 4. Trouble Alarm Mode: The trouble alarm mode shall be activated if the system experiences abnormal operating conditions, such as AC power loss, low battery, battery open lead, or ground fault. Trouble alarm shall be indicated by a front panel LED accompanied by audible tones. The trouble relay shall operate. The audible tone shall be silenced by operating the trouble silence switch. The trouble LED shall be reset only after the trouble source has been cleared. Contact shall be provided for interface by external devices.

5. Drill Mode: The drill mode shall be used to test signaling circuits manually. No audible alarms shall be generated and no auxiliary relays shall operate under the drill mode.
6. Test Mode: The test mode shall be used to verify the operation of panel alarm initiating devices and the integrity of field wiring. A combination of audible pulses shall be used to indicate the success of the tests.

PART 2 - PRODUCTS 2.01 FIRE ALARM CONTROL PANEL

- A. Fire alarm system shall be configured for Class B power limited signal circuits.
- B. Panel LED Indications for:
 1. Power On.
 2. Battery Power.
 3. Alarm.
 4. Equipment Trouble.
 5. Battery Low or Trouble.
- C. Momentary Contact and Switch Functions for:
 1. Alarm Reset.
 2. Signal Silence.
 3. Lamp Test.
- D. Auxiliary contacts for remote use:
 1. Equipment trouble.
 2. Alarm activation.
 3. Spares - minimum of four (4) additional contact outputs.
- E. Enclosure: NEMA 1, wall-mounted.
- F. Initiating and signaling circuits designed for 24VDC operation.
- G. Power Supply: 120 VAC with built-in battery charger with standby sealed lead-calcium type battery suitable for 24-hour stand-alone operation, minimum. H. Model: Edwards E-FSC502, 5208 Fire Alarm Control Panel with Digital Communicator, or approved substitute.

2.02 SMOKE DETECTORS

- A. LED alarm indication.
- B. Designed for Class A and Class B circuit application.
- C. UL listed.
- D. Tamper resistant twist lock installation.
- E. Smoke detection based on light scattering photoelectric principle.
- F. Equipped with auxiliary relay for dry contact output.
- G. Field adjustable sensitivity. H. Nominal 24VDC operation.
- I. Operating Temperature: 32 to 100 degrees F.
- J. Operating Humidity: 0% to 95% RH.
- K. Model: Edwards EC30U-3, or approved equal.

2.03 MANUAL FIRE STATION

- A. Single action break glass type.

- B. Red die cast body.
- C. UL listed.
- D. Contact Rating: 3 Amp at 125 VAC.
- E. Model: Edwards 270-SPO, or approved equal.

2.04 TEMPORAL HORN/STROBES

- A. Surface mount, combination electronic horn and strobe.
- B. Clear lens for strobe with red front plate.
- C. 110 candela output.
- D. Adjustable Sound Level: 98 dBA.
- E. Strobe rate: 1 flash per second.
- F. UL listed.
- G. Operating voltage: 24 VDC.
- H. Model: Edwards 757-8A-T for outdoor, G1RF-HDVM for indoor installation, or approved equal.

2.05 END OF LINE DEVICE

- A. As required for loop termination for smoke alarm and horn circuits.
- B. Resistor value: per fire alarm system manufacturer.

PART 3 - EXECUTION 3.01 GENERAL

- A. Install in accordance with manufacturer's instructions.
- B. Comply with referenced standards for installation and wiring requirements.
- C. Use dedicated conduits, painted red, for wiring.
- D. Provide certification by manufacturer for proper installation and calibration.

3.02 FIELD QUALITY CONTROL

- A. Provide manufacturer's field service representatives to verify proper installation and calibration of sensors.
- B. Provide name, address, and phone number of local service organizations authorized by the manufacturers.
- C. Local service shall be available for 24-hour emergency service calls.

3.03 CHECKOUT, STARTUP, AND TRAINING

- A. Calibrate detectors and control circuits.
- B. Provide field representatives to demonstrate fire alarm system is properly installed and ready for operation.
- C. Demonstrate fire and trouble alarm signals are properly interfaced with external systems for remote signaling.
- D. Provide training to PMP&L operating and maintenance staff.

- END OF SECTION -

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SECTION 31 00 00 - EARTHWORK

PART 1 -- GENERAL

1.1 SUMMARY

- A. The CONTRACTOR shall perform earthwork as indicated and required for construction of the WORK, complete and in place, in accordance with the Contract Documents.

1.2 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall submit samples of materials proposed for the WORK in conformance with the requirements of Section 01 33 00 – Contractor Submittals. Sample sizes shall be as determined by the testing laboratory
- B. CONTRACTOR's Detailed Excavation Plan for WORK
 1. The CONTRACTOR, prior to beginning any trench or structure excavation 5 feet deep or deeper below existing grade or finished floor, shall submit to the OWNER and shall be in receipt of the OWNER's written acceptance of the CONTRACTOR's detailed plan showing the design of shoring, bracing, sloping of the sides of excavation, or other provisions for worker protection against the hazard of caving ground during the excavation of such trenches or structure excavation.
 2. The CONTRACTOR's plan shall be prepared and signed and sealed by a Professional Engineer experienced in the field of geotechnical engineering and licensed in the State where the WORK is being performed.
 3. The OWNER's acceptance of said plan will be for verification of submittal of the plan with this requirement.

PART 2 -- PRODUCTS

2.1 FILL AND BACKFILL MATERIAL REQUIREMENTS

A. General

1. Fill, backfill, and embankment materials shall be selected or shall be processed and clean fine earth, rock, gravel, or sand, free from grass, roots, brush, other vegetation and organic matter.
2. Fill and backfill materials that are to be placed within 6 inches of any structure or pipe shall be free of rocks or unbroken masses of earth materials having a maximum dimension larger than 2 inches.

B. Suitable Materials

1. Materials not defined below as unsuitable will be considered as suitable materials and may be used in fills, backfilling, and embankment construction, subject to the indicated requirements.
2. If acceptable to the ENGINEER, some of the material listed as unsuitable may be

used when thoroughly mixed with suitable material to form a stable composite.

3. Mixing or blending of materials to obtain a suitable composite is the CONTRACTOR's option but is subject to the approval of the ENGINEER.
4. The CONTRACTOR shall submit certification to the ENGINEER that the chloride concentration in imported materials within the pipe zone does not exceed 100 ppm, when tested in accordance with the requirements of AASHTO T291-94 – Standard Method of Test for determining Water-Soluble Chloride Ion Content in Soil.
5. Suitable materials may be obtained from on-Site excavations, may be processed on-Site materials, or may be imported.
6. If imported materials are required by this Section or are required in order to meet the quantity requirements of the WORK, the CONTRACTOR shall provide the imported materials as part of the WORK.

C. **Types of Suitable Materials.** The following types of suitable materials are defined:

Type AS (Aggregate Subbase): Crushed rock aggregate subbase material that can be compacted readily by watering and rolling to form a firm stable base. This material is often specified and required underneath the base course of asphaltic or concrete pavement. The gradation with 2-inch maximum size gradation shall be used. The sand equivalent value shall be greater than 20. Crushed rock aggregate subbase material shall meet one of the following gradation requirements, as shown on the Drawings or approved by the OWNER:

Sieve Size	Percentage Passing (3-inch Max)	Percentage Passing (2-inch Max)
3-inch		100
2.0 inch		100
1.5 inch		95 - 100
No. 4		30 - 65
No. 16		15 - 40
No. 200		0 - 20

Type C (Civil Fill) (Not for use beneath concrete foundations or thrust blocks): Civil Fill may consist of imported materials or natural on-site materials. Civil Fill may be a combination of Type AS material, Type GF, or Type SF material, or any mixture thereof, except as shown. Some mixing, removal of oversized particles (greater than 3-inch diameter) and/or removal of other unsuitable material may be required.

Type CLSM (Controlled Low Strength Material): Controlled low strength material

(CLSM) shall be in accordance with Section 31 23 00 - Controlled Low Strength Material.

Type DRC (Drain-rock Coarse): Crushed rock or gravel meeting the following gradation requirements.

Sieve Size	Percentage Passing
2-inch	100
1.5-inch	90 - 100
1-inch	20 - 55
3/4-inch	1 - 15
No. 200	0 - 3

Type DRG (Drain-rock Graded): Drain-rock shall be crushed rock or gravel, durable and free from slaking or decomposition under the action of alternate wetting or drying. The drainrock shall have a sand equivalent value greater than 75. The finish graded surface of the drainrock immediately beneath hydraulic structures shall be stabilized to provide a firm, smooth surface upon which to construct reinforced concrete floor slabs. The material shall be uniformly graded and shall meet the following gradation requirements:

Sieve Size	Percentage Passing
1-inch	100
0.75-inch	90 – 100
0.375-inch	40 – 70
No. 4	20 – 40
No. 8	15 – 25
No. 30	5 – 15
No. 50	0 – 7
No. 200	0 – 3

The finish graded surface of the drain rock immediately beneath hydraulic structures shall be stabilized to provide a firm, smooth surface upon which to construct reinforced concrete floor slabs.

Type EF (Embankment Fills from on-site materials): Embankment Fill for portions of the project may be obtained from on-Site excavations, may be processed on-Site materials, or may be imported materials comprised of mixtures of Type AS, Type DRG, Type GF, or Type SF material. If on-site excavated material is used for embankments, it may require moisture conditioning to facilitate compaction. Drying of the embankment fill material may not be practical during cold or wet periods of the year. Acceptable embankment material shall meet or exceed the compaction density of 95 percent as determined by ASTM D-1557.

Type GF (Granular Fill 0.75-inch minus): Angular crushed rock, stone or gravel, and sand conforming to the requirements listed below. Do not use pea gravel as granular backfill: The material shall have a maximum liquid limit of 35 and a maximum plasticity index of 10. The material shall have a sand equivalent value greater than 75. (This material is also known as Class I crushed stone.)

Sieve Size	Percentage Passing
0.75-inch	100
No. 4	30 - 50
No. 200	0 - 6

Type PG (Pea Gravel fill): Crushed rock or gravel with 100 percent passing a 1/2-inch sieve and not more than 10 percent passing a Number 4 sieve.

Type SF (Structural Fill / Foundation Base): Crushed rock structural fill material of such nature that it can be compacted readily by watering and rolling to form a firm, stable base for fill material required beneath concrete foundations. This material is often specified and required directly underneath the finish course of asphaltic or concrete pavement. The fill material shall be the 3/4-inch maximum size gradation material beneath concrete foundations. The sand equivalent value shall be greater than 22. The material shall meet the following gradation requirements:

	Percentage Passing
Sieve Size	0.75-inch Max Gradation
2-inch	100
1.5-inch	100
1-inch	100
0.75-inch	90 – 100
No. 4	55 – 67
No. 16	28 – 38

No. 200	4 – 10
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Type SNF (Sand Fill): Sand material shall meet the following gradation requirements:

Sieve Size	Percentage Passing
0.375-inch	100
No. 4	90 - 100
No. 16	50 - 80
No. 50	5 - 25
No. 200	0 - 5

Type T (Topsoil): Stockpiled topsoil material which has been obtained at the Site by removing soil to a depth not exceeding 2 feet. Removal of the topsoil shall be done after the area has been stripped of vegetation and debris.

Schedule: Earth materials shall be as indicated in the Contract Drawings. Where clear definition in the drawings is not defined, the following schedule may be used to define acceptable fill materials.

Civil Work Area	Material Type
Embankment Fills – (Behind newly placed concrete thrust-blocks and existing rock retaining wall & other Embankments)	Type EF material, or Type C material.
Pipe Zone (unless indicated as Trench Zone)	
Dielectrically coated steel, polyethylene encased, non-mortar (rock-shield) coated	SF material (0.5-inch minus) or CLSM
Small PVC (< 6-inch dia), HDPE (ADS) Drain Pipe, & other pipes < 4-inch dia.	GF, SN
Pipes on grades >10% where backfills are graded with <10% passing No. 4 sieve	CLSM or SF (0.5-inch minus) w/trench plugs at intervals of 100 feet or less, if indicated in Drawings.
Trench zone backfill except as identified below	C, EF or an approved mixture thereof.
Concrete pads in Powerhouse Yard area	DRG

Civil Work Area	Material Type
Backfill around structures (including thrust blocks)	C, EF, or an approved mixture
Under structures where ground water is removed to allow placement of concrete	DRC, underlain by non-woven filter fabric

D. Unsuitable Materials.

1. Soils which, when classified under ASTM D 2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System), fall in the classifications of PT, OH, CH, MH, or OL shall be classified as unsuitable materials.
2. In addition to the materials identified as unsuitable in the table above, a material shall be classified as unsuitable if one of the following conditions is present;
 - a. Soils which cannot be compacted sufficiently to achieve the density specified for the intended use.
 - b. Materials that contain hazardous or designated waste materials including petroleum hydrocarbons, pesticides, heavy metals, and any material which may be classified as hazardous or toxic according to applicable regulations.

2.2 MATERIALS TESTING

A. Samples

1. Soils testing of samples submitted by the CONTRACTOR will be performed by an ENGINEER approved testing laboratory, in accordance with the FERC approved Quality Control and Inspection Plan and at the OWNER's expense.
2. The ENGINEER may direct the CONTRACTOR to supply samples for testing of any material used in the WORK.

B. Particle Size Analysis. Particle size analysis of soils and aggregates will be performed using ASTM D 422 - Standard Test Method for Particle-Size Analysis of Soils.

C. Sand Equivalent Value. Determination of sand equivalent value will be performed using ASTM D 2419 - Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate.

D. Unified Soil Classification System

1. References in this Section to soil classification types and standards shall have the meanings and definitions indicated in ASTM D 2487.
2. The CONTRACTOR shall be bound by applicable provisions of ASTM D 2487 in the interpretation of soil classifications.

- E. Testing for chloride shall be performed in accordance with AASHTO T291-94 – Standard Method of Test for determining Water-Soluble Chloride Ion Content in Soil.

2.3 IDENTIFICATION TAPE

- A. Unless otherwise indicated, identification tape shall be placed above buried pipelines that are not comprised of magnetic components at least in part.
- B. Identification tape shall be 6-inches wide, yellow in color, composed of polyethylene, and provided with an integral metallic wire.
- C. Tape shall be labeled with CAUTION – BURIED WATER / HYDROPOWER PIPELINE.

PART 3 -- EXECUTION

3.1 EXCAVATION AND BACKFILLING - GENERAL

A. General

1. Except when specifically provided to the contrary, excavation shall include the removal of materials, including obstructions that would interfere with the proper execution and completion of the WORK.
2. The removal of such materials shall conform to the lines and grades indicated or ordered.
3. Unless otherwise indicated, the entire Site shall be stripped of vegetation and debris and shall be grubbed, and such material shall be removed from the Site prior to performing any excavation or placing any fill.
4. The CONTRACTOR shall furnish, place, and maintain supports and shoring that may be required for the sides of excavations.
5. Excavations shall be sloped or otherwise supported in a safe manner in accordance with applicable state safety requirements and the requirements of OSHA Safety and Health Standards for Construction (29CFR1926).
6. The CONTRACTOR shall provide quantity surveys where so required to verify quantities for Unit Price Contracts.
7. Surveys shall be performed prior to beginning WORK and upon completion by a surveyor licensed in the state where the Site is located.

B. Removal and Exclusion of Water

1. The CONTRACTOR shall remove and exclude water, including stormwater, groundwater, irrigation water, and wastewater, from excavations.
2. Dewatering wells, wellpoints, sump pumps, or other means shall be used to remove water and continuously maintain groundwater at a level at least 2 feet below the bottom of excavations before the excavation WORK begins at each location.

3. Water shall be removed and excluded until backfilling is complete and field soils testing has been completed.

3.2 OVER-EXCAVATION

A. **Indicated**

1. Where areas are indicated to be over-excavated, excavation shall be to the depth indicated, and backfill shall be installed to the grade indicated.

B. **Not Indicated**

1. When ordered to over-excavate areas deeper and/or wider than required by the Contract Documents, the CONTRACTOR shall over-excavate to the dimensions ordered and backfill to the indicated grade.

C. **Neither Indicated nor Ordered**

1. Any over-excavation carried below the grade that is neither ordered or nor indicated shall be backfilled and compacted to the required grade with the indicated material as part of the WORK.
2. The CONTRACTOR shall exercise special care not to over-excavate in the following critical foundation areas:
 - a. Penstock / TIV thrust block on the south side of the Powerhouse building
 - b. Thickened concrete foundation slab beneath the new generator and generator brake equipment.

3.3 ROCK EXCAVATION

A. **Normal Excavation.** Nearly all excavation, except where indicated in the Contract Drawings and Geotechnical Report shall be considered normal excavation, and may be accomplished using conventional equipment as follows:

1. For general excavation, a D-9N Caterpillar tractor with a single shank ripper, or equivalent equipment, is considered conventional equipment, if it can rip at a production rate of at least 200 bank cubic yards per hour.
2. For trench excavation, a 235C Caterpillar excavator with a medium stick and a rock ripping bucket, or equivalent equipment, is considered conventional equipment, if it can excavate at a production rate of at least 20 bank cubic yards per hour.
3. If material is encountered which the CONTRACTOR believes cannot be excavated by conventional equipment, the ENGINEER shall be notified immediately. The CONTRACTOR shall provide performance tests of the specified conventional or equivalent equipment. If the ENGINEER confirms in writing that the conventional equipment cannot perform at the production rates indicated, the excavation will be considered rock excavation.

B. **Rock Excavation.** Rock excavation shall include removal and disposal of the following

items:

1. CONTRACTOR shall expect rock excavation at depths of 2.0-ft and lower below the current finished floor elevation inside the powerhouse.
2. CONTRACTOR shall expect that the entire bottom 1-ft of the new penstock bifurcation thrust block located on the south side of the existing powerhouse as well as the entire new 3-ft tall by 3-ft wide keyway at the base of this thrust block shall be considered rock excavation, furnished by the CONTRACTOR.
3. Boulders measuring 1/3 of a cubic yard or more in volume.
4. Rock material in ledges, bedding deposits, and un-stratified masses that cannot be removed using conventional equipment as defined herein and which require systematic drilling and blasting for removal;
5. Concrete or masonry structures that have been abandoned and require demolition; and,

C. Scope and Payment for Rock Excavation

1. Rock excavation shall be performed by the CONTRACTOR as described above under Part 3.3.B of this Section, at no added cost to the Contract price.
2. For additional rock excavation WORK, and if the quantity of rock excavation is affected by any change in the scope of the WORK, an appropriate adjustment of the Contract Price will be made.
 - a. Payment for rock excavation shall be as set forth in the Bid form as a unit price item.
 - b. If a unit price item for rock excavation is not provided in the Bid form, the extra cost for excavation of rock will be treated as a change.
3. Otherwise, payment will be made in accordance with a negotiated price.

D. Explosives and Blasting. Blasting will not be permitted on the project site.

3.4 DISPOSAL OF EXCESS EXCAVATED MATERIAL

- A. Unless otherwise indicated, excess excavated material shall be the property of the CONTRACTOR.
- B. The CONTRACTOR shall be responsible for the removal and disposal of excess excavated material, to a site selected by the OWNER that is no more than 2 miles away from the project site.
- C. The CONTRACTOR shall obtain any required permits and OWNER and agency approvals for disposal of excess excavated material off-Site and shall submit copies of related documents to the ENGINEER for information prior to disposal. CONTRACTOR shall pay costs associated with the removal and disposal of excess material.

- D. The CONTRACTOR shall obtain OWNER approvals for disposal of excess excavated material on-Site. CONTRACTOR shall pay costs associated with the removal and disposal of excess material.

3.5 BACKFILL

A. **General**

1. Backfill shall not be dropped directly upon any structure or pipe.
2. Backfill shall not be placed around or upon any structure until the concrete has attained sufficient strength to withstand the loads imposed.
3. Backfill around water-retaining structures shall not be placed until the structures have been tested, and the structures shall be full of water while backfill is being placed.

B. **Pre-Placement Conditions**

1. Except for drainrock materials being placed in over-excavated areas or trenches, backfill shall not be placed until water is removed from the excavation and the trench sidewalls and bottom have been dried to a moisture content suitable for compaction
2. Immediately prior to placement of backfill materials, the bottoms and sidewalls of trenches and structure excavations shall have any loose, sloughing, or caving soil and rock materials removed.
3. Trench sidewalls shall consist of excavated surfaces that are in a relatively undisturbed condition before placement of backfill materials.

C. **Layering**

1. Backfill materials shall be placed and spread evenly in layers. During spreading, each layer shall be thoroughly mixed as necessary in order to promote uniformity of material in each layer.
2. When compaction is achieved using mechanical equipment, the layers shall be evenly spread such that when compacted each layer shall not exceed 6 inches in thickness.

D. **Moisture Content**

1. Where the backfill material moisture content is below the optimum moisture content, water shall be added before or during spreading until the proper moisture content is achieved.
2. Where the backfill material moisture content is too high to permit the indicated degree of compaction, the material shall be dried until the moisture content is satisfactory.

3.6 STRUCTURE, ROADWAY, AND EMBANKMENT EXCAVATION AND BACKFILL

A. **Excavation Beneath Structures and Embankments**

1. Thrust blocks shall be cast directly on native, excavated rock or soil material, whichever is present. Smooth bucket excavation is required where soil is present. Material beneath thrust block locations shall be undisturbed, over-excavation and compacted backfill is not allowed.
2. The area where a fill or embankment is to be constructed shall be cleared of vegetation, roots, and foreign material.
3. Where indicated or ordered, areas beneath structures or fills shall be over-excavated.
4. The subgrade areas beneath embankments shall be excavated to remove not less than the top 8 inches of native material and where such subgrade is sloped, the native material shall be benched.
5. When such over-excavation is indicated, both the over-excavation and the subsequent backfill to the required grade shall be performed by the CONTRACTOR.

B. **Notification of ENGINEER**

1. The CONTRACTOR shall notify the ENGINEER at least 3 Days in advance of completion of any structure or roadway excavation and shall allow the ENGINEER a review period of at least one day before the exposed foundation is scarified and compacted or is covered with backfill or with any construction materials.

C. **Compaction of Fill, Backfill, and Embankment Materials**

1. Each layer of backfill materials as defined herein, where the material is graded such that 10 percent or more passes a No. 4 sieve, shall be mechanically compacted to the indicated percentage of density.
2. Equipment that is consistently capable of achieving the required degree of compaction shall be used, and each layer shall be compacted over its entire area while the material is at the required moisture content.
3. Each layer of coarse granular backfill materials with less than 10 percent passing the No. 4 sieve shall be compacted by means of at least 2 passes from a vibratory compactor that is capable of obtaining the required density in 2 passes.

D. **Heavy Equipment**

1. Equipment weighing more than 10,000 pounds shall not be used closer to walls than a horizontal distance equal to the vertical depth of the fill above undisturbed soil at that time.
2. Hand-operated power compaction equipment shall be used where the use of heavier equipment is impractical or restricted due to weight limitations.

E. Layering

1. Embankment and fill material shall be placed and spread evenly in approximately horizontal layers.
2. Each layer shall be moistened and aerated as necessary.
3. Unless otherwise approved by the ENGINEER, no layer shall exceed 6 inches of compacted thickness.
4. The embankment and fill shall be compacted in conformance with Paragraph K, below.

F. Embankments and Fills on Slopes

1. When an embankment or fill is to be constructed and compacted against hillsides or fill slopes steeper than 4:1, including the new 20-inch OD penstock slope, the slopes of the hillsides or fills shall be horizontally benched in order to key the embankment or fill to the underlying ground.
2. A minimum of 12 inches perpendicular to the slope of the hillside or fill shall be removed and re-compacted as the embankment or fill is brought up in layers.
3. Material thus cut shall be re-compacted along with the new material.
4. Hillside or fill slopes 4:1 or flatter shall be prepared in accordance with Paragraph A, above.

G. Compaction Requirements

1. The following compaction requirements shall be in accordance with ASTM D 1557 - Test Method for Laboratory Compaction Characteristics of Soils Using Modified Effort (56,000 ft - lbf/ft³) (2,700 kN-m/m³) where the material is graded such that 10 percent or more passes a No. 4 sieve and in accordance with ASTM D 4253 - Test Method for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table, and D 4254 - Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density, where the material is coarse granular backfill materials with less than 10 percent passing the No. 4 sieve:

Location or Use of Fill or Backfill	Percentage of Maximum Dry Density	Percentage of Relative Density
Embankments and fills not identified otherwise	90	55
Embankments and fills beneath paved areas or structures	95	70
Aggregate base or subbase beneath concrete pads	95	70

3.7 PIPELINE AND UTILITY TRENCH EXCAVATION AND BACKFILL

A. **Exploratory Excavations**

1. The CONTRACTOR shall excavate and expose buried points of connection to existing utilities and tailrace pipe as indicated.
2. Excavation shall be performed prior to the preparation of Shop Drawings for connections and before the fabrication of the pipe
3. The data obtained from exploratory excavations shall be used in preparing the Shop Drawings.
4. Data, including dates, locations excavated, and dimensioned sketches, shall be submitted to the ENGINEER within one week of excavation.
5. Damage to utilities from excavation activities shall be repaired by the CONTRACTOR in accordance with the General Conditions.

B. **General**

1. Unless otherwise indicated or ordered, excavation for pipelines and utilities shall be open-cut trenches with minimum widths as indicated.

C. **Trench Bottom**

1. Except where pipe bedding is required, the bottom of the trench shall be excavated uniformly to the grade of the bottom of the pipe.
2. Excavations for pipe bells and welding shall be made as required.
3. Where pipe bedding is required, the bottom of the trench shall be excavated uniformly to the grade of the bottom of the pipe bedding.

D. **Open Trenches**

1. The maximum amount of open trench permitted in any one location shall be 500 feet or the length necessary to accommodate the amount of pipe installed in a single Day, whichever is greater.
2. Trenches shall be fully backfilled at the end of each Day or, in lieu thereof, shall be covered by heavy steel plates adequately braced and capable of supporting vehicular traffic in those locations where it is impractical to backfill at the end of each Day.
3. These requirements for backfilling or use of steel plate will be waived in cases where the trench is located further than 100 feet from any traveled roadway or occupied structure; in such cases, however, barricades and warning lights meeting appropriate safety requirements shall be provided and maintained.

E. **Embankments, Fills and Structural Backfills**

1. Where pipelines are to be installed in embankments, fills, or structure backfills, the fill shall be constructed to a level at least one foot above the top of the pipe before the trench is excavated.
2. Upon completion of the embankment or structural backfill, a trench conforming to the appropriate detail may be excavated and the pipe may be installed.

F. Trench Shield

1. If a moveable trench shield is used during excavation operations, the trench width shall be wider than the shield such that the shield is free to be lifted and then moved horizontally without binding against the trench sidewalls and causing sloughing or caving of the trench walls.
2. If the trench walls cave or slough, the trench shall be excavated as an open excavation with sloped sidewalls or with trench shoring, as indicated and as required by the pipe structural design.
3. If a moveable trench shield is used during excavation, pipe installation, and backfill operations, the shield shall be moved by lifting the shield free of the trench bottom or backfill and then moving the shield horizontally.
4. The CONTRACTOR shall not drag trench shields along the trench causing damage or displacement to the trench sidewalls, the pipe, or the bedding and backfill.

G. Placing and Spreading of Backfill Materials

1. Each layer of coarse granular backfill materials with less than 10 percent passing the No. 4 sieve shall be compacted by means of at least 2 passes from a vibratory compactor that is capable of achieving the required density in 2 passes and that is acceptable to the ENGINEER.
2. Where such materials are used for pipe zone backfill, vibratory compaction shall be used at vertical intervals of the lesser of one-half the diameter of the pipe; or 24 inches, measured in the uncompacted state.
3. In addition, these materials shall be subjected to vibratory compaction at the springline of the pipe and the top of the pipe zone backfill, regardless of whether that dimension is less than 24 inches or not.
4. Each layer of backfill material with greater than 10 percent passing the No. 4 sieve shall be compacted using mechanical compactors suitable for the WORK.
5. The material shall be placed and compacted under the haunch of the pipe and up each side evenly so as not to move the pipe during the placement of the backfill.
6. The material shall be placed in lifts that will not exceed 6 inches when compacted to the required density.

H. Mechanical Compaction

1. Backfill around and over pipelines that is mechanically compacted shall be

compacted using light, hand-operated vibratory compactors and rollers that do not damage the pipe.

2. After completion of at least 2 feet of compacted backfill over the top of pipeline, compaction equipment weighing no more than 8,000 pounds may be used to complete the trench backfill.

I. Pipe and Utility Trench Backfill

1. Definitions

- a. **Bedding.** The bedding is defined as that portion of pipe zone backfill material between the trench subgrade and the bottom of the pipe.
- b. **Pipe Zone.** The pipe zone is defined as that portion of the vertical trench cross-section lying between a plane below the bottom surface of the pipe and a plane at a point above the top surface of the pipe as indicated.
- c. **Trench Zone.** The trench zone (located above the pipe zone) is defined as that portion of the vertical trench cross-section lying as indicated between a plane above the top surface of the pipe and a plane at a point 18 inches below the finished surface grade, or if the trench is under pavement, 18 inches below the roadway subgrade.
- d. **Final Backfill.** Final backfill is defined as backfill in the trench cross-sectional area within 6, inches of finished grade, or if the trench is under pavement, backfill within 18 inches of the roadway subgrade.

2. Pipe Zone Backfill

a. Final Trim

- 1) After compacting the bedding, the CONTRACTOR shall perform a final trim using a stringline for establishing grade, such that each pipe section when first laid will be continually in contact with the bedding along the extreme bottom of the pipe.
- 2) Excavation for pipe bells and welding shall be made as required.

- b. The pipe zone shall be backfilled with the indicated backfill material.
- c. Pipe zone backfill materials shall be manually spread evenly around the pipe, maintaining the same height on both sides of the pipe such that when compacted the pipe zone backfill will provide uniform bearing and side support.
- d. The CONTRACTOR shall exercise care in order to prevent damage to the pipeline coating, cathodic bonds, and the pipe itself during the installation and backfill operations.

3. Trench Zone Backfill

- a. After the pipe zone backfill has been placed, backfilling of the trench zone may

proceed.

4. Final Backfill and Grading

- a. Shall be conducted in accordance with the final elevations shown on the Civil Contract Drawings.

J. Identification Tape

- 1. Install identification tape as indicated.
- 2. Terminate the tape in a precast concrete box either adjacent to or part of the valve box, manhole, vault, or other structure into which the non-metallic pipe enters or at the end of the non-metallic pipeline.
- 3. The termination box shall be covered with a cast iron lid.
- 4. The box shall be located at grade in paved areas or 6 inches above grade in unpaved areas.

K. Trench Shield

- 1. If a moveable trench shield is used during backfill operations, the shield shall be lifted to a location above each layer of backfill material prior to compaction of the layer.
- 2. The CONTRACTOR shall not displace the pipe or backfill while the shield is being moved.

L. Compaction Requirements

- 1. The following compaction test requirements shall be in accordance with ASTM D 1557 - Test Method for Laboratory Compaction Characteristics of Soils Using Modified Effort (56,000 ft - lbf/ft³) (2,700 kN-m/m³) where the material is graded such that 10 percent or more passes a No. 4 sieve, and in accordance with ASTM D 4253 - Standard Test Method for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table, and D 4254 - Standard Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density where the material is coarse granular backfill materials with less than 10 percent passing the No. 4 sieve.

Location or Use of Fill or Backfill	Percentage of Maximum Dry Density	Percentage of Relative Density
Pipe bedding and over-excavated zones under bedding for flexible pipe, including trench plugs.	90	70

Pipe zone backfill portion above embedment for steel and flexible pipe	90	70
Final backfill, beneath concrete apron areas or structures.	95	70
Final backfill, not beneath paved areas or structures.	90	60
Trench zone backfill, beneath paved areas and structures, including trench plugs.	95	70
Trench zone backfill, not beneath paved areas or structures, including trench plugs.	85	50

3.8 FIELD TESTING

A. General:

1. Field soils testing will be performed by a testing laboratory of the OWNER's choice at the OWNER's expense, except as indicated below.

B. Density

1. Where soil material is required to be compacted to a percentage of maximum density, the maximum density at optimum moisture content will be determined in accordance with Method C of ASTM D 1557.
2. Where cohesionless, free draining soil material is required to be compacted to a percentage of relative density, the calculation of relative density will be determined in accordance with ASTM D 4253 and D 4254.
3. Field density in-place tests will be performed in accordance with ASTM D 1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method, ASTM D 2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place By Nuclear Methods (Shallow Depth), or by such other means acceptable to the ENGINEER.

C. Remediation

1. In case the test of the fill or backfill shows non-compliance with the required density, the CONTRACTOR shall accomplish such remedy as may be required to ensure compliance.
2. Subsequent testing to show compliance shall be by a testing laboratory selected by the OWNER and paid by the CONTRACTOR.

D. CONTRACTOR's Responsibilities

1. The CONTRACTOR shall provide test trenches and excavations, including excavation, trench support and groundwater removal for the OWNER's field soils testing operations.
2. The trenches and excavations shall be provided at the locations and to the depths as required by the OWNER.

- END OF SECTION -

SECTION 31 11 00 - SITE PREPARATION

PART 1 -- GENERAL

1.1 SUMMARY

- A. In its initial move onto the Site, the CONTRACTOR shall protect existing fences, houses and associated improvements, streets, and utilities downslope of construction areas from damage due to boulders, trees, or other objects dislodged during the construction process and clear, grub, strip; and regrade certain areas, in accordance with the Contract Documents.

1.2 SITE INSPECTION

- A. Prior to moving onto the Site, the CONTRACTOR shall inspect the Site conditions and review maps of the Site and facilities delineating the OWNER's property and right-of-way lines.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION

3.1 PRIMARY PLANT SITE ACCESS

- A. The CONTRACTOR shall develop temporary fencing and security gate(s) at the existing driveway entrance to the powerhouse site, as shown on Contract Drawing G-008. Temporary fencing shall include access barriers to prohibit entry of unauthorized persons.
- B. **Utility Interference:** Where existing utilities interfere with the WORK, notify the utility owner and the ENGINEER before proceeding in accordance with the General Conditions.

3.2 CLEARING, GRUBBING, AND STRIPPING

- A. Immediate construction areas shall be cleared of trees (live and downed timber), undergrowth, grass and weeds to at least a depth of 6-inches and cleared of structures, including any pavement, abandoned conduit and electrical conductors (confirm with OWNER), concrete or masonry debris, trees, logs, upturned stumps, loose boulders, and any other objectionable material of any kind which would interfere with the performance or completion of the WORK, create a hazard to safety, or impair the subsequent usefulness of the WORK, or obstruct its operation. Loose boulders within 10-feet of the top of cut lines shall be incorporated in landscaping for project site work and Access Trail Improvements WORK. Trees and other natural vegetation outside the actual lines of construction shall be protected from damage during construction.
- B. Within the limits of clearing, the areas below the natural ground surface shall be grubbed to a depth necessary to remove stumps, roots, buried logs, and other objectionable material. Septic tanks, drain fields, and connection lines and any other underground structures, debris or waste shall be removed if found on the Site. Objectionable material

from the clearing and grubbing process shall be removed from the Site and wasted in approved safe locations.

- C. The entire penstock and other excavation area to be affected by construction shall be stripped to depths as indicated on the Contract Drawings. The stripped materials shall be stockpiled and incorporated into landscaped areas or other non-structural embankments.
- D. Unless otherwise indicated, native trees larger than 12-inches in diameter at the base shall not be removed without the OWNER's approval. The removal of any trees, shrubs, fences, or other improvements outside of rights-of-way, if necessary for the CONTRACTOR's choice of means and methods, shall be arranged with the owner of the property, and shall be removed and replaced, as part of the WORK.

3.3 OVEREXCAVATION, REGRADING, AND BACKFILL UNDER FILL AREAS

- A. After the fill areas have been cleared, grubbed, and excavated, the areas to receive fill will require over-excavation, regrading, and backfill, consisting of the removal and/or stockpiling of undesirable soils. The ground surface shall be recontoured for keying the fill and removing severe or abrupt changes in the topography of the Site.
- B. After removal of organic laden soil, the remaining soils that will require removal from the bedrock surface prior to the placement of embankment fill include:
 - 1. Topsoil: This soil mantles the siltstone/claystone which comprises much of the hillslope on the southern, approximately two-thirds of the plant site.
 - 2. Colluvium: This material is also present on the hillsides and covers the valley floor of the Site.
 - 3. Artificial Fill (Quarry Waste): Most of this material is present on the west side of the plant site near Rosalind Lane.
- C. Any undesirable topsoil and colluvium shall be removed to the level designated by the ENGINEER and stockpiled for subsequent use as the first material to be placed in the compacted fill.
- D. Any steep, very abrupt rock faces and irregularly shaped rock outcrops of bedrock shall be regraded as directed by the ENGINEER.

- END OF SECTION -

SECTION 31 23 00 - CONTROLLED LOW STRENGTH MATERIAL

PART 1 -- GENERAL

1.1 SUMMARY

- A. The CONTRACTOR shall provide Controlled Low Strength Material (CLSM), complete and in place, in accordance with the Contract Documents.
- B. CLSM shall be placed where indicated and may be used, if the ENGINEER approves, for the following purposes:
 - 1. Normal CLSM with high slump, non-segregating consistency that readily flows and fills voids and difficult to reach places: pipe zone fill, trench zone fill, pipe abandonment, structure backfill, and structure cavity fill.

1.2 CONTRACTOR SUBMITTALS

- A. Furnish submittals in accordance with Section 01 33 00 - Contractor Submittals.
- B. Shop Drawings:
 - 1. CLSM mix designs which show the proportions and gradations of materials proposed for each type of CLSM indicated. Each mix design shall be accompanied by independent laboratory test results of the indicated properties.
 - 2. If the CONTRACTOR proposes to provide lower strength CLSM with aggregates that do not conform to ASTM C 33 - Concrete Aggregate, Shop Drawings shall include a testing program that will be used to control the variability of the aggregates. The testing program shall be acceptable to the Engineer.

1.3 QUALITY CONTROL

- A. Testing will be performed by a testing laboratory selected by the OWNER at the OWNER's expense, except as otherwise indicated.
- B. If tests of the CLSM show non-compliance with the specifications, the CONTRACTOR shall make changes as may be required to achieve compliance. Performing and paying for subsequent testing to show compliance shall be the CONTRACTOR's responsibility.
- C. Correlation Tests
 - 1. The CONTRACTOR shall perform a field correlation test for each mix of CLSM used in pipe zone, trench zone, or backfill used in amounts greater than 100-cubic yards or when CLSM is required to support traffic or other live loads on the fill less than 7 Days after placing CLSM.
 - 2. Field correlation tests shall be performed in a test pit similar in cross section to the WORK and at least 10-feet long at a location near the WORK. The proposed location shall be acceptable to the ENGINEER.

3. Laboratory and field tests shall be performed on samples taken from the same CLSM batch mix. Tests shall be performed by a laboratory at the CONTRACTOR's expense.
4. Testing shall be performed once each 2 hours during the first 8 hours, once each 8 hours during the first week, and once each 24 hours until the CLSM mix reaches the maximum design strength.
 - a. Compression testing shall be in accordance with ASTM D 4832 - Preparation and Testing of Soil-Cement Slurry Test Cylinders.
 - b. Setting test shall be in accordance with ASTM C 403 - Time of Setting of Concrete Mixtures by Penetration Resistance
 - c. Density tests shall be in accordance with ASTM C 138 - Unit Weight, Yield and Air Content (Gravimetric) of Concrete.

PART 2 -- PRODUCTS

2.1 CONTROLLED LOW STRENGTH MATERIAL

- A. CLSM shall be a mixture of cement, pozzolan, coarse and fine aggregate, admixtures, and water, mixed in accordance with ASTM C 94 - Ready Mixed Concrete.
- B. **Composition:** The following parameters shall be within the indicated limits and as necessary to produce the indicated compressive strengths.
 1. Mix proportions as necessary
 2. Entrained air content shall be between 3 percent minimum and 8 percent maximum.
 3. Water reducing agent content as necessary
- C. Properties
 1. Density shall be between 130 pcf minimum and 145 pcf maximum
 2. Slump shall be as required by the CONTRACTOR's methods, but shall not promote segregation nor shall slump exceed 9 inches.
 3. Compressive strength at 28 Days:
 - a. Normal CLSM: Between 100 psi minimum and 300 psi maximum compressive strength. Unless specifically indicated otherwise, CLSM shall be Normal CLSM.

2.2 CEMENT

- A. Cement shall be Type I or II in accordance with ASTM C 150 - Portland Cement.

2.3 POZZOLAN

- A. Addition of Pozzolan shall be at the CONTRACTOR's option. Pozzolan shall be Type F or C in accordance with ASTM C 618 – Fly ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete. Pozzolan content, by weight, in Normal CLSM shall not be greater than the weight of the cement content.

2.4 AGGREGATE

- A. Aggregate shall consist of a well graded mixture of crushed rock, soil, or sand, with a nominal maximum size of 3/8-inch. One hundred percent shall pass the 1/2-inch sieve; no more than 30 percent shall be retained on the 3/8-inch sieve; and no more than 10 percent shall pass the number 200 sieve. If more than 5 percent of the aggregate passes the number 200 sieve, the material passing the number 200 sieve shall have a plasticity index of less than 0.73 (liquid limit-20), when tested in accordance with ASTM D 4318 - Liquid Limit, Plastic Limit, and Plasticity Index of Soils. Aggregate shall be free from organic matter and shall not contain more alkali, sulfates, or salts than the native materials at the Site.

2.5 ADMIXTURES

- A. Air entraining admixtures shall be in accordance with ASTM C 260 - Air-Entraining Admixtures for Concrete.
- B. Water reducing admixtures shall be in accordance with ASTM C 494 - Chemical Admixtures for Concrete.

2.6 WATER

- A. Water shall be potable, clean, and free from objectionable quantities of silt, organic matter, alkali, salt, and other impurities.

PART 3 -- EXECUTION

3.1 PREPARATION

- A. Subgrade and compacted fill to receive CLSM shall be prepared according to Section 31 00 00 - Earthwork.

3.2 BATCHING, MIXING AND DELIVERY

- A. Batching, mixing, and delivery of CLSM shall conform to ASTM C 94. CLSM shall be mixed at a batch plant acceptable to the ENGINEER and shall be delivered in standard transit mix trucks.

3.3 PLACEMENT

- A. CLSM shall be placed by tailgate discharge, conveyor belts, pumped, or other means. CLSM shall be directed in place by vibrator, shovel, or rod to fill crevices and pockets. Avoid over-consolidation which causes separation of aggregate sizes.
- B. CLSM shall be continuously placed against fresh material unless otherwise approved by the ENGINEER. When new material is placed against existing CLSM, the placement area shall be free from loose and foreign material. The surface of the existing material

shall be soaked a minimum of one hour before placement of fresh material but no standing water shall be allowed when placement begins.

- C. Temperature of the CLSM shall be between 50- and 90-degrees F, when placed. CLSM shall not be placed when the air temperature is below 40 degrees F. No CLSM shall be placed against frozen subgrade or other materials having temperature less than 32 degrees F.

3.4 FINISHING

- A. The finish surface shall be smooth and to the grade indicated or directed by the ENGINEER. Surfaces shall be free from fins, bulges, ridges, offsets, and honeycombing. Finishing by wood float, steel trowel, or similar methods is not required.

3.5 CURING

- A. CLSM shall be kept damp for a minimum of 7 Days or until final backfill is placed.

3.6 PROTECTION

- A. CLSM shall be protected from freezing for 72 hours after placement.
- B. No fill or loading shall be placed on CLSM until probe penetration resistance, as measured in accordance with ASTM C 803 - Standard Test Method for Penetration Resistance of Hardened Concrete, exceeds 650 psi.
- C. CLSM shall be protected from running water, rain, and other damage until the material has been accepted and final fill completed.

- END OF SECTION -

SECTION 31 35 00 - EROSION AND SEDIMENT CONTROL, GENERAL

PART 1 -- GENERAL

1.1 SUMMARY

- A. Work includes furnishing all labor, materials and equipment required for the installation and maintenance of both permanent and temporary erosion and sediment control measures as shown on the drawings and as specified herein.
- B. Erosion and sediment control measures shall remain in place while potential for erosion exists from construction activities at the site and disposal area, during the duration of the contract and warranty period;
 - 1. Protect and stabilize soils susceptible to erosion. This includes areas where vegetative cover cannot be achieved due to soils, slopes or time of year. The contractor shall be aware of and conform to measures necessary for the control of erosion and sediment runoff according to applicable regulations.
 - 2. Prevent sediment or sediment laden water from entering all creeks and the storm drain systems or to be discharged from the construction site in accordance with the USEPA and other applicable local regulations.
- C. All temporary erosion and sediment control measures shall be installed prior to commencement of construction.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

U.S. DEPARTMENT OF AGRICULTURE (USDA) AMS Seed Act (1940; R 1988; R 1998) Federal Seed Act

Alaska Department of Environmental Conservation, Best Management Practices for Erosion and Sediment Control

1.3 SUBMITTALS

- A. ENGINEER will provide a preliminary Erosion and Sediment Control Plan for approval by the involved Agencies. CONTRACTOR will review and provide a revised plan in accordance with the provisions of Section 01 33 00 – Contractor Submittals and Section 01 57 20 – Temporary Environmental Controls.

PART 2 – PRODUCTS (NOT USED)

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. Install erosion and sediment control measures per manufacturer's directions and as illustrated on the Contract Drawings.

3.2 MAINTENANCE AND REMOVAL

- B. Repair and reinstall temporary soil erosion control measures as necessary to ensure proper function for the duration of ground disturbing activities and through the warranty period.
- C. Temporary erosion control devices shall be removed only after they have performed their intended function.
- D. All pipes, end sections, drainage curbs, sand bags, sediment fences and other materials which are removed from temporary erosion control devices and not incorporated into the permanent work shall become the property of the Contractor and shall be removed from the area.

- END OF SECTION -

SECTION 31 37 00 - RIPRAP

PART 1 -- GENERAL

1.1 SUMMARY

- A. The CONTRACTOR shall provide riprap, including associated earthwork, complete and in place, in accordance with the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

ASTM C 88	Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 535	Standard Test Method for Resistance to Degradation of Large Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
AASHTO T 85	Standard Method of Test for Specific Gravity and Absorption of Coarse Aggregate
AASHTO T 210	Method of Test for Aggregate Durability Index.

1.3 CONTRACTOR SUBMITTAL

- A. Furnish submittals in accordance with Section 01 33 00 – Contractor Submittals.
- B. Testing certificates from a qualified testing agency shall be submitted prior to acceptance of the rock source to verify the conformity to the requirements of the Contract Documents.

PART 2 -- PRODUCT

2.1 STONES FOR RIPRAP

- A. Stones shall be graded in size to produce a reasonably dense mass. Riprap shall consist of dense, natural rock fragments. Stones shall be resistant to weathering and to water action; free from overburden, spoil, shale, and organic material; and shall meet the gradation requirements below. Shale and stones with shale seams are not acceptable.
- B. Riprap shall conform to the size types as follows:
1. Type II (12-inch Average Size):

Diameter	Percentage Passing
18-inch	95 - 100
12-inch	25 - 75

6-inch	0 - 5
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2. Type III (18-inch Average Size):

Diameter	Percentage Passing
24-inch	95 - 100
18-inch	25 - 75
13-inch	0 - 5

- C. The greatest dimension of 50 percent of the stones shall be at least two-thirds but not more than 1-1/2 times the diameter of the average size. Neither the breadth nor thickness of any piece of riprap shall be less than one-third its length. Material shall be of shapes which will form a stable protection structure of required depth. Rounded boulders or cobbles shall not be used.
- D. Stones shall consist of durable, sound, hard, angular rock meeting the following requirements for durability absorption ratio, soundness test, and abrasion test:

Durability Absorption Ratio	Acceptability
Greater than 23	Passes
10 to 23	Passes only if Durability Index is 52 or greater
Less than 10	Fails
Durability Absorption Ratio	<u>Durability Index (Coarse)</u> % absorption + 1

- E. The durability index and percent absorption shall be determined by AASHTO T 210 and AASHTO T 85, respectively. The minimum apparent specific gravity of the stones shall be 2.5 as determined by AASHTO T 85.
- F. Stones shall have less than 10 percent loss of weight after five cycles, when tested per ASTM C 88.
- G. Stones shall have a wear not greater than 40 percent, when tested per ASTM C 535.
- H. Control of gradation shall be by visual inspection. The CONTRACTOR shall furnish a sample of the proposed gradation of at least 5 tons or 10 percent of the total riprap weight, whichever is less. If approved, the sample may be incorporated into the finished riprap at a location where it can be used as a frequent reference for judging the gradation of the remainder of riprap.

- I. The acceptability of the stones will be determined by the ENGINEER prior to placement. Any difference of opinion between the ENGINEER and the CONTRACTOR shall be resolved by dumping and checking the gradation of two random truckloads of stones. Arranging for and the costs of mechanical equipment, a sorting site, and labor needed in checking gradation shall be the CONTRACTOR's responsibility.

2.2 GEOTEXTILE FABRIC

- A. If required on Contract Drawings, geotextile fabric shall conform to the requirements of Section 31 05 19 - Geotextiles.

2.3 FILTER MATERIAL

- A. Filter material shall be clean and free from organic matter. It shall be crushed rock or gravel, durable and free from slaking or decomposition under the action of alternate wetting or drying. The material shall be uniformity graded and shall conform to the following gradation:

- 1. Type 1

Size	Percentage Passing
3-inch	85 – 100
1-1/2 inch	45 – 75
3/4-inch	10 – 25

PART 3 -- EXECUTION

3.1 SURFACE PREPARATION

- A. Surfaces to receive riprap shall be smooth and firm, free of brush, trees, stumps, and other objectionable material, and shall be brought to the line and grade indicated.
- B. If a boulder is encountered during excavation of areas where large riprap is to be placed, the CONTRACTOR shall excavate around the boulder. If the boulder is larger than the largest allowable stone size for that area, the CONTRACTOR shall break up the boulder to an acceptable size or remove it entirely.
- C. When called for on Contract drawings, prior to placement of the geotextile, the surface shall be prepared to a smooth condition free of debris, depressions, or obstructions which may damage the geotextile. The geotextile shall be overlapped a minimum of 2-feet at longitudinal and transverse joints. Upstream sheets shall overlap downstream sheets. For slope placement, each strip shall overlap the next downhill strip. The geotextile shall be anchored using key trenches or aprons at the crest and toe of the slope. Pins may be used in securing the geotextile during installation. In no instance shall the geotextile be left exposed to sunlight longer than 7-Days. Overexposed geotextile shall be removed and replaced.

3.2 PLACEMENT OF FILTER BLANKET

- A. Area of riprap placement shall be excavated to the bottom of the filter blanket as indicated and in accordance with Section 31 00 00 – Earthwork. After the excavation has been completed, the top 12-inches of exposed surface shall be scarified, brought to optimum moisture content, and compacted to 95 percent of maximum density. The finished grade shall be even, self-draining, and in conformance with the slope of the finished grade.
- B. Placement of filter material shall be in accordance with Section 31 00 00. Filter material shall be placed, spread, and compacted in lifts not to exceed 12-inches.
- C. The CONTRACTOR shall remove any portion of the filter blanket that has been disturbed to the degree that the layers become mixed. Replace the removed portion with the required sizes.
- D. Filter material shall be placed as follows, unless otherwise indicated.
 - 1. For Type II, and Type III riprap, use 12-inches of Type 1 filter material.
- E. No filter material is required if riprap is placed directly on bedrock.

3.3 PLACEMENT OF RIPRAP

- A. Placement of riprap shall begin at the toe of the slope and proceed up the slope. The stones may be placed by dumping and may be spread by bulldozers or other suitable equipment as long as the underlying material is not displaced. Stones shall be placed so as to provide a minimum of voids. Smaller stones shall be uniformly distributed throughout the mass. Sufficient hand work shall be done to produce a neat and uniform surface, true to the lines, grades, and sections indicated.
- B. Where riprap is placed over a geotextile fabric, the riprap shall be placed so as to avoid damage to the geotextile. Stones shall not be dropped from a height greater than 3-feet, nor shall large stones be allowed to roll downslope.

- END OF SECTION -

SECTION 32 92 19 – MANUAL OR HYDROSEEDING

PART 1 -- GENERAL

1.1 SUMMARY

- A. The CONTRACTOR shall provide all rough and final grading, run-off ditch shaping, fertilizer, seeding and required equipment, labor and materials necessary to complete the re-vegetation of the disturbed areas within the project limits.
 - 1. The disturbed areas of the project are expected to extend from just above the connection point of old 20" OD penstock to new 20" OD penstock and extend down to the powerhouse and around the powerhouse yard as part of the new 10 / 12-inch bypass piping work.
 - 2. The existing graveled areas that exist around the immediate powerhouse yard area will require regrading and regravelling by the CONTRACTOR, but are not considered areas that will require manual or hydroseed revegetation.

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.
 - 1. ASTM INTERNATIONAL (ASTM)
 - 2. ASTM C602 (2007) Agricultural Liming Material
 - 3. ASTM D4427 (2007) Peat Samples by Laboratory Testing
 - 4. ASTM D4972 (2001; R 2007) pH of Soils
 - 5. U.S. DEPARTMENT OF AGRICULTURE (USDA)
 - 6. AMS Seed Act (1940; R 1988; R 1998) Federal Seed Act
 - 7. DOA SSIR 42 (1996) Soil Survey Investigation Report No. 42, Soil Survey Laboratory Methods Manual, Version 3.0

1.3 RELATED REQUIREMENTS

- A. Section 31 00 00 – Earthwork , applies to this section for pesticide use and plant establishment requirements, with additions and modifications herein.

1.4 CONTRACTOR SUBMITTALS

- A. Submittals shall be in accordance with Section 01 33 00 - Contractor Submittals.
- B. Product Data: Manufacturer's catalog sheets on seeding, fertilizer and binder materials.

1.5 DELIVERY

- A. **Seed Protection:** Protect from drying out and from contamination during delivery, on-site storage, and handling.
- B. **Fertilizer Delivery.** Deliver to the site in original, unopened containers bearing manufacturer's chemical analysis, name, trade name, trademark, and indication of conformance to state and federal laws. Instead of containers, fertilizer may be furnished in bulk with certificate indicating the above information.

1.6 STORAGE

- A. **Seed, Binder and Fertilizer Storage.** Store in cool, dry locations away from contaminants.

1.7 TOPSOIL

- A. Prior to stockpiling topsoil, treat growing vegetation with application of appropriate specified non-selective herbicide. Clear and grub existing vegetation three to four weeks prior to stockpiling topsoil.

1.8 TIME RESTRICTIONS AND PLANTING CONDITIONS

- A. Do not hydro-seed plant material when the ground is frozen, snow covered, muddy, or when air temperature exceeds 85 degrees Fahrenheit.

1.9 TIME LIMITATIONS

- A. **Seed and Binder.** Apply seed within twenty-four hours after bed preparation.

PART 2 -- PRODUCTS

2.1 SEED

- A. Provide Alaska state-certified, state-approved seed of the latest season's crop delivered in original sealed packages, bearing producer's guaranteed analysis for percentages of mixtures, purity, germination, weed seed content, and inert material. Label in conformance with AMS Seed Act and applicable state seed laws.
 - 1. Wet, moldy, or otherwise damaged seed will be rejected.
 - 2. Field mixes will be acceptable when field mix is performed when approved on-site in the presence of the OWNER.

PART 3 -- EXECUTION

3.1 PREPARATION

- A. Provide smooth graded areas to be manually or hydroseeded free from weeds, limbs, rocks etc. at the required locations.
- B. **CONTRACTOR** shall not commence manual-or hydroseeding until approved to proceed by the OWNER.

3.2 MAINTENANCE

- A. Regularly inspect and repair damaged or eroded areas as directed. Unless otherwise directed, maintain the seeded areas until final acceptance.

- END OF SECTION -

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**SECTION 33 11 11 - STEEL PENSTOCK PIPE, SPECIALS, AND FITTINGS
(AWWA C200, MODIFIED)**

PART 1 -- GENERAL

1.1 SUMMARY

- A. The CONTRACTOR shall provide steel pipe, specials, and fittings, complete and in place, in accordance with the Contract Documents.
- B. A single pipe manufacturer shall be made responsible for furnishing steel pipe, specials, fittings, and appurtenances such as bolts and gaskets for the WORK.
- C. **Pipe Material Group No. 8.** The piping system defined in this section is referred to in the Pipe Schedule on Contract Sheet G007 as Piping Material Group No. 8. **(Note that steel Pipe of 14-inch diameter and larger, as called out on the Contract Drawings, shall be based upon outside diameter dimensions, per Part 2.1.A of this Section.)**
- D. **Shop Welded Piping System.** The project design intent is that nearly all welding of steel pipe and steel pipe fittings, including flanges and specials occur in the Manufacturer's shop. Field welding of steel pipe shall be held to a minimum at locations as indicated on the Contract Drawings.

1.2 CONTRACTOR SUBMITTALS

- A. Furnish submittals in accordance with Section 01 33 00 – Contractor Submittals.
- B. Furnish the following information with Shop Drawings:
 - 1. Certified dimensional drawings of fittings and appurtenances
 - 2. Joint and pipe/fitting wall construction details which indicate the type and thickness of cylinder; the position, type, size, and area of reinforcement; coating and lining holdbacks, manufacturing tolerances, and other pertinent information required for the manufacture of the product
 - 3. Details for elbows, penstock bifurcations and wyes, tees, outlets, connections, test bulkheads, and nozzles or other specials that indicate amount and position of reinforcement
 - 4. Fittings and specials, showing proper reinforcement to withstand the internal pressure, both circumferential and longitudinal, and the external loading conditions as indicated
 - 5. Material lists and steel reinforcement schedules that describe materials to be utilized, including metallurgical, chemical, and physical test reports from each heat of steel to verify the steel conforms to the indicated requirements
 - 6. Line layout and marking diagrams which indicate the specific number of each pipe and fitting, the location of each pipe, the direction of each fitting in the completed line, and the following:

- a. the pipe station and invert elevation at every change in grade or horizontal alignment
 - b. the station and invert elevation to which the bell end of each pipe will be laid
 - c. elements of curves and bends, both in horizontal and vertical alignment
 - d. the limits within each reach of restrained and/or welded joints or of concrete encasement
 - e. location and dimensional allocations for each indicated valve, fitting, and appurtenance
 - f. Specials design calculations in accordance with AWWA M11
7. Welds
- a. Submit full and complete information regarding location, type, size, and extent of welds.
 - b. The Shop Drawings shall distinguish between shop and field welds.
 - c. Shop Drawings for field welds shall indicate by welding symbols or sketches the details of the welded joints and the preparation of parent metal required to make them. Submittal shall include a complete Welding Procedure Specification (WPS) guide sheet for each category of weld (fillet weld, single-bevel butt weld, double-bevel butt weld, etc.) that defines all specific details for the supplied weld including:
 - 1) Welding Procedure Specification (WPS) which identifies characteristics including joint and backing ring (if applicable) geometry, base metal and filler metal characteristics, pre-heating and post-heating requirements, electrical characteristics, welding technique, and a welding parameter sheet.
 - 2) Propose Welding Procedure Qualification (WPQ) process,
 - 3) Proposed inspection and non-destructive examination (NDE) requirements to meet the requirements of this Section.
 - d. Joints or groups of joints in which welding sequence or technique are especially important shall be carefully controlled to minimize shrinkage stresses and distortion.
8. Rubber gasket joint design and details (where used on the penstock)
9. Drawings showing the location, design, and details of bulkheads for hydrostatic testing of the pipeline, and details for removal of test bulkheads and repair of the lining
10. Details and locations of closures for length adjustment and for construction convenience

11. Detail drawings indicating the type, number, and other pertinent details of the slings, strutting, and other methods proposed for pipe handling during manufacturing, transport, and installation
12. Manufacturer's Written Quality Assurance / Control Program

C. Certifications

1. The CONTRACTOR shall furnish a certified affidavit of compliance for pipe and other products or materials in accordance with
 - AWWA C200 - Steel Water Pipe 6 in and Larger,
 - AWWA C208 - Dimensions for Fabricated Steel Water Pipe Fittings,
 - AWWA C210 - Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines,
 - AWWA C213 - Fusion-Bonded Epoxy Coatings for the Interior and Exterior of Steel Water Pipelines,
 - AWWA C216 - Heat-Shrinkable Cross-Linked Polyolefin Coatings for the Exterior of Special Sections, Connections, and Fittings,
 - AWWA C218 - Coating the Exterior of Aboveground Steel Water Pipelines and Fittings
 - AWWA C219 - Bolted, Sleeve-Type Couplings for Plain-End Pipe,
 - AWWA C221 - Fabricated Steel Mechanical Slip-Type Expansion Joints, and
 - AWWA C222 - Polyurethane Coatings for the Interior and Exterior of Steel Water Pipelines and Fittings,

and the following supplemental requirements:

- a. physical and chemical properties of steel
 - b. hydrostatic test reports
 - c. results of production weld tests
 - d. sand, cement, and mortar tests
 - e. rubber gasket tests
 - f. coating adhesion test
2. Performance and payment for sampling and testing necessary for certification are the CONTRACTOR's responsibility as part of the WORK.

D. Manufacturer's Qualifications

1. Furnish a copy of manufacturer's certification to ISO 9000, SPFA, or LRQA, and documentation of manufacturer's experience in fabricating AWWA C200 pipe.

E. Design Calculations of Fittings and Specials

1. Furnish a copy of the design calculations for fittings and specials including miters, welds, and reinforcement, prior to manufacture of the pipe, fittings, and specials.

1.3 QUALITY CONTROL

A. **Pipe Manufacturer Qualifications**

1. The pipe manufacturer shall be certified to ISO 9000, the Steel Plate Fabricator's Association (SPFA), or Lloyd's Register Quality Assurance (LRQA), and shall be experienced in fabrication of AWWA C200 pipe of similar diameters, lengths, and wall thickness to this WORK.
2. Experience shall be in the production facilities and personnel, not the name of the company that owns the production facility or employs the personnel.

B. **Inspection**

1. Pipe shall be subject to inspection at the place of manufacture in accordance with the provisions of AWWA C200, C208, and C222, as supplemented by the indicated requirements.
2. The CONTRACTOR shall notify the ENGINEER in writing of the manufacturing start date not less than 14 Days prior to the start of any phase of the pipe manufacture.

C. **Shop Tests**

1. Except as indicated otherwise, materials used in the manufacture of the pipe shall be tested in accordance with the requirements of AWWA C200, C208, and C214 as follows and as applicable:
 - a. Shop Tests
 - 1) After the joint configuration is completed and prior to lining with cement mortar, each length of pipe of each diameter and pressure class shall be shop-tested and certified to a pressure of at least 75 percent of the yield strength of the steel.
 - 2) The test pressure shall be held for 2 minutes and the pipe visually inspected to confirm that welds are sound and leak-free.
 - b. In addition to the tests required in AWWA C200, at least one (1) weld tests shall be conducted on each batch of production welds and at any other times there is a change in the grade of steel, welding procedure, or welding equipment.
 - c. Fittings fabricated from straight pipe previously passing a hydrostatic test need not have an additional hydrostatic test, provided that the welds are tested by nondestructive means and are demonstrated to be sound.

D. Shop Testing of Steel Plate Specials

1. If any special has been fabricated from straight pipe not previously tested and is of the type listed herein (bends, wyes, tees or bifurcations with side outlet diameter greater than 30 percent of the main pipe diameter, and manifolds), the special shall be hydrostatically tested with a pressure equal to no less than 1.3 times the hydrostatic design working pressure.
2. Specials not required to be hydrostatically tested shall be tested by liquid dye penetrant inspection method in accordance with ASTM E 165 - Standard Test Methods for Liquid Penetrant Examination, Method A, or the magnetic particle method in ASME Section VIII, Division 1, Appendix VI.
3. Reinforcing plates shall be tested by the solution method using approximately 40 psig air pressure introduced between the plates through a threaded test hole; the test hole shall be properly plugged following successful testing.
4. Weld Imperfections
 - a. Weld defects, cracks, leaks, distortion, or signs of distress during testing shall require corrective measures.
 - b. Weld defects shall be gouged out and re-welded.
 - c. After corrections, the special shall be retested.
5. Test Heads
 - a. Where welded test heads or bulkheads are used, extra length shall be provided to each opening of the special.
 - b. After the removal of each test head, the special shall be trimmed back to the design points with finished plate edges ground smooth, straight, and prepared for the field joint.
6. Testing shall be performed before joints have been coated or lined.
7. Ultrasonic examination shall be performed in accordance with the following:
 - a. Steel plate that will be in welded joints or welded stiffener elements shall be examined ultrasonically for laminar discontinuities where both of the following conditions exist:
 - 1) any plate in the welded joint has a thickness exceeding 0.50 inches.
 - 2) any plate in the welded joint is subject to transverse tensile stress through its thickness during the welding or service
 - b. Ultrasonic examination may be waived where joints are designated to minimize potential laminar tearing.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Lined and coated steel pipe and specials shall conform to AWWA C200, C207, C208, and C222, subject to the following supplemental requirements:

1. The pipe, specials, and fittings shall be of the diameter and class indicated and shall be provided complete with rubber gaskets or welded joints as indicated.
2. **Steel Pipe of 14-inch Diameter and Larger Based upon Outside Diameter Dimension. For pipe, specials, and fittings of 14-inch diameter and larger, the pipe diameter as indicated on the Contract Drawings is the required minimum outside diameter of the pipe, as measured from the outside face of the steel shell to the outside face of the steel shell.** Use of standard IPS outside diameter steel pipe dimensions is acceptable for pipe classified as pipe material No. 8 on the Contract Drawings. Also, pipe, specials, and fittings of 12-inch diameter and smaller may be furnished in standard outside iron pipe size (IPS) diameters.
3. When indicated as a minimum, wall thickness tolerance shall be as allowed by AWWA C200 or the ASTM nominal sheet or plate tolerance, whichever is less.

B. Markings

1. The manufacturer shall legibly mark pipe, specials, and fittings in accordance with the laying schedule and marking diagram.
2. Each pipe, special, and fitting shall be numbered in sequence and said number shall appear on the laying schedule and marking diagram in its proper location for installation.
3. Each pipe, fitting, and special shall be marked at each end with top field centerline.

C. Handling and Storage

1. The pipe, specials, and fittings shall be handled by use of wide slings, padded cradles, or other devices designed and constructed to prevent damage to the pipe coating and exterior.
2. The use of chains, hooks, or other equipment that might injure the pipe coating or exterior will not be permitted.
3. Stockpiled pipe, specials, and fittings shall be supported on padded skids, sand or earth berms free of rock exceeding 1-inch in diameter, sand bags, or suitable means so that the pipe including coating and lining coating will not be damaged.
4. Pipe, specials, and fittings shall not be rolled and shall be secured to prevent accidental rolling.
5. The CONTRACTOR shall replace or repair damaged pipe, specials, and fittings.

D. Strutting

1. Adequate strutting shall be provided on specials, fittings, and straight pipe in order to avoid damage to the pipe, specials, and fittings during handling, storage, hauling, and installation.

E. Laying Length

1. The maximum pipe laying length shall be 40-feet, with shorter lengths to be provided as indicated and required.

F. Lining

1. The pipe, specials, and fittings shall have smooth, dense interior surfaces and shall be free from fractures, excessive interior surface crazing, and roughness.
2. Pipe segments for this project shall be supplied with a 4-inch diameter female NPT half-coupling hand-hole at each joint to allow for field application of the interior liquid liner product after welding is complete. Each hand-hole shall be furnished with a mating male 4-inch diameter NPT Class 300 plug for sealing the hand-hole after its use.

G. Closures and Correction Pieces

1. Closures and correction pieces shall be provided as required such that closures may be made due to different headings in the pipe laying operation and such that corrections may be made to adjust the pipe laying to conform to the indicated pipe stationing.

2.2 MATERIALS

A. Steel for Pipe Cylinder and Fittings

1. Pipe, specials, and fittings manufactured under AWWA C200 shall satisfy the following requirements:
 - a. minimum yield strength of steel: 42,000 psi
 - b. manufactured by a continuous casting process
 - c. fully kilned
 - d. fine grain practice
 - e. maximum carbon content: 0.25 percent
 - f. maximum sulfur content: 0.015 percent
 - g. minimum elongation: 22 percent in a 2-inch gauge length
 - h. in accordance with one of the following Standards:

- 1) ASTM A1011 - Steel Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
 - 2) ASTM A572 - High Strength Low-Alloy Columbium-Vanadium Structural Steel
 - 3) ASTM A1018 - Steel, Sheet and Strip, Heavy Thickness Coils, Hot-Rolled Carbon, Structural, High-Strength Low-Alloy Columbium or Vanadium, and High-Strength Low-Alloy with Improved Formability
2. Impact Testing (for pipes of 0.5-inch thickness or more)
- a. Steel equal to or greater than 0.5-inch-thick used in fabricating pipe shall be tested for notch toughness using the Charpy V-Notch test in accordance with ASTM A 370 - Test Methods and Definitions for Mechanical Testing of Steel Products.
 - b. The frequency of testing shall be one impact test (set of 3 specimens - transverse, not longitudinal) for each coil used in manufacturing the pipe.
 - c. The testing frequency for sheets and plates shall be one impact test (set of 3 specimens) for each 200 tons of product.
 - d. The steel shall withstand a minimum impact of 25 ft-lb at a temperature of 30 degrees F.

B. Polyurethane Lining and Coating of new Steel Pipe and Fittings

1. Where indicated, the interior surfaces of pipe, fittings, and specials shall be lined with polyurethane in accordance with AWWA C222 and the following:
 - a. Surface Preparation: grit blast to near white metal condition, SSPC SP 10
 - b. Application: total primer and interior lining and coating product thicknesses shall be per minimum requirements specified below.
 - c. No single coat thickness shall exceed the manufacturer's recommendations.
 - d. Manufacturer: ***Sherwin Williams Hi-Solids***, or equal.

C. Urethane Field Re-Coating of Existing Steel Pipe and Fittings

1. Where indicated, the exterior surfaces of existing pipe, fittings, and sleeve couplings covered originally with coal-tar enamel system, shall be coated with a single component, moisture-cured, aluminum and micaceous iron oxide (MIO) filled urethane product of 75 to 80% by weight solids. Application of this exterior coating shall be performed in the field in accordance with the following:
 - a. Surface Preparation: SSPC SP-2 / SP-3

- b. Application: total primer and exterior coating product thicknesses shall be per minimum requirements specified below.
- c. No single coat thickness shall exceed the manufacturer's recommendations.
- d. Product adhesion, direct impact resistance, and moisture condensation resistance and salt-fog resistance shall be per the ASTM test methods indicated by the manufacturer (Sherwin Williams or equal), and to the minimum results as indicated in their product information literature.
- e. Manufacturer: **Sherwin Williams Corothane** / MIO-Aluminum, B65S14, or equal.

2.3 DESIGN OF PIPE

A. General

- 1. The pipe shall be suitable to transmit raw, unfiltered water under the indicated conditions.
- 2. The steel pipe shall have either flanged joints or factory applied grooved joints as indicated on the Contract Drawings.
- 3. The pipe shall consist of a steel cylinder that is either spiral welded or extruded pipe, shop-lined and exterior coated with polyurethane in accordance with AWWA C222.
- 4. The pipe shall be designed, manufactured, tested, inspected, and marked according to applicable requirements as indicated and, except as indicated, shall conform to AWWA C200.

B. Pipe Dimensions

- 1. The pipe shall be of the diameter and minimum wall thickness indicated on the Contract Drawings.

C. Fitting Dimensions

- 1. Fittings shall be of the diameter and class indicated.

D. Joint Design

- 1. Butt-strap joints shall not be used.
- 2. Rolled gasket joints and Carnegie gasket joints shall not be allowed where joint restraint is required.
- 3. Unless indicated otherwise, the standard field joint for steel pipe shall be as indicated and either flanged joint (ASME B16.5 Class 300 flanges) or shall be of a complete joint penetration weld.

E. Lap Joint, Bell and Spigot Ends for Field Welding (not allowed)

F. **Bell-and Spigot Ends with Rubber Gaskets (not allowed):**

G. **Lining & Coating Hold-Backs.** Shop-applied interior linings and exterior coatings at each butt-weld joint shall have a minimum 6-inch long hold-back on both the interior and exterior from the end of the pipe as indicated or as otherwise acceptable to the ENGINEER. The project design intent is that nearly all welding of steel pipe and steel pipe fittings, flanges and specials shall be butt-weld joints executed in the field as shown on the Contract Drawings.

H. **Restrained Joints**

1. All joints on the new penstock shall be restrained joints and located generally where indicated on the drawings.
2. Restrained joints shall be either by means of flanged joints ~~or advanced-grooved joints for use with approved rigid couplings~~. The new piping system will require one or two make up pieces where a field-welded butt-weld, or butt-strap joint will be required.
3. Designs shall include stresses created by the greater of:
 - a. a maximum temperature differential of 50 degrees F plus Poisson's effect in combination with hoop stress, or;
 - b. thrust due to bulkheads, bends, reducers, and line valves resulting from working pressure in combination with hoop stress.
4. For field-welded joints, design stresses shall not exceed 50 percent of the specified minimum yield strength of the grade of steel utilized, or 21,000 psi, whichever is less, for the part being examined when longitudinal thrust is assumed to be uniformly distributed around the circumference of the joint

2.4 SPECIALS AND FITTINGS

A. **Design**

1. Except as otherwise indicated, materials, fabrication and shop testing of specials and fittings shall conform to the requirements stated above for pipe and shall conform to the dimensions of AWWA C208.
2. The minimum thickness of plate for pipe from which specials are to be fabricated shall be the greatest of those determined by the following 3 criteria:
 - a. Working and Transient Pressure Design

$$T = \frac{P_w D / 2}{Y / S_w}$$

$$T = \frac{P_t D / 2}{Y / S_t}$$

Where:

- T = Steel cylinder thickness in inches
D = Outside diameter of steel cylinder in inches
P_w = Design working pressure in psi

- P_t = Design transient pressure in psi
- Y = Specified minimum yield point of steel in psi
- S_w = Safety factor of 2.5 at design working pressure
- S_t = Safety factor at design transient pressure; for elbows 1.875 and 2.0 for other specials

- b. Mainline Pipe Thickness: Plate thickness for specials shall be not less than the adjacent mainline pipe.
- c. Thickness Based on Pipe Diameter

Nominal Pipe Diameter, inches	Pipe Manifolds Piping Above Ground Piping Structures
16 and under	3/8-inch
18 to 24	7/16-inch

B. Specials

- 1. Specials installed on saddle supports shall be designed to limit the longitudinal bending stress to a maximum of 10,000 psi.
- 2. Design of bifurcations and other specials shall be in accordance with the provisions of
 - a. ASCE Manual 79 – Chapter 7
 - b. AWWA Manual M11, Chapter 13.

Bifurcations and reinforcement collars and wrappers shall be designed in accordance with the pressure-diameter value (PDV) method as provided in Chapter 13 of Manual M11

C. Deflections and Angles

- 1. Moderate deflections and long radius curves may be constructed by means of beveled joint rings, by pulling standard joints, by using short lengths or pipe, or a combination of these methods provided that pulled joints shall not be used in combination with bevels.
- 2. The maximum total allowable angle for beveled joints shall be 5 degrees per pipe joint.
- 3. Bevels shall be provided on the bell ends.
- 4. Mitering of the spigot ends will not be accepted.

5. The maximum allowable angle for pulled joints shall be in accordance with the manufacturer's recommendations, or the angle which results from a 3/4-inch pull-out from normal joint closure, whichever is less.
6. Horizontal deflections or fabricated angles shall fall on the alignment.
7. Vertical Deflections
 - a. Vertical deflections shall fall on the alignment and shall be at locations adjacent to underground obstructions, points of minimum earth cover, and pipeline outlets and structures.
 - b. The pipe angle points shall match the indicated angle points.

D. Outlets, Tees, Wyes, Crosses, and Nozzles

1. Outlets 12 inches and smaller may be fabricated from Schedule 30 or heavier steel pipe in the standard outside diameters, that is, 12-3/4-inch, 10-3/4-inch, 8-5/8-inch, 6-5/8-inch, and 4-1/2-inch.
2. The minimum plate thickness for reinforcements shall be as required by Part 2.4.B above.
3. The outlet reinforcement design shall be in accordance with the procedures given in Chapter 13 of AWWA Manual M11, and the design pressures and factors of safety indicated above.
4. In lieu of saddle or wrapper reinforcement as provided by the design procedure in Manual M11, pipe or specials with outlets may be fabricated entirely of steel plate having a thickness equal to the sum of the pipe wall plus the required reinforcement.
5. Where Manual M11 requires the design procedure for crotch plate reinforcement, such reinforcement shall be provided.
6. Reinforcing Plates
 - a. Outlets shall be fabricated such that there is always at least a 12-inch distance between the outer edge of the reinforcing plate and any field-welded joints.
 - b. For outlets without reinforcing plates, outlets shall penetrate the steel cylinders so that there is at least a 12-inch clearance between the outlet and any field-welded joints.
7. Tees, wyes, crosses, elbows, and manifolds shall be fabricated such that the outlet clearances and reinforcing plates from any weld joints are a minimum of 5 times cylinder thickness or 2 inches, whichever is greater.
8. Longitudinal weld joints in adjacent cylinder sections shall be oriented such that there is a minimum offset of 5 times cylinder thickness or 2 inches, whichever is greater.
9. Reinforcement

- a. Reinforcement for wyes, tees, outlets, and nozzles shall be designed in accordance with AWWA Manual M11.
 - b. Reinforcement shall be designed for the design pressure indicated and shall be as indicated.
10. Specials and fittings shall be equal in pressure design strength and shall have the same lining and coating as the adjoining pipe.
11. Unless otherwise indicated, the minimum radius of elbows shall be 2.5 times the pipe diameter and the maximum miter angle on each section of the elbow shall not exceed 11.25 degrees.
- E. **Welded Fittings.** Steel welding fittings shall conform to ASTM A 234 - Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.

2.5 PIPE INTERIOR LINING

- A. Interior surfaces of pipe, specials, and fittings shall be cleaned and centrifugally lined in the shop with either of the following two liquid applied lining systems:
1. An approved liquid, 2-component, polyurethane system in conformity with AWWA C222, and as specified below
 2. An approved liquid applied epoxy system in conformity with AWWA C210, and as specified below.
- B. **Polyurethane Lining for Shop Application**
1. Interior surfaces of pipe, specials, and fittings shall be cleaned and centrifugally lined in the shop with an approved liquid, 2-component, polyurethane system in conformity with AWWA C222, and meet the requirements listed above and the following:
 - a. Steel surface preparation shall be in accordance with SSPC SP-10.
 - b. Apply 1 or more coats, as recommended by the product manufacturer of either ***Life-Last Durashield 210-61***, or approved equal system for a minimum total dry film thickness of 35 mils.
 - c. Inspection and testing of the lining shall be per AWWA C222 and the product Manufacturer's recommendations.
 2. During the lining operation and thereafter, the pipe, specials, and fittings shall be maintained in a round condition by suitable bracing or strutting.
 3. The lining machines shall be of a type that has been used successfully for similar Work.
 4. Every precaution shall be taken to prevent damage to the lining.

5. If the lining is damaged or found defective at the Site, the damaged or unsatisfactory portions shall be replaced with lining conforming to the indicated requirements.

C. Liquid Epoxy Lining for Shop Application

1. Interior surfaces of pipe, specials, and fittings shall be cleaned and centrifugally lined in the shop with an approved liquid applied epoxy system in conformity with AWWA C210, and meet the following requirements:
 - a. Steel surface preparation shall be in accordance with SSPC SP-10.
 - b. Apply 2 or more coats of either Devoe Bar Rust 233H, Tnemec Epoxopoline 80, Carboline 140HS, or Amerlock 400 for a minimum dry film thickness of 16 mils and a total thickness of 20 mils.
 - c. Inspection and testing of the lining shall be per AWWA C210 and the product Manufacturer's recommendations.
2. During the lining operation and thereafter, the pipe, specials, and fittings shall be maintained in a round condition by suitable bracing or strutting.
3. The lining machines shall be of a type that has been used successfully for similar WORK.
4. Every precaution shall be taken to prevent damage to the lining.
5. If the lining is damaged or found defective at the Site, the damaged or unsatisfactory portions shall be replaced with lining conforming to the indicated requirements.

D. Liquid Lining of Field Joints

1. Where field welding of final butt-strap or other make-up joints occur, damage to interior lining from exterior welding may not be repairable in the field. In such cases, no repair is required.
2. Ends of the linings shall be left square and uniform, where holdbacks are utilized.
3. At all butt-weld joints, the interior lining shall be hand-repaired after welding. The interior surface of the pipe shall be accessed by use of 4-inch diameter half-coupling NPT hand-holes located on the exterior of the pipe and within 10-inches of the end of the pipe. Half-couplings shall be designed as minimum Class 300 and capable of working under static pressures of no less than 540 psig.
 - a. Each half-coupling shall be furnished with a mating 4-inch diameter male NPT plug working under the same static pressure requirements.
 - b. Each plug shall be seal welded around its complete perimeter after the lining repairs are complete.
 - c. Field QC of the seal weld shall be performed in accordance with Part 3.2 of this Section.

4. Feathered or uneven edges will not be accepted.
5. Two-component polyurethane for field patching shall be the same materials as the polyurethane used during shop-applied lining process.
 - a. Product shall be ***Life-Last Durashield 310-61 Joint and Repair System***, or equal.

E. Field Joints

1. The pipe shall be left bare (i.e. lining and coating hold-back) as indicated where field welding joints occur, with lining holdbacks as indicated either in AWWA C210 / AWWA C222 or as shown on the drawing details.
2. Ends of the linings shall be left square and uniform.
3. Feathered or uneven edges will not be accepted.
4. Liquid epoxy and/or liquid polyurethane for field patching shall be the same materials and/or fully compatible with the product used during shop-applied lining process.

F. Defective Linings

1. Defective linings, as determined by the ENGINEER, shall be removed from the pipe wall and shall be replaced to the full thickness required.
2. Defective linings shall be cut back to a square shoulder in order to avoid feather-edged joints.

G. Hand-Applied Linings

1. Specials and fittings that cannot be mechanically lined and coated shall be lined and coated by hand-application using the same materials as used for the pipe and in accordance with the applicable AWWA or ASTM standards and as indicated.
2. Coating and lining applied in this manner shall provide protection equal to that for the pipe.
3. Fittings may be fabricated from pipe that has been mechanically lined and/or coated.
4. Areas of lining and coating that have been damaged by such fabrication shall be repaired by hand-application.

H. Protection of Pipe Lining/Interior

1. For pipe, specials, and fittings with plant-applied linings, the CONTRACTOR shall provide a 12-mil polyethylene sheet or other suitable bulkhead on the ends of the pipe and on each opening to prevent the lining from drying out.

2. Bulkheads shall be substantial enough to remain intact during shipping and storage until the pipe is installed.

2.6 PIPE EXTERIOR COATING

A. Exterior Coating of Exposed Piping

1. The exterior surfaces of pipe, specials, and fittings that will be exposed to the atmosphere inside tunnels, structures (excluding air-release valve vaults) or above ground shall be thoroughly cleaned and then given a shop coat of primer compatible with the finish coating required. The final exterior liquid applied coating shall be per the requirements of either AWWA C210 or C222 and shall be field-applied under atmospheric / environmental conditions as required by the coating manufacturer.

B. Polyurethane Coating for Shop Application

1. Unless indicated otherwise, exterior surfaces of pipe, specials, and fittings shall be cleaned and coated in the shop with an approved liquid, 2-component, polyurethane system in conformity with AWWA C222, and meet the requirements listed above and the following:
 - a. Steel surface preparation shall be in accordance with SSPC SP-10.
 - b. Apply 1 or more coats, as recommended by the product manufacturer of either ***Life-Last Durashield 210-61***, or approved equal system, for a minimum total dry film thickness of 45 mils.
 - c. Inspection and testing of the lining shall be per AWWA C222 and the product Manufacturer's recommendations.
2. During the coating operation and thereafter, the pipe, specials, and fittings shall be maintained in a round condition by suitable bracing or strutting.
3. The coating machines shall be of a type that has been used successfully for similar Work.
4. Hold-backs of the exterior coating at the factory shall be a minimum of 6-inches and as defined above under the joint options defined above. No holdback of primers shall be allowed on the exterior of any pipe.

C. Polyurethane Coating of Field Joints

1. Where field welding of lap-weld joints occur, hold back of the exterior coating shall be as defined above with only primer being provided in the holdback zone. Damage to the exterior coating from exterior welding shall be repaired in the field with a two part liquid component polyurethane mixture that contains no volatile organic carbon (VOC) or solvents, and that can be hand or spray applied to interior joints or other repair zones.
2. Ends of the coating shall be left square and uniform.
3. Feathered or uneven edges will not be accepted.

D. Exterior Coating of Buried Piping

1. Pipe for buried service, including bumped heads, shall be coated with the same coating product as that identified for above ground piping systems above.
2. Unless otherwise indicated, exterior surfaces of pipe or fittings passing through structure walls or concrete thrust-blocks shall be provided with a shop primer coat only to a point about 4-inches in-board from the end of the concrete thrust-block.

E. Field Exterior Re-Coating of Existing Steel Pipe and Fittings

1. Where indicated in the ***Penstock Pipe Support and Coupling Repair Table*** (Sheets GC006 thru GC008), exterior surfaces of existing pipe, pipe supports, and sleeve couplings shall be cleaned and coated in the field with an approved moisture-cured, 1-component, aluminum and MIO filled urethane system in conformity with the requirements listed above and the following:
 - a. Steel surface preparation shall be in accordance with SSPC SP-2 and SP-3, at a minimum.
 - b. Apply a minimum of one primer coat and one intermediate coat, as recommended by the product manufacturer of ***Sherwin Williams Corothane B65S14***, or approved equal system, for a minimum total dry film thickness (DFT) of 6 mils, 3 mils each coat.
 - c. Inspection and testing of the lining shall be per the product Manufacturer's recommendations.
2. The coating machines shall be of a type that has been used successfully for similar Work.
3. The extent of recoating at each specified pipe support or coupling shall be of sufficient size, and no less than 4-inches beyond the visual extent of the existing jeopardized or failed coating system, to insure proper adhesion to the existing pipe or coupling system.

2.7 PIPE APPURTENANCES

- A. Pipe appurtenances shall be in accordance with the requirements of Section 40 23 00 – Piping General.
- B. Threaded outlets shall be forged steel suitable for 3000-psi service, and shall be as manufactured by **Vogt**, or equal.

PART 3 -- EXECUTION

3.1 INSTALLATION OF PIPE

A. Handling and Storage

1. Pipe, specials, and fittings shall be carefully handled and protected against damage to lining and coating/interior and exterior surfaces, and impact shocks and free fall.
 2. Pipe, specials, and fittings shall not be placed directly on rough ground but shall be supported in a manner that will protect the pipe against injury whenever stored at the Site or elsewhere.
 3. Pipe, specials, and fittings shall be handled and stored at the Site in accordance with the requirements indicated in Part 2, above.
 4. No pipe shall be installed when the lining or coating, or interior or exterior surfaces show cracks that may be harmful as determined by the ENGINEER.
 5. Such damaged lining and coating, and interior and exterior surfaces shall be repaired or a new undamaged pipe, special, or fitting shall be provided.
- B. Pipe damaged prior to Substantial Completion shall be repaired or replaced.
- C. The CONTRACTOR shall inspect each pipe, special, and fitting for damage.
- D. The CONTRACTOR shall remove or smooth out any burrs, gouges, weld splatter, or other small defects prior to laying the pipe, special, or fitting.
- E. Cleaning**
1. Before the placement of pipe, specials, or fittings in the trench, each shall be thoroughly cleaned of any foreign substance that may have collected thereon and shall be kept clean thereafter.
 2. For this purpose, the openings of pipes, specials, and fittings in the trench shall be closed during any interruption to the WORK.
- F. Placement**
1. CONTRACTOR shall avoid all laying procedures which create concentrated loads on the steel pipe. Pipe, specials, and fittings shall be laid directly:
 - a. On the imported and properly compacted bedding material, or
 - b. If CLSM is being utilized in the pipe zone and pipe bedding area, on soil pads or other approved compressible material such as extruded polystyrene foam insulation. Soil pads shall maintain horizontal and vertical alignment during backfilling operation, and shall have a lower compressible strength than the surrounding CLSM material
 2. Only compressible blocking as specified will be permitted, and the bedding shall be such that it forms a continuous, solid bearing for the full length of the pipe, special, or fitting.
 3. Excavations shall be made as needed to facilitate removal of handling devices after the item has been laid.

4. Bell holes shall be formed at the ends of the pipe to prevent point loading at the bells or couplings.
5. Excavation outside the normal trench section shall be made at field joints as needed to permit adequate access to the joints for field connection operations and for application of coating on field joints.
6. Except for short runs that may be permitted by the ENGINEER, pipes shall be laid uphill if on grades exceeding 10 percent.
7. Pipe that is laid on a downhill grade shall be blocked and held in place until sufficient support is furnished by the following pipe to prevent movement.
8. Bends shall be installed as indicated.

G. Installation Tolerances

1. Each section of pipe, special, or fitting shall be laid in the order and position on the laying diagram and in accordance with the following:
 - a. Each section of pipe, special, or fitting having a nominal diameter less than 48 inches shall be laid to line and grade, within plus or minus 2 inches horizontal deviation and plus or minus one inch vertical deviation.
 - b. Each section of pipe, special, or fitting having nominal diameter 48 inches and larger shall be laid to line and grade, within plus or minus 5 percent of diameter horizontal deviation and plus or minus 2.5 percent of diameter vertical deviation.
 - c. In addition to the horizontal and vertical tolerances above, the pipe shall be laid so that no high or low points other than those on the laying diagram are introduced.
 - d. After installation, the pipe, specials, and fittings shall not show deflection greater than:
 - 1) flexible-lined and flexible-coated or bare pipe, specials, and fittings: 3.0 percent
 - 2) flexible-lined and mortar-coated (rock-shielded) pipe, specials, and fittings: 2.25 percent
 - 3) mortar-lined and mortar-coated pipe, specials, and fittings: 1.5 percent
 - e. The allowable deflection shall be based on the design inside diameter.

H. Test Section

1. At the beginning of pipe laying operations, the CONTRACTOR shall perform a test section to demonstrate that the methods and materials to be used will satisfy the pipe zone backfill compaction and pipe deflection criteria.

2. The maximum length of the test section shall be 500 feet.
3. The CONTRACTOR shall not proceed with production pipe laying beyond the test section without the ENGINEER's approval.
4. The entire test section length that does not comply with the Contract Documents shall be reworked as necessary to comply.
5. The ENGINEER will observe construction of the test section.
6. The OWNER will take measurements and keep records for quality assurance purposes.
7. Any change in means, methods, and trench conditions, including excavation, bedding, and pipe zone materials, in situ soils, water conditions, and backfill and compaction methods shall require another successful test section before additional production pipe installation.

I. Changes in Alignment and/or Grade

1. Where necessary to raise or lower the pipe, specials, or fittings due to unforeseen obstructions or other causes, the ENGINEER may change the alignment and/or the grade.
2. Such change shall be made by the deflection of joints, by the use of bevel adapters, or by the use of additional fittings, although in no case shall the deflection in a joint exceed 75 percent of the maximum deflection recommended by the pipe manufacturer.
3. No joint shall be misfit any amount that will be detrimental to the strength and water tightness of the finished joint.

J. Struts

1. Struts in pipe 42-inch diameter and larger shall be left in place until backfilling operations have been completed.
2. Struts in pipe smaller than 42-inch may be removed immediately after laying.
3. A laboratory selected and paid by the OWNER may monitor pipe deflection by measuring pipe inside diameter before struts are removed and 24 hours after struts are removed.
4. Pipe deflection shall not exceed 1.5 percent 24 hours after the struts have been removed.
5. After the backfill has been placed, the struts shall be removed and shall remain the property of the CONTRACTOR.

K. Cold Weather Protection

1. No pipe, special, or fitting shall be installed upon a foundation into which frost has penetrated or at any time that there is a danger of the formation of ice or penetration of frost at the bottom of the excavation.
2. No pipe, special, or fitting shall be laid unless it can be established that the trench will be backfilled before the formation of ice and frost occurs.

L. Pipe, Specials, and Fitting Protection

1. The openings of pipe, specials, and fittings with shop-applied mortar lining shall be protected with suitable bulkheads to maintain a moist atmosphere and to prevent unauthorized access by persons, animals, water, or any undesirable substance.
2. The bulkheads shall be designed to prevent the drying out of the interior of the pipe, specials, and fittings.
3. The CONTRACTOR shall introduce water into the pipe to keep the mortar moist if moisture has been lost due to damaged bulkheads.
4. Means shall be provided to prevent the pipe from floating due to water in the trench from any source.
5. Pipe that has floated shall be repaired, including restoration to original condition and profile.

M. Pipe Cleanup

1. As pipe laying progresses, the CONTRACTOR shall keep the pipe interior free of debris.
2. The CONTRACTOR shall completely clean the interior of the pipe of sand, dirt, mortar splatter, and any other debris following completion of pipe laying, pointing of joints, and any necessary interior repairs prior to testing and disinfecting of the completed pipeline.

3.2 WELDED JOINTS

A. General

1. CONTRACTOR shall submit a Welding Procedure Specification (WPS) in accordance with ASME Section IX to define the parameters of the weld and welding procedure for each major type of weld provided for the project.
2. Prior to beginning the welding procedure, any tack welds used to position the pipe during laying shall be removed.
3. Any annular space between the faying surfaces of the bell and spigot shall be equally distributed around the circumference of the joint by shimming, jacking, or other suitable means.

4. Where more than one pass is required, each pass except the first and final ones shall be peened to relieve shrinkage stresses, and dirt, slag, and flux shall be removed before the succeeding bead is applied.
5. Prior to butt welding, the pipe and joint shall be properly positioned in the trench using line up clamps so that, in the finished joint, the abutting pipe sections shall not be misaligned more than 1/16 inch.
6. Unless double fillet welds are indicated, field welded lap joints may, at the CONTRACTOR'S option, be made on either the inside or the outside of the pipe.
7. Field welded joints shall be in accordance with AWWA C206 - Field Welding of Steel Water Pipe.
8. Where exterior welds are performed, adequate space shall be provided for welding and inspection of the joints.
9. A heat resistant shield shall be draped over at least 24-inches of coating beyond the holdback on both sides of the weld during welding to avoid damage to the coating by hot weld splatter.
10. Welding grounds shall not be attached to the coated part of the pipe.
11. Back-gouging of welds is not required for penstock pipe applications. Interior of all V-groove welds shall be ground smooth to allow for proper field application of liner over the joint, and to prevent hydraulic vortices from forming when water passes over the weld zone.
12. Following hydraulic tests of the welded joint, the exterior joint spaces shall be field coated as indicated.

B. Butt Weld Joints for Beveled-end Pipe (Single V-Groove Bevel)

1. Single V-groove bevels shall be used on steel pipe with wall thicknesses up to 0.625 inches. V-groove shall be developed for either interior or exterior joint welding, as required by the Contract Documents.
2. Single V-groove bevel end joints shall be such as to provide a complete joint penetration (CJP) weld.
3. Bevel angles shall be between 30 and 35 degrees maximum. Total included angle shall be between 60 and 70 degrees.
4. Geometry of the root (face height and width opening) shall be determined by the CONTRACTOR, but shall be no less than 1/16-inch each dimension.
5. OWNER will inspect all welding. All penstock CJP welds will be radiographically inspected. Acceptance criteria will be ASME VIII. All other welds will be visually inspected in accordance with AWS D1.1.

C. Trench Backfilling after Joint Welding

1. After the pipe and joint are properly positioned in the trench, the length of pipe between joints shall be backfilled to at least one foot above the top of the pipe.
2. Care shall be exercised during the initial backfilling to prevent movement of the pipe and to prevent any backfill material from being deposited on the joint.

D. Temperature Stresses

1. To control temperature stresses, the unbackfilled joint areas of the pipe shall be shaded from the direct rays of the sun by the use of properly supported awnings, umbrellas, tarpaulins, or other suitable materials for a minimum period of 2 hours prior to the beginning of the welding operation and until the weld has been completed.
2. Shading materials at the joint area shall not rest directly on the pipe but shall be supported to allow air circulation around the pipe.
3. Shading of the pipe joints need not be performed when the ambient air temperature is below 45 degrees F.

E. Shrinkage Control Joints

- ~~1. At intervals not exceeding 250 feet along welded reaches of the pipeline and at the first regular lap-welded field joints outside concrete encasements and structures, the pipe shall be laid with an initial lap of not less than one inch greater than the minimum lap dimension.~~
- ~~2. The welding of each such shrinkage control joint shall be performed when the temperature is approximately the lowest during the 24 hour day, after at least 250 feet of pipe have been laid and the joints have been welded ahead of and in back of the shrinkage control joint, and after backfill has been completed to at least one foot above the top of the pipe ahead of and in back of the shrinkage control joint.~~
- ~~3. Where shrinkage control joints occur in a traveled roadway or other inconvenient location, the location of the shrinkage control joint may be adjusted, as acceptable to the ENGINEER.~~
4. For the Butt joint, single outside weld section of pipe from Station xx+00 to Station xx+00, shrinkage control joints utilizing a butt strap or other approved closure piece shall be applied at intervals no less than every 400 ft, to control temperature shrinkage per the requirements of Part 3.3.D of Section 33 11 11. These butt straps shall not be placed when temperatures are above 50 degrees Fahrenheit.

F. Inspection of Field-Welded Joints

1. An independent testing laboratory acceptable to the ENGINEER but paid by the CONTRACTOR shall inspect the joints.
2. Inspection shall be as soon as practicable after the welds are completed.
3. Fillet welds shall be tested by the Magnetic Particle Inspection Method in accordance with ASME Section VIII, Division 1, Appendix VI.

4. Butt weld joints shall be inspected by Non-destructive Examination (NDE) processes utilizing either radiographic methods in accordance with API Standard 1104, or approved ultrasonic testing methods.

G. Repair of Welds

1. Defective welds shall be repaired by the CONTRACTOR to meet the indicated requirements.
2. Defects in welds or defective welds shall be removed, and that section of the joint shall then be re-welded.
3. Only sufficient removal of defective material that is necessary to correct the defect shall be required.
4. After the repair is made, the joint shall be checked by repeating the original test procedure.
5. Welds deficient in size shall be repaired by adding weld metal.

3.3 PREPARATION FOR FIELD COATING

- A. **General:** Surfaces to receive protective coatings shall be prepared as indicated prior to application of coatings. The CONTRACTOR shall examine surfaces to be coated and shall correct surface defects before application of any coating material. Marred or abraded spots on shop-primed and on factory-finished surfaces shall receive touch-up restoration prior to any field coating application. Surfaces to be coated shall be dry and free of visible dust.
- B. Care shall be exercised not to damage adjacent Work during blasting operations. Spraying shall be conducted under carefully controlled conditions. The CONTRACTOR shall be fully responsible for and shall promptly repair any and all damage to adjacent Work or adjoining property occurring from blasting or coating operations.
- C. **Protection of Painted Surfaces:** Cleaning and coating shall be coordinated so that dust and other contaminants from the preparation process will not fall on wet, newly-coated surfaces, or likewise harm existing surfaces.

3.4 SURFACE PREPARATION STANDARDS

- A. **Steel Structures Painting Council (SSPC) Standards.** The following referenced standards for surface preparation according to specifications of the Steel Structures Painting Council (SSPC) shall form a part of this specification:
 1. **SSPC SP1 - Solvent Cleaning:** Removal of oil, grease, soil, salts, and other soluble contaminants by cleaning with solvent, vapor, alkali, emulsion, or steam.
 2. **SSPC SP2 - Hand Tool Cleaning:** Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, by hand chipping, scraping, sanding, and wire brushing.

3. **SSPC SP3 - Power Tool Cleaning:** Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, by power tool chipping, descaling, sanding, wire brushing, and grinding.
4. **SSPC SP5 - White Metal Blast Cleaning:** Removal of all visible rust, oil, grease, soil, dust, mill scale, paint, oxides, corrosion products and foreign matter by blast cleaning.
5. **SSPC SP6 - Commercial Blast Cleaning:** Removal of all visible oil, grease, soil, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except that staining shall be limited to no more than 33 percent of each square inch of surface area.
6. **SSPC SP7 Brush-Off Blast Cleaning:** Removal of all visible oil, grease, soil, dust, loose mill scale, loose rust, and loose paint.
7. **SSPC SP10 Near-White Blast Cleaning :** Removal of all visible oil, grease, soil, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except that staining shall be limited to no more than 5 percent of each square inch of surface area.
8. **SSPC-SP13 Surface Preparation of Concrete:** Removal of protrusions, laitance and efflorescence, existing coatings, form-release agents, and surface contamination by detergent or steam cleaning, abrasive blasting, water jetting, or impact or power tool methods as appropriate for the condition of the surface and the requirements of the coating system.

3.5 JOINT COATING AND LINING

A. General

1. The interior and exterior joint recesses shall be thoroughly wiped clean.
2. Remove water, loose scale, dirt, and other foreign material from the inside surface of the pipe.

B. Testing

1. The ENGINEER will test each joint with an electrical detector, furnished by the CONTRACTOR and capable of at least a 12,000 volt output.
2. The tests will be performed using 6,000 to 7,000 volts.
3. The CONTRACTOR shall repair any holidays.
4. Re-Testing
 - a. When a visual inspection indicates that a portion of the coating system has sustained physical damage, the CONTRACTOR shall perform an electrical holiday test of 6,000 to 7,000 volts.

- b. When the test indicates no holiday, a notation shall be applied to the area indicating the test is satisfactory.

C. Coating Repair

1. Liquid-Coated Pipe: Perform coating repairs on epoxy or polyurethane-coated pipe in accordance with the Manufacturer's recommendations and the requirements of AWWA C210 or C222, respectively, satisfying both requirements at a minimum.

D. Coating of Fittings and Specials: Fittings and specials shall be coated in accordance with AWWA C210 or AWWA C222, as required.

E. Joint Lining

- ~~1. After the backfill has been placed and compacted to at least 1-ft above the top of the pipe, to final grade, the interior joint recess shall be coated with liquid-applied epoxy per AWWA C210, and the pipe manufacturer's recommendations.~~
- ~~2. Materials of construction for mortar shall be in accordance with the requirements of AWWA C602.~~
- ~~3. The mortar shall be tightly packed into the joint recess and troweled flush with the interior surface, and excess shall be removed.~~
- ~~4. At no point shall there be an indentation or projection of the mortar exceeding 1/16 inch.~~
- ~~5. With pipe smaller than 24-inch in diameter, before the spigot is inserted into the bell, the bell shall be daubed with mortar.~~
6. The joint shall be completed and excess mortar on the inside of the joint shall be swabbed out.

3.6 INSTALLATION OF PIPE APPURTENANCES

A. Protection of Appurtenances: Where the joining pipe is tape-coated, buried appurtenances shall be coated with cold-applied tape in accordance with Section 09 96 11 – Polyethylene Tape Coating.

B. Installation of Valves

1. Valves shall be handled in a manner to prevent any injury or damage to the valve or any part of it.
2. Joints shall be thoroughly cleaned and prepared prior to installation.
3. The CONTRACTOR shall adjust stem packing and operate each valve prior to installation to verify proper operation.
4. Valves shall be installed so that the valve stems are plumb and in the location indicated.

C. Installation of Flanged Joints

1. Before the joint is assembled, the flange faces shall be thoroughly cleaned of foreign material with a power wire brush.
2. The gasket shall be centered and the connecting flanges drawn up watertight without unnecessarily stressing the flanges.
3. Bolts shall be tightened in a progressive diametrically opposite sequence and torqued with a suitable and calibrated torque wrench.
4. Clamping torque shall be applied to the nuts only.
5. Full-face reinforced rubber gaskets shall be applied to the inside face of blind flanges with adhesive.

D. Flexible Coupled Joints

- ~~1. When installing flexible couplings, care shall be taken that the connecting pipe ends, couplings, and gaskets are clean and free of dirt and foreign matter, with special attention given to the contact surfaces of the pipe, gaskets, and couplings.~~
- ~~2. The couplings shall be assembled and installed in conformance with the recommendations and instructions of the coupling manufacturer.~~

E. Bolting

1. Wrenches used in bolting couplings shall be of a type and size recommended by the coupling manufacturer.
2. Coupling bolts shall be tightened in such a manner as to secure a uniform annular space between the follower rings and the body of the pipe.
3. Bolts shall be tightened approximately the same amount.
4. Diametrically opposite bolts shall be tightened progressively and evenly.
5. Final tightening shall be performed with a suitable and calibrated torque wrench set for the torque recommended by the coupling manufacturer.
6. Clamping torque shall be applied to the nut only.

- END OF SECTION -

**SECTION 33 11 23 – LARGE POLYETHYLENE PRESSURE PIPING
(AWWA C906, MODIFIED)**

PART 1 -- GENERAL

1.1 SUMMARY

- A. The CONTRACTOR shall provide high density polyethylene (HDPE) pressure pipe, complete and in place, in accordance with the Contract Documents.
- B. **Pipe Material Group No. 31.** The piping system defined in this section is referred to in the Pipe Schedule on Contract Sheet G-007 as Piping Material Group No. 31.

1.2 REFERENCES

- A. The following is a list of standards which may be referenced in this Section:
 - 1. American Water Works Association (AWWA):
 - a. AWWA C906 Polyethylene (PE) Pressure Pipe and Fittings, 4 In Through 63 In, for Water Distribution and Transmission
 - 2. American Society for Testing and Materials (ASTM):
 - a. ASTM D2837 Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products
 - b. ASTM D3035 Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter
 - c. ASTM D3350 Polyethylene Plastics Pipe and Fittings Materials

1.3 CONTRACTOR SUBMITTALS

- A. Furnish submittals in accordance with the requirements of Section 01 33 00 – Contractor Submittals.
- B. **Certifications:** Furnish a certified affidavit of compliance for pipe and other products or materials furnished under this Section:
 - 1. hydrostatic proof test reports;
 - 2. sustained pressure test reports; and,
- C. Expenses incurred in making samples for certification of tests shall be borne by the CONTRACTOR as part of the WORK.

1.4 QUALITY CONTROL

- A. Each manufacturer shall have an approved in-house QA/QC program for compliance to the testing specifications and requirements of AWWA C906 for both pipe and fittings.
- B. **Inspection:** Pipe shall be subject to inspection at the place of manufacture in accordance with the provisions of the referenced standards as supplemented by the requirements herein. The CONTRACTOR shall notify the ENGINEER in writing of the manufacturing start date not less than 14 calendar days prior to the start of any phase of manufacture.
- C. During manufacture of the pipe, the ENGINEER shall be given access to areas where manufacturing is in process confirm compliance with the Specifications.
- D. **Tests:** Except as modified herein, materials used in the manufacture of the pipe shall be tested in accordance with the requirements of this Section and in the referenced standards, as applicable.
- E. The CONTRACTOR shall perform said material tests in accordance with the requirements of the Contract Documents. The ENGINEER shall have the right to witness testing conducted by the CONTRACTOR, provided that the CONTRACTOR'S schedule will not be delayed for the convenience of the ENGINEER.
- F. In addition to those tests specifically required, the ENGINEER may request additional samples of any material for testing by the OWNER. The additional samples shall be furnished as part of the WORK.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. **Scope:** The pipe nominal diameters shall be of the size indicated on the Contract Drawings, meeting the specifications and requirements of AWWA C906. The pipe outside diameter shall be fabricated according to steel pipe sizes (IPS) standards.
- B. **Materials:** Pipe and fittings shall be made from prime virgin resins with an established hydrostatic-design basis of 1600 psi for water at 73° F per ASTM D 2837. The resin shall be listed by the PPI (Plastic Pipe Institute) in its pipe-grade registry Technical Report (TR) 4, "Listing of Plastic Pipe Compounds". The CONTRACTOR shall select one of the following
 - 1. The pipe shall be made from PE 4710 with a density cell class of 4 and slow crack growth cell class of 7 or higher, in accordance with ASTM D 3350, with a hydrostatic design stress of 1,000 psi at 73° F.
- C. **Pipe and Fittings:** The design pressure rating shall be a minimum 80 psi with a dimension ratio of no greater than 26 and as shown on the Contract Drawings. Minimum laying lengths shall be 30-ft. Both pipe and fittings shall be listed as compliant with NSF Standard 61 and shall bear the "NSF-pw" logo or mark.
- D. **Joints:** Pipe sections shall be joined by heat fusion.

- E. **Marking:** Pipe and fittings shall be marked as prescribed by AWWA C906 and NSF. Pipe markings shall include nominal size, OD base (i.e.: 12-inch iron pipe sizing, IPS), dimension ratio, pressure class, AWWA C906, manufacturer's name, manufacturer's production code including day, month, and year extruded, manufacturer's plant and extrusion line, and NSF - pw logo.

2.2 PLASTIC MARKING TAPE

- A. The pipeline shall be marked with a magnetically detectable marking tape. The tape shall be placed along the trench centerline between 12 and 24 inches above the pipe.

PART 3 -- EXECUTION

3.1 GENERAL

- A. Laying, jointing, and testing for defects and for leakage shall be performed in the presence of the ENGINEER and shall be subject to approval before acceptance. All material found to be defective will be rejected and the CONTRACTOR shall promptly remove such materials from the Site.
- B. Installation shall conform to AWWA M23, instructions furnished by the pipe manufacturer, and to the supplementary requirements or modifications herein. Wherever the provisions of this Section and the aforementioned requirements are in conflict, the more stringent provision shall apply.

3.2 HANDLING AND STORAGE

- A. **Handling:** Pipe, fittings, and accessories shall be carefully inspected before and after installation and those found defective will be rejected. Pipe and fittings shall be free from fins and burrs. Before placing in position, clean pipe, fittings, and accessories, and maintain them in a clean condition. Proper methods shall be used for lowering sections of pipe into trenches. Under no circumstances shall pipe, fittings, or any other material be dropped or dumped into trenches.
- B. **Storage:** Pipe shall be stored, if possible, at the Site in unit packages provided by the manufacturer. Caution should be exercised to avoid compression damage or deformation to the pipe. Pipe shall be stored in such a way as to prevent sagging or bending, and it shall be protected from exposure to direct sunlight by covering with an opaque material that allows adequate air circulation above and around the pipe. Gaskets shall be stored in a cool, dark place out of the direct rays of the sun, preferably in original cartons.

3.3 TRENCHING AND BACKFILL

- A. Trench excavation and backfill shall conform to Section 31 00 00 - Earthwork.

3.4 JOINING

- A. Prior to installation of any pipe, the manufacturer shall provide training in the recommended butt fusion and saddle fusion procedures, testing procedures, and any other installation methods required by the WORK. Training shall include the

CONTRACTOR'S installation personnel, an OWNER'S representative, the ENGINEER'S representative, and any other personnel chosen by the OWNER. The CONTRACTOR shall record the names of trained personnel.

- B. On every day that butt fusion joints are to be made, the first fusion of the day shall be a test. The test fusion shall be allowed to cool completely, then fusion test straps shall be cut out. Test strap length shall be 12-inches (min) or 30 times the wall thickness with the fused area in the center and width shall be 1-inch (min) or 1.5 times the wall thickness. The CONTRACTOR shall bend the test strap until the ends of the strap touch. If the test strap fails at the joint, the CONTRACTOR shall perform a new test to be cooled completely and bent as before. The CONTRACTOR shall not commence installation of pipe until a test fusion has passed the bent strap test.
- C. After joint fusing is complete, an auger / reaming device, or other approved method, shall be used to **remove all excess weld bead material from the interior surface of the joint.** Weld beads that protrude more than 0.25-inches into the flow profile of the pipe shall not be acceptable.

3.5 INSTALLATION

- A. Trench shall be graded in straight lines, taking care to avoid formation of any dips or low points. Pipe shall not be laid when the conditions of trench or weather are unsuitable. At the end of each day's work, open ends of pipe shall be closed temporarily with wood blocks or bulkheads.
- B. Pipe shall be cut by means of saws, power driven abrasive wheels, pipe cutters, or other manufacturer recommended methods that will produce a clean, square cut.
- C. Pipe shall be supported uniformly and firmly at its proper elevation. Wood support blocking will not be permitted. The full length of each section of pipe and fittings shall rest solidly on the soil, with recesses to accommodate joints and couplings. Anchors and supports shall be provided where necessary and where indicated for fastening WORK into place. Fittings shall be independently supported.
- D. Short lengths of pipe shall be used in and out of each rigid joint or rigid structure. Piping that does not allow sufficient space for proper installation of jointing shall be replaced.
- E. Joints shall be installed according to manufacturer's recommendations. Trenches shall be kept free of water until joints have been properly made. The maximum combined deflection at any coupling shall be in accordance with the manufacturer's recommendations.

3.6 FIELD TESTING AND DISINFECTION

- A. Field testing shall conform to the requirements of Section 01 74 30 - Pressure Pipe Cleaning, Testing and Disinfection.

- END OF SECTION -

SECTION 40 00 00 - EQUIPMENT GENERAL PROVISIONS

PART 1 -- GENERAL

1.1 SUMMARY

- A. The CONTRACTOR shall provide equipment and appurtenant WORK, complete and operable, in accordance with the Contract Documents.
- B. The provisions of Section 48 13 01 – Installation of Owner Furnished Equipment shall apply to any equipment, excluding valves and valve actuators, that are furnished by the CONTRACTOR as part of the WORK of the General Construction project.
- C. Installation requirements for valves and valve actuators shall be as specified in the Division 43 specifications.
- D. **Equipment Arrangement:** Unless specifically indicated otherwise, the arrangement of equipment indicated is based upon information available at the time of design and is not intended to show exact dimensions particular to a specific manufacturer. Some aspects of the Drawings are diagrammatic, and some features of the illustrated equipment arrangement may require revision to meet the actual equipment requirements. Structural supports, foundations, piping and valve connections, and electrical and instrumentation connections indicated may have to be altered to accommodate the equipment provided. No additional payment will be made for such revisions and alterations.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Equipment shall be in accordance with the following standards, as applicable and as indicated in each equipment specification:
 - 1. American Society for Testing and Materials (ASTM).
 - 2. American National Standards Institute (ANSI).
 - 3. American Society of Mechanical Engineers (ASME).
 - 4. American Water Works Association (AWWA).
 - 5. American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE).
 - 6. American Welding Society (AWS).
 - 7. National Fire Protection Association (NFPA).
 - 8. Federal Specifications (FS).
 - 9. National Electrical Manufacturers Association (NEMA).
 - 10. Manufacturer's published recommendations and specifications.

11. General Industry Safety Orders (OSHA).

B. The following standards are referenced in this Section:

ASME B16.1	Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800
ASME B16.5	Pipe Flanges and Flanged Fittings, Steel, Nickel Alloy and other Special Alloys
ASME B46.1	Surface Texture
ANSI S12.6	Method for the Measurement of the Real-Ear Attenuation of Hearing Protectors
ASME B1.20.1	General Purpose Pipe Threads (Inch)
ASME B31.1	Power Piping
AWWA C206	Field Welding of Steel Water Pipe
AWWA C207	Steel Pipe Flanges for Waterworks Service - Sizes 4 In. Through 144 In. (100 mm through 3,600 mm)
AWWA D100	Welded Steel Tanks for Water Storage
ASTM A 48	Gray Iron Castings
ASTM A 108	Steel Bars, Carbon, Cold-Finished, Standard Quality

1.3 CONTRACTOR SUBMITTALS

- A. Furnish submittals in accordance with Section 01 33 00 - Contractor Submittals.
- B. **Shop Drawings:** Furnish complete drawings and technical information for equipment, piping, valves, and controls.
- C. **Spare Parts List:** The CONTRACTOR shall obtain from the manufacturer and submit at the same time as Shop Drawings a list of suggested spare parts for each piece of equipment. CONTRACTOR shall also furnish the name, address, and telephone number of the nearest distributor for each piece of equipment.
- D. Certifications that equipment and equipment supports comply with seismic and wind design criteria from Code.

1.4 QUALITY ASSURANCE

- A. **Costs:** The CONTRACTOR shall perform and pay the costs of inspection, startup, testing, adjustment, and instruction services performed by factory representatives.

1. The CONTRACTOR shall be required to provide and pay for the cost of providing all

temporary utilities, including electrical power and utility water, related to the startup, testing, and instruction services of equipment.

2. If electrical power or utility water is specified to be provided or derived from permanent OWNER's facilities, the OWNER shall be responsible to pay for the consumed electricity and utility water.
- B. **Assistance by OWNER's Staff:** None of the OWNER's on-site staff will be available to provide operational assistance related to support facilities only, during field startup and testing of new equipment
- C. **Inspection.** The CONTRACTOR shall inform the local county and state authorities, such as building and plumbing inspectors, fire marshal, OSHA inspectors, and others, to witness required tests for piping, plumbing, fire protection systems, pressure vessels, safety systems, and related items to obtain required permits and certificates.
1. All fees required for local and state permits and inspections shall be paid for by CONTRACTOR.
- D. **Quality and Tolerances:** Tolerances and clearances shall be as identified in Section 48 05 13 - General Mechanical Requirements of the Equipment Procurement specification package.
- E. **Machine Finish:** The type of finish shall be the most suitable for the application and shall be shown in micro-inches in accordance with ANSI B46.1 and as identified in Section 48 05 13 - General Mechanical Requirements of the Equipment Procurement specification package.

PART 2 -- PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. **Noise Level:** When in operation, no single piece of equipment shall exceed the OSHA noise level requirement of 105 dBA for one-hour exposure per day at the safe distance viewing space required for each piece of equipment.
- B. **High Noise Level Location:** The CONTRACTOR shall provide one personal hearing protection station at each high noise level location. Locations are defined as follows:
1. Indoor Location
 - a. Any single equipment item or any group of equipment items located within a single room not normally occupied, that produces noise exceeding OSHA noise level requirements for a 2-hour exposure.
 - b. Any single equipment item or any group of equipment items located within a single room normally occupied by workers, that produces noise exceeding OSHA noise level requirements for an 8-hour exposure.
- C. **Personal Hearing Protection:** The CONTRACTOR shall furnish two (2) pairs of high attenuation hearing protectors in the original unopened packaging. The ear protectors

shall be capable of meeting the requirements of ANSI S12.6 and shall produce a noise level reduction of 25 dBA at a frequency of 500 Hz. The hearing protectors shall have fluid filled ear cushions and an adjustable, padded headband. The protectors shall be stored in a weatherproof, labeled, steel cabinet, provided at an approved location near the noise producing equipment.

- D. **Service Factors:** For requirements of drive train, mechanical and electrical motor service factors, see Equipment Procurement Specification Section 48 05 13 - General Mechanical Requirements.
- E. **Welding:** Unless otherwise indicated in Section 48 05 13 – General Mechanical Requirements or in other Division 03 or 05 specifications, welding shall conform to the following:
1. Any structural welding shall be in accordance with AWS D1.1
 2. Latest revision of AWWA D100.
 3. Latest revision of AWWA C206.
 4. Welding shall be by the metal-arc method or gas-shielded arc method as described in the American Welding Society's "Welding Handbook" as supplemented by other pertinent standards of the AWS. Qualification of welders shall be in accordance with the AWS Standards.
 5. In assembly and during welding, the component parts shall be adequately clamped, supported, and restrained to minimize distortion and for control of dimensions. Weld reinforcement shall be as specified by the AWS code. Upon completion of welding, weld splatter, flux, slag, and burrs left by attachments shall be removed. Welds shall be repaired to produce a workmanlike appearance with uniform weld contours and dimensions. Sharp corners of material that are to be painted or coated shall be ground to a minimum of 1/32-inch on the flat.
- F. **Protective Coating:** Equipment shall be painted or coated in accordance with Section 09 96 00 - Protective Coating, unless otherwise indicated. Non-ferrous metal and corrosion-resisting, rotating or moving steel surfaces shall be coated with grease or lubricating oil. Coated surfaces shall be protected from abrasion or other damage during handling, testing, storing, assembly, and shipping.
1. Cleaning of stainless steel surfaces shall be performed with solvents, cloths and abrasives that do not contain halides. Only stainless steel, clean, iron-free hand or power tools or aluminum oxide abrasives shall be used on stainless steel components. Materials used to clean carbon steel or cast iron shall not be used to clean stainless steel surfaces
- G. **Protection of Equipment:** Equipment shall be boxed, crated, or otherwise protected from damage and moisture during shipment, handling, and storage. Equipment shall be protected from exposure to corrosive fumes and shall be kept thoroughly dry. Pumps, motors, drives, electrical equipment, and other equipment having anti-friction or sleeve bearings shall be stored in weather-tight storage facilities prior to installation. For extended storage periods, plastic equipment wrappers should be avoided to prevent accumulation of condensate in gears and bearings. In addition, motor space heaters shall

be energized and shafts shall be rotated. Equipment delivered to the Site with rust or corroded parts shall be rejected. If equipment develops defects during storage, it shall be disassembled, cleaned, and recoated to restore it to original condition.

H. **Identification of Equipment Items**

1. At the time of shipping, each item of equipment shall have a legible identifying mark corresponding to the equipment number in the Contract Documents for the particular item.
2. After installation, engraved corrosion resistant nameplates shall be securely attached at easily accessible and visible points for all equipment and components. The nameplates shall be stamped with information required by applicable code(s) and shall include Manufacturer's name, serial number, shop order number, project identification number, type of equipment and tag number. The size, material, and designation wording for nameplates shall be submitted to OWNER for review prior to engraving or stamping. All markings shall agree with similar markings on the Drawings. Nameplates shall be stainless steel or other material approved by OWNER. The method of attachment shall be non-deleterious to the equipment.

- I. **Nameplates / Labels.** Nameplates for all instruments, relays, control switches, selector switches, pushbuttons, circuit breakers, and other devices shall be furnished and mounted by CONTRACTOR. Nameplate size and designation shall be coordinated with OWNER. All nameplates shall be black and engraved with white lettering of laminated plastic material similar to Lamicaid. Nameplates shall be fastened in place with corrosion-resistant screws or bolts.

- J. **Shop Fabrication:** Shop fabrication shall be performed in accordance with the Contract Documents and the Shop Drawings.

2.2 PIPING CONNECTIONS

- A. **Pipe Hangers, Supports, and Guides:** Pipe connections to equipment shall be supported, anchored, and guided to avoid stresses and loads on equipment flanges and equipment. Supports and hangers shall be in accordance with Section 40 23 02 - Pipe Supports.
- B. **Flanges and Pipe Threads:** Flanges on equipment and appurtenances shall conform to ASME B16.5, Class 400, unless otherwise indicated. Pipe threads shall be in accordance with ASME B1.20.1 and Section 40 23 01 - Piping, General.

2.3 LIFTING EYES / LUGS

- A. All equipment weighing over 100 pounds shall be supplied with lifting eyes or lugs for use with a crane or hoist.

2.4 NAMEPLATES

- A. Equipment nameplates of stainless steel shall be engraved or stamped and fastened to the equipment in an accessible location with No. 4 or larger oval head stainless steel screws or drive pins. Nameplates shall contain the manufacturer's name, model, serial number, size, characteristics, and appropriate data describing the machine performance

ratings.

PART 3 -- EXECUTION

3.1 SERVICES OF MANUFACTURER

A. **Inspection, Startup, and Field Adjustment:** Where required by individual sections, an authorized, experienced, and competent service representative of the manufacturer shall visit the Site for the number of Days indicated in those sections to witness or perform the following and to certify in writing that the equipment and controls have been properly installed, aligned, lubricated, adjusted, and readied for operation.

1. Installation of equipment
2. Inspection, checking, and adjusting the equipment and approving its installation
3. Startup and field testing for proper operation, efficiency, and capacity
4. Performing field adjustments during the test period to ensure that the equipment installation and operation comply with requirements

B. **Instruction of the OWNER'S Personnel**

1. Where required by the individual equipment sections, an authorized training representative of the manufacturer shall visit the Site for the number of Days indicated in those sections to instruct the OWNER'S personnel in the operation and maintenance of the equipment, including step-by-step troubleshooting with necessary test equipment. Instruction shall be specific to the models of equipment provided.
2. The training materials shall remain with the trainees after the session.
3. The OWNER may videotape the training for later use by the OWNER'S personnel.

3.2 INSTALLATION

A. **General:** Equipment shall be installed in accordance with the manufacturer's written recommendations.

B. **Alignment:** Equipment shall be field tested to verify proper alignment.

3.3 PACKAGED EQUIPMENT

A. When any system is furnished as pre-packaged equipment, the CONTRACTOR shall coordinate space and structural requirements, clearances, utility connections, signals, and outputs with Subcontractors to avoid later change orders.

B. If the packaged system has any additional features (as safety interlocks, etc.) other than required by the Contract Documents, the CONTRACTOR shall coordinate such features with the ENGINEER and provide material and labor necessary for a complete installation as required by the manufacturer.

3.4 FIELD ASSEMBLY

- A. Studs, cap screws, bolt and nuts used in field assembly shall be coated with **Never Seize** compound or equal.

3.5 WELDING

- A. Welds shall be cleaned of weld-slag, splatter, etc. to provide a smooth surface.

3.6 FIELD TESTS

- A. Where indicated by the individual equipment sections, equipment shall be field tested after installation to demonstrate satisfactory operation without excessive noise, vibration, or overheating of bearings or motor.
- B. The following field testing shall be conducted:
 - 1. Start equipment, check, and operate the equipment over its entire operating range. Vibration level shall be within the amplitude limits as indicated or as recommended by the reference applicable standards.
 - 2. Obtain concurrent readings of motor voltage, amperage, capacity, vibration, and bearing temperatures.
 - 3. Operate equipment indicated in accordance with Section 01660, if provided.
- C. The ENGINEER shall witness field-testing. The CONTRACTOR shall notify the ENGINEER or OWNER of the test schedule no less than 5 Days in advance.
- D. In the event that any equipment fails to meet the test requirements, the equipment shall be modified and retested until it satisfies the requirement.

- END OF SECTION -

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SECTION 40 23 00 - PIPING, GENERAL

PART 1 -- GENERAL

1.1 SUMMARY

- A. The CONTRACTOR shall provide the piping systems indicated, complete and operable, in accordance with the Contract Documents.
- B. The provisions of this Section shall apply to all piping sections in Divisions 33 and 40.
- C. **Pipe Fabrication Drawings.** The mechanical Drawings define the general layout, configuration, routing, method of support, pipe size, and pipe type. The mechanical drawings are **not** pipe construction or fabrication drawings. The CONTRACTOR shall provide detailed pipe fabrication and pipe laying submittals in accordance with the requirements of the individual pipe material specification sections.
- D. **Pipe Supports and Spacing.** Where pipe supports and spacing are indicated on the Drawings and are referenced to a standard detail, the CONTRACTOR shall use that detail. Where pipe supports are not indicated on the Drawings, it is the CONTRACTOR'S responsibility to develop the details necessary to design and construct mechanical piping systems to accommodate the specific equipment provided, and to provide spacers, adapters, and connectors for a complete and functional system.

1.2 CONTRACTOR SUBMITTALS

- A. Furnish submittals in accordance with Section 01 33 00 - Contractor Submittals.
- B. **Shop Drawings:** Shop Drawings shall contain information as required in the individual pipe material specification section as well as the following information:
 - 1. **Layout and Fabrication Drawings:** Layout drawings including necessary details, dimensions, and material lists for pipe joints, fittings, specials, bolts and nuts, gaskets, valves, appurtenances, anchors, and guides. Fabrication drawings shall indicate spacers, pipe adapters and couplings, connectors, fittings, and location of pipe supports to accommodate the equipment and valves in a complete and functional system.
 - 2. Where applicable, all pipe coupling systems, including standard sleeve couplings, flange coupling adaptors, welded-ring restrained couplings, and /or grooved joint products shall be shown on shop drawings and product submittals and shall be specifically identified with the applicable Manufacturer's style or series number.
- C. **Samples:** The CONTRACTOR shall provide and pay for any pipe material sampling and product testing as necessary and as required in the individual pipe material specifications.
- D. **Certifications**
 - 1. Necessary certificates, test reports, and affidavits of compliance shall be obtained

by the CONTRACTOR.

2. A certification from the pipe fabricator that each pipe length will be manufactured subject to the fabricator's or a recognized Quality Control Program. An outline of the Quality Control Program shall be submitted to the ENGINEER for review prior to the manufacture of any pipe.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. **Extent of Work:** Pipes, fittings, and appurtenances shall be provided in accordance with the requirements of the applicable Sections of Divisions 33 and 40 and as indicated.
- B. **Pipe Supports:** Pipes shall be adequately supported, restrained, and anchored in accordance with Section 40 23 02 - Pipe Supports, and as indicated on the Contract Drawings.
- C. **Interior Linings:** Application, thickness, and curing of pipe interior linings shall be in accordance with the applicable Sections of Division 33, unless otherwise indicated.
- D. **Exterior Coatings:** Application, thickness, and curing of exterior coatings on buried pipe shall be in accordance with the applicable Sections of Division 33, unless otherwise indicated. For pipes above ground or in structures, exterior coatings of such pipe shall be in accordance with the applicable Sections of Division 33.
- E. **Pressure Rating:** Piping systems shall be designed for the maximum expected pressure as defined in Section 01 74 30 – Penstock Cleaning and Pressure Testing, or as indicated on the Contract Drawing, Piping Schedule, whichever is greater.
- F. **Inspection:** Pipe shall be subject to inspection at the place of manufacture. During the manufacture, the OWNER and ENGINEER shall be given access to areas where manufacturing is in progress and shall be permitted to make inspections necessary to confirm compliance with requirements.
- G. **Tests:** Except where otherwise indicated, materials used in the manufacture of the pipe shall be tested in accordance with the applicable specifications and standards. Welds shall be tested as indicated. The CONTRACTOR shall be responsible for performing material tests.
- H. **Welding Requirements:** Qualification of welding procedures used to fabricate pipe shall be in accordance with the provisions of AWS D1.1 - Structural Welding Code. Welding procedures shall be submitted for the ENGINEER's review.
- I. **Welder Qualifications:** Welding shall be done by skilled welders and welding operators who have adequate experience in the methods and materials to be used. Welders shall be qualified under the provisions of AWS D1.1 or the ASME Boiler and Pressure Vessel Code, Section 9, by an independent local, approved testing agency not more than 6 months prior to commencing WORK on the piping. Machines and electrodes similar to those used in the WORK shall be used in qualification tests. Qualification testing of

welders and materials used during testing is part of the WORK.

- J. **Grooved Joint Components:** If utilized, all grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.

2.2 PIPE FLANGES

- A. **General:** Flanges shall have flat faces and shall be attached with bolt holes straddling the vertical axis of the pipe unless otherwise indicated. Attachment of the flanges to the pipe shall conform to the applicable requirements of ASME B16.5 Class 300 flanges. Flange faces shall be perpendicular to the axis of the adjoining pipe. Flanges for miscellaneous small diameter pipes shall be in accordance with the standards indicated for these pipes.

B. Pressure Ratings

1. 100 psi to 275 psi: Flanges shall conform to either AWWA C207 Class E or Class F, or ASME B16.5 150 lb class.
2. 275 psi to 700 psi: Flanges shall conform to ASME B16.5, Class 300, 400, or 600, as indicated.
3. Selection based on test pressure: AWWA flanges shall not be exposed to test pressures greater than 125 percent of rated capacity. For higher test pressures, the next higher rated AWWA flange or an ANSI-rated flange shall be selected.

- C. **Blind Flanges:** Blind flanges shall be in accordance with AWWA C207, or as indicated for miscellaneous small pipes. Blind flanges for pipe sizes 10-inches and greater shall be provided with lifting eyes in the form of welded or screwed eye bolts.

- D. **Flange Coating:** Machined faces of metal blind flanges and pipe flanges shall be coated with a temporary rust-inhibitive coating to protect the metal until the installation is completed.

- E. **Flange and Coupling Bolts and Nuts:** All above-grade and below-grade bolts and nuts shall conform to ASTM A-193, Grade B-7 and as specified in Section 05 50 00 - Miscellaneous Metalwork, whichever is of greater yield stress material. All above grade bolts and nuts shall be galvanized.

F. Flange Gaskets

1. Gaskets for flanged joints used in general water and penstock service shall be full-faced type, with material and thickness in accordance with AWWA C207, suitable for temperatures to 700 deg F, a pH of one to 11, and pressures to 1,000 psig. Blind flanges shall have gaskets covering the entire inside face of the blind flange and shall be cemented to the blind flange. Ring gaskets shall not be permitted unless otherwise indicated. Flange gaskets shall be as manufactured by **John Crane, Style 2160, Garlock, Style 3000**, or equal.

2.3 THREADED INSULATING CONNECTIONS

- A. **General:** Threaded insulating bushings, unions, or couplings, as appropriate, shall be used for joining threaded pipes of dissimilar metals and for piping systems where corrosion control and cathodic protection systems are involved.
- B. **Materials:** Threaded insulating connections shall be of nylon, Teflon, polycarbonate, polyethylene, or other non-conductive materials, and shall have ratings and properties to suit the service and loading conditions.

2.4 SLEEVE-TYPE COUPLINGS

- A. **General:** Sleeve-type couplings shall be provided where indicated. The CONTRACTOR will not be allowed to substitute a sleeve-split coupling, or any other type in lieu of sleeve coupling unless approved by the ENGINEER.
- B. **Construction:** Sleeve couplings shall be in accordance with AWWA C219 - Standard for Bolted Sleeve-Type Couplings for Plain-End Pipe. Couplings shall be steel with steel bolts, without pipe stop. Couplings shall be of sizes to fit the pipe and fittings indicated. The middle ring shall be not less than 1/4-inch thick or at least the same wall thickness as the pipe to which the coupling is connected. If the strength of the middle ring material is less than the strength of the pipe material, the thickness of the middle ring shall be increased to have the same strength as the pipe. The coupling shall be either 5- or 7- inches long for sizes up to and including 30-inches and 10-inches long for sizes greater than 30-inches, for standard steel couplings, and 16-inches long for long-sleeve couplings. The followers shall be single-piece contoured mill sections welded and cold-expanded as required for the middle rings, and of sufficient strength to accommodate the number of bolts necessary to obtain adequate gasket pressures without excessive rolling. The shape of the follower shall be of such design as to provide positive confinement of the gasket. Bolts and nuts shall conform to the requirements of Section 05500. Buried sleeve-type couplings shall be epoxy-coated at the factory as indicated.
- C. **Pipe Preparation:** Where indicated, the ends of the pipe shall be prepared for flexible steel couplings. Plain ends for use with couplings shall be smooth and round for a distance of 12-inches from the ends of the pipe, with outside diameter not more than 1/64-inch smaller than the nominal outside diameter of the pipe. The middle ring shall be tested by cold-expanding a minimum of one percent beyond the yield point, to proof-test the weld to the strength of the parent metal. The weld of the middle ring shall be subjected to air test for porosity.
- D. **Gaskets**
 - 1. Gaskets for sleeve-type couplings shall be rubber-compound material that will not deteriorate from age or exposure to air under normal storage or use conditions. Gaskets for wastewater and sewerage applications shall be Buna "N," Grade 60, or equivalent suitable elastomer. The rubber in the gasket shall meet the following specifications:
 - a. Color: Black
 - b. Surface: Non-blooming

- c. Durometer Hardness: 75 ± 5
 - d. Tensile Strength: 1,000 psi minimum
 - e. Elongation: 175 percent minimum
2. The gaskets shall be immune to attack by impurities normally found in water or wastewater. Gaskets shall meet the requirements of ASTM D 2000 - Classification System for Rubber Products in Automotive Applications, AA709Z, meeting Suffix B13 Grade 3, except as noted above.
- E. **Piping Connection to Equipment:** Where piping connects to mechanical equipment such as pumps, turbine isolation valves, and blowers, the piping shall be brought to the equipment connection aligned and perpendicular to the axis of the flange or fitting for which the piping is to be connected. The piping shall not impose excessive stress to the equipment connection to cause misalignment of the equipment. The CONTRACTOR shall assign the responsibility to the equipment manufacturer to review the piping connection to the equipment and submit any modifications to the ENGINEER for review.
- F. **Restrained Joints:** Sleeve-type couplings on pressure lines shall be harnessed unless thrust restraint is provided by other means. Harnesses shall be designed by the pipe manufacturer in accordance with AWWA Manual M11, or as indicated. Harness sets shall be designed for the maximum test pressure of the pipe in which they are installed. Where harness sets are installed near the suction and discharge of the pump, harness bolts shall have zero elongation to prevent misalignment of the pump imparted by the thrust within the piping system.
- G. **Manufacturers, or equal**
- 1. Dresser, Style 38
 - 2. Ford Meter Box Co., Inc., Style FC1 or FC3
 - 3. Smith-Blair, Style 411
- 2.5 SLEEVE SPLIT-TYPE COUPLINGS (**Victaulic Depend-O-Lok**, or equal)
- A. **General:** Where indicated sleeve-split type couplings shall be furnished.
- B. **Construction:** Couplings shall be split-type, consisting of one or 2 piece housing, gasket assembly, bolts and nuts, and end rings. The double arch cross section that closes around the pipe ends shall be smooth to allow for expansion or contraction requirements. The pipe ends with steel end rings affixed shall provide restraint requirements. As the coupling closes, it shall confine the elastomeric gasket beneath the arches of the sleeve to create a radial seal. The axial seal shall squeeze the closure plates as the bolts pull the coupling snug around the pipe. The coupling shall permit angular pipe deflection, flexibility, contraction and expansion as designed by the manufacturer. The coupling housing shall be designed for internal pressure and external loads as determined by the design procedures of AWWA M11. The coupling shell thickness of the steel coupling shall be calculated using the formula:

$$T = PwDy / 2Fs$$

where:

T = steel coupling thickness, inches

Dy = pipe outside diameter, inches

Pw = Design working pressure, psi

Fs = 50 percent of minimum yield point of steel, psi

1. Coupling design calculations shall be stamped and signed by a registered engineer and shall be included in the Shop Drawing submittal for couplings.
2. The sealing members shall comprise of two "O"-ring gaskets and an elastomer sealing pad bonded to sealing plate. Internal pressure shall not be required to make the seal.

C. Materials

1. Unless otherwise indicated, coupling housing material shall be the same material as the piping. Carbon steel couplings shall be fabricated from ASTM A 36. Stainless steel couplings shall be fabricated from ASTM A 240, T-304, 304L, 316, or 316L.
2. Carbon steel end rings shall conform to ASTM A 108 Grade 1018. Stainless steel end rings shall conform to ASTM A 276 T-316L.
3. Bolts and nuts shall be in conformance with Section 05 50 00.
4. Gaskets shall be EPDM conforming to ASTM D 2000 for air service up to 240 degrees F. Gaskets for general water or sewerage service within the temperature range of -20 to 180 degrees F shall be isoprene or EPDM conforming to ASTM D 2000.
5. Carbon steel couplings shall be fusion bond epoxy coated inside and outside of the coupling in accordance with Section 09 96 00. Couplings installed underground shall be provided with **Depend-O-Wrap** tape or equal. Application of wrapping material shall be in conformance with AWWA C209.

D. Pipe Preparation

1. Ends of pipes shall be prepared for the flexible split sleeve type couplings inspected and approved by the coupling manufacturer. The pipe outside diameter and roundness tolerances shall comply with tolerances listed in AWWA C219.
2. Plain ends for use with couplings shall be smooth and round for a distance of 12-inches from end of the pipe.
3. End rings shall be furnished with couplings when restraint is required. Carbon steel end rings shall be ASTM A 108 Grade 1018. Stainless steel end rings shall conform to ASTM A 276 T-316L.

4. Where the split-type coupling is used to take up thermal expansion or contraction (**Depend-O-Lok Style 230**) at the pipe joint, one end ring shall be fixed to one end of the pipe to keep the coupling in the proper location.
5. Where the split-type coupling is used for a fully restrained pipe joint (**Depend-O-Lok Style 232**) at the pipe joint, one end ring shall be welded to each of the pipe ends to fit beneath the coupling and shall be protected by the coating. Welding design and specification shall be in conformance with the coupling manufacturer's recommendation.

E. **Manufacturer**, or equal

1. Victaulic, Depend-O-Lok

2.6 FLANGE COUPLING ADAPTERS

- A. Flange coupling adapters shall be provided where indicated. The CONTRACTOR will not be allowed to substitute any other type in lieu of flange coupling adapter unless approved by the ENGINEER. The coupling shall be rated as indicated.
- B. **Construction:** Flange coupling adapter body shall be fabricated from steel ASTM A 512 - Cold-Drawn Buttweld Carbon Steel Mechanical Tubing or A 513 - Electric-Resistance Welded Carbon and Alloy Steel Mechanical Tubing with steel bolts, without pipe stop. Flange shall be in accordance with AWWA C207. Couplings shall be of sizes to fit the pipe and fittings indicated. The body shall be not less than 1/4-inch thick or at least the same wall thickness as the pipe to which the coupling is connected. If the strength of the body material is less than the strength of the pipe material, the thickness of the middle ring shall be increased to have the same strength as the pipe. The follower flange shall be fabricated from steel, ASTM A 576 - Steel Bars, Carbon, Hot Wrought, Special Quality or AISI C1012. The shape of the follower shall be of such design as to provide positive confinement of the gasket. Flange coupling adapters installed in piping system rated for positive pressure, the coupling shall be restrained with harness bolts or tie rods. Other means of restraining the coupling such as set screws will not be acceptable. Bolts and nuts shall conform to the requirements of Section 05 50 00. Buried couplings shall be epoxy-coated at the factory as indicated.
- C. **Gaskets:** Gaskets for flange coupling adapters shall be rubber-compound material that will not deteriorate from age or exposure to air under normal storage or use conditions. Gaskets for wastewater and sewerage applications shall be Buna "N," Grade 60 NSF approved, or equivalent suitable elastomer.
 1. The rubber in the gasket shall meet the following specifications:
 - a. Color - Jet Black
 - b. Surface - Non-blooming
 - c. Durometer Hardness - 74 ± 5
 - d. Tensile Strength - 1,000 psi Minimum

- e. Elongation - 175 percent Minimum
 - 2. The gaskets shall be immune to attack by impurities normally found in water or wastewater. Gaskets shall meet the requirements of ASTM D 2000 - Classification System for Rubber Products in Automotive Applications, AA709Z, meeting Suffix B13 Grade 3, except as noted above. Where flange coupling adapters are used in water containing chloramine or other fluids which attack rubber materials, gasket material shall be compatible with the piping service and fluid utilized.
- D. **Piping Connection to Equipment:** Where piping connects to mechanical equipment such as pumps, compressors, and blowers, the piping shall be brought to the equipment connection aligned and perpendicular to the axis of the flange or fitting for which the piping is to be connected. The piping shall not impose excessive stress to the equipment connection to cause misalignment of the equipment. The CONTRACTOR shall assign the responsibility to the equipment manufacturer to review the piping connection to the equipment and submit any modifications to the ENGINEER for review.
- E. **Restrained Joints:** Flange coupling adapters on pressure lines shall be harnessed unless thrust restraint is provided by other means. Harnesses shall be designed by the pipe manufacturer in accordance with AWWA Manual M11, or as indicated. Harness sets shall be designed for the maximum test pressure of the pipe in which they are installed. Where harness sets are installed near the suction and discharge of the pump, harness bolts shall have zero elongation to prevent misalignment of the pump imparted by the thrust within the piping system.
- F. **Manufacturers, or equal**
- 1. Smith-Blair, Model 975
 - 2. JCM, Model 309
- 2.7 PIPE THREADS
- A. Pipe threads shall be in accordance with ASME B1.20.1 - Pipe Threads, General Purpose (inch), and be made up with Teflon tape unless otherwise indicated.
- 2.8 HEAT TRACING
- A. Pipes subject to freezing shall be protected by heat tracing in accordance with Section 40 42 00 - Pipe and Valve Insulation and Section 23 05 00 – HVAC General.

PART 3 -- EXECUTION

3.1 MATERIAL DELIVERY, STORAGE, AND PROTECTION

- A. Piping materials, fittings, valves, and accessories shall be delivered in a clean and undamaged condition and stored off the ground for protection against oxidation caused by ground contact. Defective or damaged materials shall be replaced with new materials.

3.2 GENERAL

- A. Piping, fittings, and appurtenances shall be installed in accordance with the requirements of applicable Sections of Division 33 and Division 40. Proprietary manufactured couplings shall be installed in accordance with the coupling manufacturer's recommendation.
- B. Care shall be taken to insure that piping flanges, mechanical-type couplings, sleeve-type couplings, flexible connectors, and expansion joints are properly installed as follows:
 - 1. Gasket surfaces shall be carefully cleaned and inspected prior to making up the connection. Each gasket shall be centered properly on the contact surfaces.
 - 2. Connections shall be installed to prevent inducing stress to the piping system or the equipment to which the piping is connected. Contact surfaces for flanges, couplings, and piping ends shall be aligned parallel, concentric, and square to each axis at the piping connections.
 - 3. Bolts shall be initially hand-tightened with the piping connections properly aligned. Bolts shall be tightened with a torque wrench in a staggered sequence to the AISC recommended torque for the bolt material.
 - 4. Groove ends shall be clean and free from indentations, projections, and roll marks in the area from the pipe end to the groove.
 - a. Install in accordance with the manufacturer's latest published installation instructions.
 - b. Gasket shall be manufactured by the coupling manufacturer and verified as suitable for the intended service.
 - c. A factory trained representative (direct employee) of the coupling manufacturer shall provide on-site training for contractor's field personnel in the use of grooving tools, application of groove, and product installation. The representative shall periodically visit the job site and review installation to ensure best practices in grooved joint installation are being followed. Contractor shall remove and replace any improperly installed products.
 - 5. After installation, joints shall meet the indicated leakage rate. Flanges shall not be deformed nor cracked.
- C. **Lined Piping Systems:** The lining manufacturer shall take full responsibility for the complete, final product and its application.
- D. **Protective Coatings for Buried Couplings (rigid and flexible).** Where pipe couplings are buried, all such couplings shall be given a liquid epoxy coating in the factory (unless otherwise specified) and shall be protected in the ground with a field applied use of a cross-linked polyolefin backed, heat-shrunked protective wrapping (*Canusa Aqua-Shield* or equal).
- E. **Core Drilling:** Where core drilling is required for pipes passing through existing

concrete, core drilling locations shall be determined by radiograph of concrete construction to avoid damage to embedded raceways and reinforcing bars.

- F. **Cleanup:** After completion of the WORK, cuttings, joining and wrapping materials, and other scattered debris shall be removed from the Site. The entire piping system shall be handed over in a clean and functional condition.

- END OF SECTION -

SECTION 40 23 02 - PIPE SUPPORTS

PART 1 -- GENERAL

1.1 SUMMARY

- A. Provide pipe supports, hangers, guides, and anchors, complete and in place, as indicated in accordance with the Contract Documents.
- B. Where pipe support systems are not indicated on the Drawings, the CONTRACTOR shall design and provide the supports in accordance with this Section.
- C. Wind Load Forces
 - 1. Pipe support repair and maintenance improvement details are indicated in the Contract Drawings. Actual Record Drawing information on the pipe supports and their anchoring systems are generally not available to the design ENGINEER. As such, improvements to the pipe support systems are designed for maintenance upkeep only and are not an indication that the current pipe support systems are able to withstand the site-specific wind-load criteria for the project.

1.2 CONTRACTOR SUBMITTALS

- D. Furnish submittals in accordance with the requirements of Section 01 33 00 – Contractor Submittals.
- E. Shop Drawings
 - 1. Submit Shop Drawings which shall include the following information:
 - a. Drawings of pipe supports, hangers, anchors, and guides
 - b. Calculations for special supports and anchors, stamped and signed by a registered professional engineer.

PART 2 -- PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Code Compliance
 - 1. Piping systems and pipe connections to equipment shall be properly anchored and supported in order to prevent undue deflection, vibration, and dislocation due to seismic events, line pressures, pipe weight, fluid weight, liquid movement, thermal changes, vibration, probable forces applied during construction, and stresses on piping, equipment, and structures.
 - 2. Supports and parts thereof shall conform to the requirements of ASME B31.1 - Power Piping, except as supplemented or modified in this Section.
- B. Structural Members

1. Wherever possible, pipes shall be supported from structural members.
2. Where it is necessary to frame structural members between existing members, such supplementary members shall be provided by the CONTRACTOR.
3. Supplementary members shall be in accordance with the requirements of the Building Code and the American Institute of Steel Construction, and shall be as acceptable to the ENGINEER.

C. Pipe Hangers

1. Pipe hangers shall be capable of supporting the pipe in operation, allowing free expansion and contraction of the piping and preventing excessive stress on equipment.
2. Hangers shall have a means of vertical adjustment after erection.
3. Hangers shall be designed to prevent becoming disengaged by any movement of the supported pipe.
4. Hangers subject to shock, seismic disturbances, or thrust imposed by the actuation of safety valves shall include hydraulic shock suppressors.
5. Hanger rods shall be subjected to vertical loading only.

D. Hangers Subject to Horizontal Movements

1. At hanger locations where lateral or axial movement is anticipated, suitable linkage shall be provided to permit such movement.
2. Where horizontal pipe movement is greater than 1/2 inch, or where the hanger rod deflection from the vertical is greater than 4 degrees from the cold-to-hot position of the pipe, the hanger rod and structural attachment shall be offset in such a manner that the rod is vertical in the hot position.

E. Thermal Expansion

1. Wherever expansion and contraction of piping is expected, a sufficient number of expansion loops or expansion joints shall be provided, together with the necessary rolling or sliding supports, anchors, guides, pivots, and restraints permitting the piping to expand and contract freely away from the anchored points.
2. Components shall be structurally suitable to withstand the imposed loads.

F. Riser Supports

1. Where practical, risers shall be supported on each floor with riser clamps and lugs, independent of the connected horizontal piping.

G. Freestanding Piping

1. Freestanding pipe connections to equipment such as chemical feeders and pumps

shall be firmly attached to steel frames fabricated from angles, channels, or I-beams anchored to the structure.

2. Exterior, freestanding overhead piping shall be supported on fabricated pipe stands consisting of pipe columns anchored to concrete footings, or with horizontal, welded steel angles, and U-bolts or clamps securing the pipes.

H. Materials of Construction

1. Pipe support assemblies, including framing, hardware, and anchors, shall be of steel construction, galvanized after fabrication, unless otherwise indicated.

I. Concrete Anchors

1. Unless otherwise indicated, concrete anchors for pipe supports shall be according to the following table; consult the ENGINEER for any anchor applications not appearing on the table.
2. Anchor embedment shall be in accordance with the requirements of Section 05 50 00 – Miscellaneous Metalwork.

Pipe Support Application	Type of Concrete Anchor
New Concrete:	Use embedded concrete insert anchors on a grid pattern. Use Grinnell (Anvil International), Tolco pipe supports, or equal.
Existing Concrete:	Use non-shrink grouted anchors, metallic type expansion anchors, or epoxy anchors. Exceptions: Metallic type expansion anchors and epoxy anchors are not permitted for pipe supports subject to vibrating loads. Epoxy anchors are not permitted where the concrete temperature is in excess of 100 deg F or higher than the limiting temperature recommended by the manufacturer. Epoxy anchors are not accepted where anchors are subject to vibration or fire.

2.2 SUPPORT SPACING

- A. Supports for piping with the longitudinal axis in approximately a horizontal position shall be spaced to prevent excessive sag, bending, and shear stresses in the piping, with special consideration given where components such as flanges and valves impose concentrated loads.
- B. Pipe support spacing shall not exceed the maximum indicated spans.
- C. For temperatures other than ambient temperatures or those listed, and for other piping materials or wall thicknesses, the pipe support spacings shall be modified in

accordance with the pipe manufacturer's recommendations.

- D. Vertical supports shall be provided to prevent the pipe from being overstressed from the combination of loading effects.

E. Steel Pipe

1. Install supports for steel pipe in accordance with the requirements of AWWA: Manual of Practice MOP-11.
2. For steel pipe sizes not indicated, the support spacing shall be designed such that the stress on the pipe does not exceed 5,000 psi.
3. Where support spacing is not indicated on the Drawings, the CONTRACTOR shall use the spacing indicated in the following schedule, for the indicated support condition:

PRACTICAL SPANS FOR SIMPLY SUPPORTED PIPE IN 120-DEGREE CONTACT SADDLES, FEET ¹										
Nominal Pipe Diameter, inches	Pipe Wall Thickness, inches									
	3/16	1/4	5/16	3/8	7/16	1/2	5/8	3/4	7/8	1
6	36	40	44							
8	38	42	45							
10	39	43	46							
12	40	44	47							
14	40	44	47							
16	41	45	48							
18	41	46	49	52						
20	42	46	50	53						
22	42	46	51	54						
24	42	48	52	55	58	60				

¹ Reference: AWWA MOP 11, Table 7-1

F. Schedule 80 PVC Pipe

1. Install supports for Schedule 80 PVC pipe as indicated in the following schedule:

Support Spacing for Schedule 80 PVC Pipe ¹

Nominal Pipe Size, inches	Maximum Support Spacing, feet, at Various Temperatures				
	60 deg F	80 deg F	100 deg F	120 deg F	140 deg F
1	6	5.5	5	3.5	3
1-1/2	6.5	6	5.5	3.5	3.5
2	7	6.5	6	4	3.5
3	8	7.5	7	4.5	4
4	9	8.5	7.5	5	4.5
6	10	9.5	9	6	5

¹ Reference: USACE based on Harvel Plastics Product Bulletin 112/401 (rev, 10/1/95), p. 63; spacing values based on test data developed by the manufacturer for the specific product and continuous spans; the piping is insulated and full of liquid with a specific gravity of 1.0

G. Other Pipe Materials

1. Support spacing for pipe constructed of other materials shall be based on design temperature and in accordance with the pipe manufacturer's recommendations.

2.3 MANUFACTURED SUPPORTS

A. Provide pipe supports, hangers, guides, and anchors, complete and in place, as indicated in accordance with the Contract Documents.

B. Stock Parts

1. Where not specifically indicated, designs that are generally accepted as exemplifying good engineering practice and using stock or production parts shall be utilized wherever possible.
2. Such parts shall be locally available, new, of best commercial quality, and designed and rated for the intended purpose.

C. Manufacturers, or Equal

1. **Basic Engineers Inc.**
2. **Bergen-Paterson Pipesupport Corp.**
3. **Grinnell Corp. (Anvil International)**
4. **NPS Products, Inc.**
5. **Power Piping Company**
6. **Tolco Incorporated**

2.4 COATING

A. Galvanizing

1. Unless otherwise indicated, fabricated pipe supports other than stainless steel or non-ferrous supports shall be blast-cleaned after fabrication and hot-dip galvanized in accordance with ASTM A 123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. General

1. Pipe supports, hangers, brackets, anchors, guides, and inserts shall be fabricated and installed in accordance with the manufacturer's printed instructions and ASME B31.1 - Power Piping.
2. Concrete inserts for pipe hangers and supports shall be coordinated with the formwork.

B. Appearance

1. Pipe supports and hangers shall be positioned in order to produce an orderly, neat piping system.
2. Hanger rods shall be vertical, without offsets.
3. Hangers shall be adjusted to line up groups of pipes at the proper grade for drainage and venting, as close to ceilings or roofs as possible, and without interference with other WORK.

3.2 FABRICATION

A. Quality Control

1. Pipe hangers and supports shall be fabricated and installed by experienced welders and fitters, using the best welding procedures available.
2. Fabricated supports shall be neat in appearance without sharp corners, burrs, or edges.

- END OF SECTION -

SECTION 40 23 15 - STEEL PIPE (ASTM A53 / A106, MODIFIED)

PART 1 -- GENERAL

1.1 SUMMARY

- A. The CONTRACTOR shall provide steel pipe and appurtenances, complete and in place, in accordance with the Contract Documents.
- B. The requirements of Section 40 23 00 - Piping, General apply to the WORK of this Section.
- C. **Pipe Material Group No. 2 and No. 7.** The piping system defined in this section is referred to in the Pipe Schedule on Contract Sheet G-07 as
 - 1. **Piping Material Group No. 2** for diameters of 4-inches or less, galvanized steel, schedule 40 or 80 as indicated.
 - 2. **Piping Material Group No. 7** for diameters of 6-inches or larger, galvanized steel, schedule 20 or 30 unless otherwise noted

PART 2 -- PRODUCTS

2.1 PIPE MATERIAL

- A. **Water, Service:** Unless otherwise indicated, galvanized and black steel pipe shall conform to ASTM A 53 - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless or ASTM A 106 - Seamless Carbon Steel Pipe for High Temperature Service, Grade B, and shall be Schedule 20 or 30, or 40, as indicated in the Piping Schedule. Galvanized steel pipe shall not be cement mortar lined.

2.2 PIPE JOINTS

- A. Black steel pipe for general service shall have screwed ends with NPT threads, welded joints, or flanged joints. Screwed joints shall be made up with Teflon tape and welded joints may have butt-weld fittings, or flanges. Where indicated, black steel pipe shall have grooved ends for shouldered couplings.
- B. Galvanized steel pipe of 3-inch diameter or less shall have screwed ends with NPT threads made up with Teflon tape. Where indicated, galvanized steel pipe shall have grooved ends for shouldered couplings or plain ends for sleeve-type couplings.

2.3 FITTINGS

- A. **Common Use:** The following fittings shall be provided for galvanized or black steel pipe, as indicated in the Piping Schedule:
 - 1. Threaded malleable iron fittings conforming to ASME B 16.3 - Malleable-Iron Threaded Fittings, Class 300.

2. Forged steel socket welded fittings conforming to ASME B 16.11 - Forged Fittings, Socket - Welding and Threaded.
3. Butt welding fittings conforming to ASME B 16.9 - Factory-Made Wrought Steel Butt Welding Fittings, Schedule 40, or as indicated.
4. Flanged cast iron fittings conforming to ASME B 16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 250 and 800.
5. Grooved ductile iron fittings with grooving dimensions conforming to AWWA C 606 - Joints, Grooved and Shouldered Type.

B. Special Applications

1. High tensile alloy steel corrosion-resistant bolts and nuts shall be used with each set of flanged unions. Unions shall be rated for 500 lb. CWP service pressure, reducing-type, straight-type or blind-type, as required for the installation. Blind unions shall be provided as cleanouts where indicated, and straight unions shall be provided adjacent to each threaded valve or piece of equipment. Unions shall be as manufactured by **Henry Valve Company, Vogt Valve Co.**, or equal.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. **General:** Pipes shall be installed in a neat and workmanlike manner, properly aligned, and cut from measurements taken at the Site to avoid interferences with structural members, architectural features, openings, and equipment. Exposed pipes shall afford maximum headroom and access to equipment, and where necessary, piping shall be installed with sufficient slopes for venting or drainage of liquids and condensate to low points. Installation shall be free from defects.
- B. **Supports and Anchors:** Piping shall be firmly supported with fabricated or commercial hangers or supports in accordance with Section 40 23 02 - Pipe Supports. Where necessary to avoid stress on equipment or structural members, the pipes shall be anchored or harnessed. Expansion joints and guides shall compensate for pipe expansion due to temperature differences.
- C. **Valves and Unions:** Water, lubrication oil, and compressed air supply piping to fixtures, groups of fixtures, and equipment shall be provided with a shutoff valve and union, unless the valve has flanged ends. Low points in water systems and driplegs in steam, gas, and air systems shall have drainage valves. Unions shall be provided at threaded valves, equipment, and other devices requiring occasional removal or disconnection.
- D. **Branch Connections:** Branch connections in horizontal runs of air and gas piping shall be made from the top of the pipe, to avoid drainage of condensate into the equipment.

3.2 PIPE PREPARATION

- A. Prior to installation, each pipe length shall be carefully inspected, be flushed clean of any debris or dust, and be straightened if not true. Ends of threaded pipes shall be reamed and filed smooth. Fittings shall be equally cleaned before assemblage.

3.3 PIPE JOINTS

- A. **Threaded Joints:** Pipe threads shall conform to ASME B 1.20.1 - Pipe Threads, General Purpose (inch), and shall be full and cleanly cut with sharp dies. Not more than 3 threads shall remain exposed after installation.
- B. **Welded Joints:** Welded joints shall conform to the specifications and recommendations of ASME B 31.1 - Power Piping. Welding shall be done by skilled and qualified welders per Section 40 23 00 - Piping, General.
- C. **Grooved Joints:** Grooves for grooved couplings and fittings shall be made with specially designed grooving tools to the manufacturer's recommendations and conform to AWWA C 606. Grooves shall be clean and sharp without flaws, and the pipe ends shall be accurately cut at 90 degrees to the pipe axis.

3.4 INSPECTION AND FIELD TESTING

- A. **Inspection:** Finished installations shall be carefully inspected for proper supports, anchoring, interferences, and damage to pipe, fittings, and coating. Any damage shall be repaired.
- B. **Field Testing:** Prior to enclosure or burying, piping systems shall be pressure tested as required in the Piping Schedule for a period of not less than one hour without exceeding the tolerances listed in the Piping Schedule. Where no pressures are indicated, the pipes shall be subject to 1-1/2 times the maximum working pressure. The CONTRACTOR shall furnish test equipment, labor, materials, and devices as part of the WORK. For additional testing requirements, refer to Section 01 74 30 – Penstock Cleaning and Pressure Testing.
 - 1. Leakage may be determined by loss of pressure, soap solution, chemical indicator, or other positive and accurate method. Fixtures, devices, or other accessories which are to be connected to the lines and which would be damaged if subjected to the test pressure shall be disconnected and ends of the branch lines plugged or capped as required during the testing procedures.
 - 2. Leaks shall be repaired, and the system shall be re-tested until no leaks are found.

- END OF SECTION -

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SECTION 40 23 16 - STAINLESS STEEL PIPE (ASTM A312, MODIFIED)

PART 1 -- GENERAL

1.1 SUMMARY

- A. The CONTRACTOR shall provide stainless steel pipe and appurtenances, complete and in place, in accordance with the Contract Documents.
- B. The requirements of Section 40 23 00 - Piping, General apply to the WORK of this Section.
- C. **Pipe Material Group No. 15.** The piping system defined in this section is referred to in the Pipe Schedule on Contract Sheet G-007 as Piping Material Group No. 15 (for schedule 20 or 40 pipe).

PART 2 -- PRODUCTS

2.1 PIPE MATERIAL

- A. Unless otherwise indicated, stainless steel pipe shall be in accordance with ASTM A 312 - Seamless and Welded Austenitic Stainless Steel Pipe, Type 304, seamless, Schedule 40, with screwed fittings for sizes up to and including 2.5 inches and welded fittings or flanged fittings for sizes 3-inches and larger. Stainless steel pipe 12-inches in diameter and larger shall be in accordance with ASTM A 409 - Welded Large Diameter Austenitic Steel Pipe for Corrosive or High-Temperature Service, or A 778 - Welded, Unannealed Austenitic Stainless Steel Tubular Products, Type 304, of the schedules indicated, with welded or flanged joints.

2.2 PIPE JOINTS

- A. Stainless steel pipe for sizes 2.5 inches and smaller shall have screwed ends with NPT threads made up with Teflon tape. Stainless steel pipe 3-inches and larger and where indicated shall have welded joints with socket-welding fittings, butt-welding fittings, or socket welded flanges. Stainless steel flanges shall have stainless steel bolts and nuts. Where indicated, stainless steel pipe shall have grooved ends for shouldered couplings, except that no pipe with less than Schedule 40 wall thickness shall be grooved. Where indicated, stainless steel pipe shall have plain ends for sleeve-type couplings.

2.3 FITTINGS

- A. **Threaded Fittings:** Forged stainless steel fittings conforming to ASME B 16.11 - Forged Fittings, Socket-Welding and Threaded, Type 316.
- B. **Socket-Welding Fittings:** Forged stainless steel fittings conforming to ASME B 16.11, Type 304.
- C. **Butt-Welding Fittings:** Wrought stainless steel butt-welding fittings conforming to ASTM A 403 - Wrought Austenitic Stainless Steel Piping Fittings, and ASME B 16.9 - Factory-Made Wrought Steel Butt-Welding Fittings, Type 304.

- D. **Grooved Fittings:** Wrought stainless steel grooved fittings conforming to ASTM A 403 and ASME B 16.9, with grooving conforming to AWWA C606 - Grooved and Shouldered Joints, Type 304.
- E. **Flanged Fittings:** Type 316 stainless steel flanged fittings and flanges conforming to ASME B 16.5 - Pipe Flanges and Flanged Fittings.
- F. **Pressure Class:** Unless otherwise indicated, fittings shall be in accordance with the pressure classes called for in the Piping Schedule. Where not indicated, the fittings shall have the same pressure rating as the adjoining pipe.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. **General:** Stainless steel pipe shall be installed in a neat and workmanlike manner, properly aligned and cut from measurements taken at the Site to avoid interferences with structural members, architectural features, openings, and equipment. Exposed pipe shall afford maximum headroom and access to equipment, and where necessary piping shall be installed with sufficient slopes for venting or drainage of liquids and condensate to low points. Installation shall be free from defects.
- B. **Supports and Anchors:** Piping shall be firmly supported with fabricated or commercial hangers or supports in accordance with Section 40 23 02 - Pipe Supports. Where necessary to avoid stress on equipment or structural members, the pipe shall be anchored or harnessed. Expansion joints and guides shall compensate for pipe expansion due to temperature differences.
- C. **Valves and Unions:** Unless otherwise indicated, connections to fixtures, groups of fixtures, and equipment shall be provided with a shutoff valve and union, unless the valve has flanged ends. Unions shall be provided at threaded valves, equipment, and other devices requiring occasional removal or disconnection.

3.2 PIPE PREPARATION

- A. Prior to installation, each pipe length shall be carefully inspected, be flushed clean of any debris or dust, and be straightened if not true. Ends of threaded pipes shall be reamed and filed smooth. Fittings shall be equally cleaned before assembly.

3.3 PIPE JOINTS

- A. **Threaded Joints:** Pipe threads shall conform to ASME B 1.20.1 - Pipe Threads, General Purpose (inch), and shall be full and cleanly cut with sharp dies. Not more than 3 threads shall remain exposed after installation.
- B. **Welded Joints:** Welded joints shall conform to the specifications and recommendations of ASME B 31.1 - Power Piping. Welding shall be done by skilled and qualified welders per Section 40 23 00 - Piping, General.
 - 1. Field welding shall be minimized to the greatest extent possible by use of couplings and prefabrication of pipe systems at the factory. Pipe butt welds may be performed

at the Site, providing the butt welds are performed only with an inert gas shielded process and that other indicated welding requirements are followed rigidly.

2. Residue, oxide, and heat stain shall be removed from any type of field weld and the affected areas adjacent by the use of stainless steel wire brushes, followed by cleaning with an agent such as **Eutectic Company's "Euclean"** or equal, followed by complete removal of the agent.

- C. **Grooved Joints:** Grooves for grooved couplings and fittings shall be made with specially designed grooving tools to the manufacturer's recommendations and conforming to AWWA C606. Grooves shall be clean and sharp without flaws, and the pipe ends shall be accurately cut at 90 degrees to the pipe axis.

3.4 INSPECTION AND FIELD TESTING

- A. **Inspection:** The finished installation shall be carefully inspected for proper supports, anchoring, interferences, and damage to pipe, fittings, and coating. Defects shall be repaired.

- B. **Field Testing:** Prior to enclosure or burying, piping systems shall be pressure tested as required in the Piping Schedule, for a period of not less than one hour without exceeding the tolerances listed in the Piping Schedule. Where no pressures are indicated, the pipes shall be subject to 1.5 times the maximum working pressure. The CONTRACTOR shall furnish test equipment, labor, materials, and devices as part of the WORK. For additional testing requirements refer to Section 01 74 30 – Penstock Cleaning and Pressure Testing.

1. Leakage may be determined by loss of pressure, soap solution, chemical indicator, or other positive and accurate method. Fixtures, devices, or other accessories which are to be connected to the lines and which would be damaged if subjected to the test pressure shall be disconnected and ends of the branch lines plugged or capped as required during the testing procedures.
2. Leaks shall be repaired, and the system shall be re-tested until no leaks are found.

- END OF SECTION -

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SECTION 40 42 00 – PIPE AND VALVE INSULATION

PART 1 -- GENERAL

1.1 SUMMARY

- A. The CONTRACTOR shall provide pipe and valve insulation, complete and in place, as indicated in accordance with the Contract Documents.

1.2 REFERENCES

- A. The following is a list of standards which may be referenced in this Section:
 - 1. American Society for Testing and Materials (ASTM):
 - a. ASTM C1136 Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation
 - b. ASTM C1290 Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts
 - c. ASTM E84 Test Method for Surface Burning Characteristics of Building Materials

1.3 CONTRACTOR SUBMITTALS

- A. Furnish submittals in accordance with the requirements of Section 01 33 00 – Contractor Submittals.
- B. Submit complete Shop Drawings of thermal insulation, with manufacturer's data on materials, covering, jackets, and finish.
- C. Furnish the following certifications:
 - 1. Certification from the heating system manufacturer that the insulation has been installed in accordance with the manufacturer's recommendations.
 - 2. Certification from the acoustic insulation/duct lining manufacturer that the lining has the indicated sound absorption coefficients.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Components of the insulation, including covering, mastics, and adhesives, shall have a flame-spread rating of not greater than 25 and a smoke development rating of not greater than 50.
- B. Ratings shall be as established by tests in accordance with ASTM E 84, and the above federal and commercial specification standards.

- C. Insulation shall be applied in strict accordance with the manufacturer's instructions.

2.2 BASIC MATERIALS

- A. Unless otherwise indicated, the insulation thickness shall be as follows:

Table 2-1. Basic Pipe and Valve Materials

Pipe		Minimum Thickness of Insulation (inches)
Heat-traced piping and Valves	3-inch and smaller	1
	4-inch and larger	2
Valves and manufactured equipment	as recommended by manufacturer	

2.3 PIPING INSULATION

- A. Except as indicated otherwise, piping shall be insulated with heavy density, unfaced, fiberglass pipe insulation.
- B. Pipe insulation shall have an average density of 5 pounds per cubic foot or greater, and its conductivity (k) shall not exceed 0.23 BTU-inch per (hour) (square foot) (° F) at a mean temperature of 75° F.
- C. Supporting Hangers
 1. For 3-inch piping and larger, the insulation shall be protected at supporting hangers by the suitable hollow steel protection saddles, filled with loose glass fiber insulation as indicated.
 2. For piping smaller than 3-inch, place 1/16-inch thick sheet metal shims between the insulation and the supporting hanger; the shim shall be at least 6 inches long.
 3. The insulation shall be oversized for installation over electric heating cable.
 4. The insulation shall have a factory-applied white fire-retardant vapor-barrier jacket of kraft paper and aluminum foil laminated together and reinforced with fiberglass yarn.
 5. Fittings and valves shall be covered with the same material as the pipe, cut in segments to fit snugly without open spaces, held in place with copper wire or cement, and then covered with the same jacketing material as the pipe.
 6. Insulated fittings adjacent to vapor-barrier insulation shall be sealed with an acceptable vapor-barrier cement before installation of the finish jacket.
 7. The pipe insulation and vapor-barrier shall be continuous through hangers and supports.
 8. Where insulation is indicated for the top-half segment of pipe, insulation at support

locations shall be of the same density.

9. The bottom-half insulation segments provided between the pipe and the insulation protection shields shall have a density of not less than 6 lb/cu ft.

D. Jacketing

1. A final covering of the insulation for piping shall be of 0.030-inch thick PVC or equivalent strength smooth aluminum, preformed jacketing with a factory-attached moisture barrier.
2. Valves, flanges, fittings, and ends of insulation shall be covered with a pre-molded, precision-formed, high-low temperature PVC fitting cover or end cap, or equivalent preformed unit to match the piping insulation jacket.
3. The pre-molded covers shall be sized to receive same thickness of insulation as used on the adjacent piping, and shall be sized to cover and protect the insulated fitting.
4. Joints shall be sealed with silicone mastic or solvent welding to provide a continuous air- and weather-tight joint.
5. Strapping shall be 1/2-inch wide, Type 3003 aluminum or stainless steel.
6. Pre-molded fittings shall be **Zeston 2000 PVC**, or equal.

E. Standard Temperature Insulation

1. Standard temperature insulation shall be used for process, cold and hot water, steam, and condensate piping and equipment with surface temperatures up to 850° F.
2. Pipe insulation and jacketing shall be applied to piping where indicated, including associated fittings, flanges, and valves.
3. Pipe insulation shall consist of a molded-type pipe covering, constructed of fibrous glass with a minimum k-factor of 0.23 at 75° F mean temperature.

2.4 EQUIPMENT AND VALVE INSULATION

A. Low Temperature Insulation

1. For equipment and tank insulation up to 250° F, use pipe insulation as described above.
2. The installation shall be in strict accordance with the manufacturer's recommendations.
3. An aluminum or PVC jacket shall be installed over the insulation for protection.

- B. The insulation thickness shall be as recommended by the manufacturer of the equipment or tank.

C. Ductwork Insulation Manufacturer, or Equal:

1. **Owens Corning, Fiberglas All-Service Duct Wrap;** and,
2. **Johns Manville, Type 150.**

PART 3 -- EXECUTION

3.1 GENERAL

- A. Insulation and liners shall be installed by a qualified insulation contractor in strict accordance with the manufacturer's recommendations.

3.2 PIPING INSULATION

- A. Piping, fittings, and valves to be insulated shall be clean and dry prior to installation of insulation.
- B. Piping indicated to be insulated shall be completely insulated inside structures, except where indicated otherwise.

3.3 FIBERGLASS INSULATION

- A. Fiberglass insulation shall be securely held in place before the final covering is applied.
- B. A scrim fabric, similar to a 20 x 10 thread count mesh and 100 percent fiberglass, shall be pasted in place to hold the pipe insulation securely to the pipe.
- C. The scrim fabric shall be at least 4-inches wide, with at least two (2) applications per length of pipe insulation, and one at each joint.

3.4 JACKETING

- A. Joints shall be neatly finished with no ragged ends.
- B. When finished, the covering shall show no exposed staples or other binding used during installation.
- C. Staples, if used, shall be stainless steel.

3.5 LAGGING FABRIC

- A. The final lagging fabric shall be neatly pasted in place with a 3-inch longitudinal overlap using a **Luben No. 9 adhesive**, or equal.
- B. Each transverse joint shall have a 3-inch butt strip of the same fiberglass fabric.
- C. Final joints shall be neatly finished with no ragged ends and the covering shall present a neat, uniform surface when finished.
- D. The fabric shall show no exposed staples or other binding used during construction; staples, if used, shall be stainless steel.

- END OF SECTION -

SECTION 43 25 00 - VALVES, GENERAL

PART 1 -- GENERAL

1.1 SUMMARY

- A. Valve described in this Section include all valves on the project. The following valves shall be Owner Furnished – Contractor Installed (OFCl):
 - 1. V-200, 12" Nominal dia butterfly valve (AWWA C504B), low pressure
 - 2. V-201, 12" Nominal dia butterfly valve (AWWA C519), high pressure
 - 3. V-202, 12" Nominal dia butterfly valve (AWWA C519), high pressure
 - 4. V-204, 10" Nominal dia fixed sleeve valve, high pressure
 - 5. V-205, 10" Nominal dia fixed sleeve valve, high pressure
- B. The requirements of Section 44 00 00 - Equipment General Provisions, apply to the WORK of this Section.
- C. The provisions of this Section shall apply to valves and valve actuators except where otherwise indicated. Valves and actuators in particular locations may require a combination of units, sensors, limit switches, and controls indicated in other Sections of the Specifications.
- D. **Unit Responsibility:** A single manufacturer shall be made responsible for coordination of design, assembly, testing, and furnishing each valve; however, the Valve Supplier shall be responsible to the OWNER for compliance with the requirements of each valve section. Unless indicated otherwise, the responsible manufacturer shall be the manufacturer of the valve.
- E. **Single Manufacturer:** Where 2 or more valves of the same type and size are required, the valves shall be furnished by the same manufacturer.

1.2 CONTRACTOR SUBMITTALS

- A. Valve Supplier shall furnish submittals in accordance with Section 01 33 00 - Contractor Submittals.
- B. **Shop Drawings:** Shop Drawings shall contain the following information:
 - 1. Valve name, size, Cv factor, pressure rating, identification number (if any), and specification section number.
 - 2. Complete information on valve gear box and actuator sizing, including torque requirements at operating pressure, size, manufacturer, model number, limit switches (where required), and mounting.
 - 3. Cavitation limits for control valves.

4. Assembly drawings showing part nomenclature, materials, dimensions, weights, and relationships of valve handles, handwheels, position indicators, limit switches, integral control systems, needle valves, and control systems.
 5. Data in accordance with Section 26 05 10 - Electric Motors for electric motor-actuated valves, as applicable.
 6. Complete wiring diagrams and control system schematics.
 7. Valve Labeling: A schedule of valves to be provided with stainless steel tags, indicating in each case the valve location and the proposed wording for the tag.
- C. **Technical Manual:** The Technical Manual shall contain the required information for each valve.
- D. **Spare Parts List:** A Spare Parts List shall contain the required information for each valve assembly, where indicated.
- E. **Factory Test Data:** Where indicated, signed, dated, and certified factory test data for each valve requiring certification shall be submitted before shipment of the valve. The data shall also include certification of quality and test results for factory-applied coatings.

PART 2 -- PRODUCTS

2.1 PRODUCTS

- A. **General:** Valves shall be new and of current manufacture. Shut-off isolation valves 6-inches and larger shall have actuators with position indicators. Buried valves shall be provided with valve boxes and covers containing position indicators and valve shaft extensions. Manual shut-off valves mounted higher than 7-feet above working level shall be provided with chain actuators.
- B. **Valve Actuators:** Unless otherwise indicated, actuators shall be in accordance with Section 43 25 01 - Valve and Gate Actuators.
- C. **Protective Coating:** The exterior surfaces of all valves, exposed or buried, including the wet interior surfaces of ferrous valves of sizes 4-inches and larger shall be furnished with a fusion bonded epoxy coating in accordance with AWWA C213 at a minimum total dry film thickness (DFT) of 14 mils. The valve manufacturer shall certify in writing that the required coating has been applied and tested in the manufacturing plant prior to shipment, in accordance with these Specifications. Flange faces of valves shall not be epoxy coated.
- D. **Valve Labeling:** Valve Labels shall be furnished by the Installation CONTRACTOR. Except when such requirement is waived by the ENGINEER in writing, a label shall be provided on shut-off valves and control valves. The label shall be of 1/16-inch thick stainless steel, minimum 2-inches by 4-inches in size, as indicated in Section 40 23 01 - Piping Identification, and shall be permanently attached to the valve or on the wall adjacent to the valve as directed by the ENGINEER.
- E. **Valve Testing:** As a minimum, unless otherwise indicated or recommended by the

reference standards, valves of cold working pressure rating of 250 psig or less shall be tested in accordance with manufacturer's standard.

Valves of CWP over 250 psig shall be factory tested as follows:

1. **Hydrostatic Testing:** Valve bodies shall be subjected to internal hydrostatic pressure equivalent to at least 1.5 times the hydrostatic water working pressure of the valve. Metallic valve rating pressures shall be at 80 degrees F. During the hydrostatic test, there shall be no leakage through the valve body, end joints, or shaft seals, nor shall any part of the valve be permanently deformed. The duration shall be sufficient time to allow visual examination for leakage. Test duration shall be at least 10 minutes.
 2. **Seat Testing:** Valves shall be tested for leaks in the closed position with the pressure differential across the seat equal to the water rated pressure of the valve or 550 psig, whichever is larger. The duration of test shall be sufficient time to allow visual examination for leakage. Test duration shall be at least 1-hour. Leakage past the closed valve shall not exceed 1 fluid ounce per hour per inch diameter for metal seated valves. Resilient-seated valves shall be drop-tight.
 3. **Performance Testing:** Valves shall be shop-operated from fully closed to fully open position and reverse under no-flow conditions and full project static pressure head conditions, in order to demonstrate the valve assembly operates properly.
- F. **Certification:** Prior to shipment, the Valve Supplier shall submit for valves of 10-inches in diameter and larger, certified, notarized copies of the hydrostatic factory tests, showing compliance with the applicable standards of AWWA, ANSI, or ASTM.
- G. **Valve Marking:** Valve bodies shall be permanently marked in accordance with MSS SP25 - Standard Marking Systems for Valves, Fittings, Flanges, and Unions.

2.2 MATERIALS

- A. **General:** Materials shall be suitable for the intended application. Materials not indicated shall be high-grade standard commercial quality, free from defects and imperfections that might affect the serviceability of the product for the purpose for which it is intended. Unless otherwise indicated, valve and actuator bodies shall conform to the following requirements:
4. **Cast Iron:** Cast iron bodies, disks and other components are not allowed on any valves, unless specifically called for.
 2. **Ductile Iron:** ASTM A 536 - Ductile Iron Castings, or to ASTM A 395 - Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
 3. **Steel:** ASTM A 216 - Steel Castings, Carbon Suitable for Fusion Welding for High-Temperature Service, or to ASTM A 515 - Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service.
 4. **Bronze:** ASTM B 62 - Composition Bronze or Ounce Metal Castings, and valve stems not subject to dezincification shall conform to ASTM B 584 - Copper Alloy

Sand Castings for General Applications.

5. **Stainless Steel:** Stainless steel valve and operator bodies and trim shall conform to ASTM A 351 - Steel Castings, Austenitic, for High-Temperature Service, Grade CF8M, or shall be Type 316 stainless steel.

2.3 VALVE CONSTRUCTION

- A. **Valve Schedule.** Valve Supplier shall follow all valve and component requirements of the Valve Schedule presented on Contract Drawing GM-003. The Valve Schedule shall govern over any discrepancies between the Valve Schedule and the Contract Specifications.
- B. **Bodies:** Valve bodies shall be as indicated in the Valve Schedule (Contract Sheet GM-003) of ductile iron castings, forged, or welded of the materials indicated, with smooth interior passages. Wall thicknesses shall be uniform in agreement with the applicable standards for each type of valve, without casting defects, pinholes, or other defects that could weaken the body. Welds on welded bodies shall be done by certified welders and shall be ground smooth. Valve ends shall be as indicated on Valve Schedule, and be rated for the 80-degrees F and the maximum pressure (hydrostatic pressure plus minimum 10% transient pressure allowance) to which the valve will be subjected.
- C. **Valve End Connections:** Unless otherwise indicated, valves 1.5 inches diameter and smaller may be provided with threaded end connections. Valves 2-inches and larger shall have flanged end connections as stated on the Valve Schedule.
- D. **Bonnets:** Valve bonnets, where required, shall be clamped, screwed, or flanged to the body and shall be of the same material, temperature, and pressure rating as the body. The bonnets shall have provision for the stem seal with the necessary glands, packing nuts, or yokes.
- E. **Stems:** Valve stems shall be of the materials indicated, or, if not indicated, of the best commercial material for the specific service, with adjustable stem packing, O-rings, Chevron V-type packing, or other suitable seal. Where subject to dezincification, bronze valve stems shall conform to ASTM B 62, containing not more than 5 percent of zinc or more than 2 percent of aluminum, with a minimum tensile strength of 30,000 psi, a minimum yield strength of 14,000 psi, and an elongation of at least 10 percent in 2 inches.
- F. **Internal Parts:** Internal parts and valve trim shall be as indicated for each individual valve. Where not indicated, valve trim shall be of Type 316 stainless steel or other best suited material.
- G. **Nuts and Bolts:** Nuts and bolts on valve flanges, as supplied by the CONTRACTOR, and on pipe supports shall be in accordance with ASTM A 193, Grade B7, alloy steel, all hot-dipped galvanized.

2.4 VALVE ACCESSORIES

- A. Valves shall be furnished complete with the accessories required to provide a functional system.

2.5 SPARE PARTS

- A. The Valve Supplier shall furnish the required spare parts suitably packaged and labeled with the valve name, location, and identification number, as identified in each valve specification section. The Valve Supplier shall also furnish the name, address, and telephone number of the nearest distributor for the spare parts of each valve. Spare parts are intended for use by the OWNER, after expiration of the correction of defects period.

2.6 MANUFACTURERS

- A. **Manufacturer's Qualifications:** Valve manufacturers shall have a successful record of not less than 5 years in the manufacture of the valves indicated.

PART 3 -- EXECUTION

3.1 VALVE INSTALLATION

- A. **General:** Valves, actuating units, stem extensions, valve boxes, and accessories shall be installed in accordance with the manufacturer's written instructions and as indicated. Gates shall be adequately braced to prevent warpage and bending under the intended use. Valves shall be firmly supported to avoid undue stresses on the pipe.
- B. **Access:** Valves shall be installed with easy access for actuation, removal, and maintenance and to avoid interference between valve actuators and structural members, handrails, or other equipment.
- C. **Valve Accessories:** Where combinations of valves, sensors, switches, and controls are indicated, the CONTRACTOR shall properly assemble and install such items so that systems are compatible and operating properly. The relationship between interrelated items shall be clearly noted on Shop Drawing submittals.

- END OF SECTION -

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SECTION 43 25 01 - VALVE ACTUATORS

PART 1 -- GENERAL

1.1 SUMMARY

- A. **Valve actuators described in this Section are generally outdoor valves which shall be Owner Furnished – Contractor Installed (OFCI).** The CONTRACTOR is responsible to furnish all valves and associated actuators that are of 6-inch diameter and smaller as called for on the Contract Documents.
- B. The Valve Supplier shall provide valve actuators and appurtenances, complete and operable, in accordance with this section and the Contract Documents.
- C. The provisions of this Section shall apply to valves except where otherwise indicated in the Contract Documents.
- D. **Unit Responsibility:** The valve manufacturer shall be made responsible for coordination of design, assembly, testing, and installation of actuators on the valves; however, the CONTRACTOR shall be responsible to the OWNER for compliance of the valves, and actuators with the Contract Documents.
- E. **Single Manufacturer:** Where 2 or more valve actuators of the same type or size are required, the actuators shall be produced by the same manufacturer.

1.2 CONTRACTOR SUBMITTALS

- A. The Valve Supplier shall furnish actuator submittals in accordance with Section 01 33 00 - Contractor Submittals and Section 43 25 00 - Valves, General.
- B. **Shop Drawings:** Shop Drawing information for actuators shall be submitted together with the valve submittals as a complete package.
- C. **Calculations:** Selection calculations showing dynamic seating and unseating torques versus output torque of actuator.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Unless otherwise indicated, shut-off and throttling valves and externally actuated valves shall be provided with manual or power actuators. The CONTRACTOR shall furnish actuators complete and operable with mounting hardware, motors, gears, controls, wiring, solenoids, handwheels, levers, chains, and extensions, as applicable. Actuators shall have the torque ratings equal to or greater than required for valve seating and dynamic torques, whichever is greater, and shall be capable of holding the valve in any intermediate position between fully-open and fully-closed without creeping or fluttering. Wires of motor-driven actuators shall be identified by unique numbers.
- B. **Manufacturers:** Where indicated, all manual operators of valves shall be provided with actuators manufactured by the valve manufacturer. Where actuators are furnished by

different manufacturers, such as with electric motor operators, the Valve Supplier shall coordinate selection to have the fewest number of manufacturers possible.

- C. **Materials:** Actuators shall be current models of the best commercial quality materials and be conservatively sized for the required torque. Materials shall be suitable for the environment in which the valve is to be installed.
- D. **Actuator Mounting and Position Indicators:** Actuators shall be securely mounted by means of brackets or hardware specially designed and sized for this purpose and be of ample strength. The word "open" shall be cast on each valve or actuator with an arrow indicating the direction to open in the counterclockwise direction. Gear and power actuators shall be equipped with position indicators. Where possible, manual actuators shall be located between 48- and 60-inches above the floor or the permanent working platform.
- E. **Standard:** Unless otherwise indicated and where applicable, actuators shall be in accordance with AWWA C 540 - Power-Actuating Devices for Valves and Slide Gates.
- F. **Functionality:** Electric and hydraulic actuators shall be coordinated with the power requirements of Division xx and instrumentation equipment indicated in Section 40 90 00 - Process Instrumentation and Controls, General.
- G. Fasteners on all actuators shall be in accordance with Section 43 25 00 – Valves General, and shall be Type 316 stainless steel unless otherwise noted.
- H. Protective coatings shall be fusion bonded epoxy in accordance with AWWA C213, unless otherwise specified.

2.2 MANUAL ACTUATORS

- A. **General:** Unless otherwise indicated, valves shall be furnished with manual actuators.
 - 1. Valves in sizes up to and including 4-inches shall have direct acting lever or handwheel actuators of the manufacturer's best standard design. Larger valves shall have gear-assisted manual handwheel actuators, with an operating pull of maximum 60 pounds on the rim of the handwheel.
 - 2. Submerged gear-assisted valves, gear-assisted valves for pressures higher than 250 psig, valves 30-inches in diameter and larger, and where so indicated, shall have **worm gear actuators**, hermetically-sealed water-tight and grease-packed.
 - 3. Other valves 6-inches to 24-inches in diameter may have traveling nut actuators, worm gear actuators, spur or bevel gear actuators, as appropriate for each valve.
- B. **Manual Worm Gear Actuator:** The actuator shall consist of a single or double reduction gear unit contained in a weather-proof cast iron or steel body with cover and minimum 12-inch diameter handwheel. The actuator shall be capable of 90-degree rotation and shall be equipped with travel stops capable of limiting the valve opening and closing. The actuator shall consist of spur or helical gears or worm gearing. The gear ratio shall be self-locking to prevent "back-driving." The spur or helical gears shall be of hardened alloy steel and the worm gear shall be alloy bronze. The worm gear shaft and the handwheel shaft shall be of 17-4 PH or similar stainless steel. Gearing shall be

accurately cut with hobbing machines. Ball or roller bearings shall be used throughout. Output shaft end shall be provided with spline to allow adjustable alignment. Actuator output gear changes shall be mechanically possible by simply changing the exposed or helical gearset ratio without further disassembly of the actuator. Gearing shall be designed for a 100 percent overload. The entire gear assembly shall be sealed weatherproof.

2.3 ELECTRIC MOTOR ACTUATORS

A. General

1. **Equipment Requirements:** Where electric motor actuators are indicated (for Valve V-202), an electric motor-actuated valve control unit shall be attached to the actuating mechanism housing by means of a flanged motor adapter piece.
2. **Gearing:** The motor actuator shall include the motor, reduction gearing, reversing starter, torque switches, and limit switches in a weather-proof NEMA 4 / 4X assembly. The actuator shall be a single or double reduction unit consisting of spur or helical gears and worm gearing. The spur or helical gears shall be of hardened alloy steel, and the worm gear shall be alloy bronze. Gearing shall be accurately cut with hobbing machines. Power gearing shall be grease- or oil-lubricated in a sealed housing. Ball or roller bearings shall be used throughout. Actuator output speed changes shall be mechanically possible by simply removing the motor and changing the exposed or helical gearset ratio without further disassembly of the actuator.
3. **Starting Device:** Except for modulating valves, the unit shall be so designed that a hammer blow is imparted to the stem nut when opening a closed valve or closing an open valve. The device should allow free movement at the stem nut before imparting the hammer blow. The actuator motor must attain full speed before stem load is encountered.
4. **Switches**
 - a. **Electronic Type Switches:** Limit switches or valve position shall be sensed by a 15 bit, optical, absolute position encoder. The open and closed positions shall be stored in a permanent, non-volatile memory. The encoder shall measure valve position continuously, including both motor and hand wheel operation, with or without use of battery. An electronic torque sensor shall be furnished. The torque limit may be adjusted from 40 to 100 percent of rating in 1 percent increments. The motor shall be de-energized if the torque limit is exceeded. A boost function shall be included to prevent torque trip during initial valve unseating, and a "jammed valve" protection feature with automatic retry sequence shall be incorporated to de-energize the motor if no movement occurs. Valve actuators with electronic type switches shall be as manufactured by **Limitorque, Rotork** or **AUMA Actuators, Inc.**
 - b. The actuator shall be wired in accordance with the schematic diagram. Wiring for external connections shall be connected to marked terminals. A minimum of two of 1.0-inch conduit connections shall be provided in the enclosing case. A calibration tag shall be mounted near each switch correlating the dial setting to the unit output torque. Switches shall not be subject to breakage or slippages due to over-travel.

- c. Limit switches shall be of the heavy-duty open contact type with rotary wiping action. Traveling-nuts, cams, or micro switch tripping mechanisms shall not be used.
5. **Handwheel Operation:** A permanently attached handwheel shall be provided for emergency manual operation. The handwheel shall not rotate during electrical operation. The maximum torque required on the handwheel under the most adverse conditions shall not exceed 60 ft-lb, and the maximum force required on the rim of the handwheel shall not exceed 60 lb. An arrow and either the word "open" or "close" shall be cast or permanently affixed on the handwheel to indicate the appropriate direction to turn the handwheel. A clutch lever shall be provided to put actuator into handwheel operation. Valves with electric motor actuators having stems more than 7-feet above the floor shall be provided with chain activator handwheels. The clutch lever shall be provided with a cable secured to the chain to allow disengagement for manual operation.
6. **Motor:** The motor shall be of the totally enclosed, non-ventilated, high-starting torque, low-starting current type for full voltage starting. It shall be suitable for operation on 480 volt, 3-phase, 60 Hz current, and have Class F insulation and a motor frame with dimensions in accordance with the latest revised NEMA MG Standards. The observed temperature rise by thermometer shall not exceed 55 degrees C above an ambient temperature of 40 degrees C when operating continuously for 15 minutes under full rated load. With a line voltage ranging between 10 percent above to 10 percent below the rated voltage, the motor shall develop full rated torque continuously for 15 minutes without causing the thermal contact protective devices imbedded in the motor windings to trip or the starter overloads to drop-out. Bearings shall be of the ball type and thrust bearings shall be provided where necessary. Bearings shall be provided with suitable seals to confine the lubricant and prevent the entrance of dirt and dust. Motor conduit connections shall be watertight.
 - a. Motor construction shall incorporate the use of stator and rotor as independent components from the valve operation such that the failure of either item shall not require actuator disassembly or gearing replacement.
 - b. Two Class B thermal contacts or solid-state thermistors imbedded within the motor windings shall be provided to protect against over-temperature damage.
 - c. The motor shall be provided with a space heater suitable for operation on 120-volt, single phase, 60 Hz circuit unless the entire actuator is a hermetically sealed, non-breathing design with a separately sealed terminal compartment which prevents moisture intrusion.
 - d. Each electric motor actuator shall be provided with a local disconnect switch or circuit breaker to isolate power from the motor and controller during maintenance activities
7. **Conventional Hard Wire Inputs / Outputs:** Control of designated actuators shall be accomplished through the use of conventional hard-wired analog signals (4 to 20mA) and discrete input / output wiring. Microprocessor-based 2 wire control systems are not required of the actuator for valve V-202.

8. **Field Interface Unit:** A field unit shall be enclosed in each actuator. The field unit receives commands and requests for information over the network for the following capabilities.
 - a. Commands - OPEN valve, CLOSE valve, STOP valve, and LOCKOUT (inhibit local and remote electrical operation). Modulating control valves shall receive a positioning control command (0 -100 percent open).
 - b. Status - valve OPEN, valve CLOSED, selector switch in REMOTE, and selector switch in LOCAL. Some of the designated valves shall also have valve position (0 -100 percent) indication
 - c. Alarms - field unit "fuse blown", "motor overload tripped", "torque switches tripped", and "communications failure"
 - d. Additional features: Local push buttons shall be wired directly to the motor contactor circuit and shall not depend on a microprocessor for proper operation. Malfunction or removal of the microprocessor circuit board shall not affect electrical operation.
 - e. Status lights shall be green for "open" and red for "closed"
9. **Open/Close Operating Speed:** Unless otherwise indicated, electric actuators shall provide a full close to full open or full open to full close operating time range from 30 to 60 seconds.

B. Electric Motor Actuators (AC Modulating Control Type)

1. General: Where indicated, modulating electric motor actuators shall be the AC modulating type complete with a local control station with power disconnect switch or circuit breaker, local/remote switch, non-latching open/close pushbuttons, and open/close status lights
2. Actuator Appurtenances: The actuator for each valve shall be provided with a padlock-able disconnect switch, open and closed status lights, open, close and lockout stop pushbuttons, local/remote selector switch, and other devices indicated.
3. Control Module: The control module shall be of the electronic solid-state AC type with control outputs for positioning the valve via 4 - 20 mA input signals.
4. Starter: The actuator shall control a solid-state reversing starter designed for minimum susceptibility to power line surges and spikes. The solid-state starter and control module shall be rated for continuous modulating applications. Power supply shall be 480 volt, 3 phase, 60 Hz. A disconnect switch shall be included with each actuator.
5. Construction: The control unit shall be microprocessor-based and shall contain an analog/digital converter, separate input-output switches, non-volatile random access memory for storage of calibration parameters and pushbutton calibration elements for field setup. Potentiometer adjustments shall contain a PID control function internally. In addition, the controller shall contain as standard feature a loss of command signal protection selectable to lock in last or lock in pre-set valve position

and a valve position output signal in 4 - 20 mA. As an alternative to the construction requirement, the motor shall be capable of modulating at a rate of 200 starts per hour at the 40 percent to 85 percent travel range of the valve.

6. Local Control Station: Each actuator shall be provided with a local control station with the valve actuator assembly. The station shall include open, close, and stop push buttons, and a local/remote selector switch. This system shall allow communications to the PLC via a hard-wired analog signal (with twisted shielded pair cabling) to monitor and control the valve as indicated above and in Section 40 90 30 - Control Descriptions. The local control station and local power disconnect may be provided as an integral part of the actuator or as otherwise indicated or required to permit operation by a person at floor elevation and within sight of the valve actuator.
7. Manufacturers, or equal
 - a. **AUMA Actuators**, Multi-turn SAR series, model 10.2 or larger.
 - b. **Limitorque Corp**, MXa series

PART 3 -- EXECUTION

3.1 SERVICES OF MANUFACTURER

- A. **Field Adjustments:** Field representatives of manufacturers of valves with hydraulic, or electric actuators shall adjust actuator controls and limit-switches in the field for the required function.

3.2 INSTALLATION

- A. Valve actuators and accessories shall be installed in accordance with Section 43 25 00 - Valves, General. Actuators shall be located to be readily accessible for operation and maintenance without obstructing walkways. Actuators shall not be mounted where shock or vibrations will impair their operation, nor shall the support systems be attached to handrails, process piping, or mechanical equipment.
- B. **Inspection, Startup, and Field Adjustment:** For all valves on the hatchery flow bypass pipeline, an Factory Authorized Representative of the manufacturer shall visit the Site during installation and startup and witness the following:
 1. Installation of the equipment for not less than one Day.
 2. Inspection, checking, and adjusting the equipment for not less than one Day. On the same trip, provide startup and field-testing services for proper operation of each valve.
 3. Cost for installation, startup and field adjustment services, and instruction of OWNER's personnel by the Factory Authorized Representative shall be furnished and paid for by the CONTRACTOR.
- C. **Instruction of OWNER's Personnel:** The Factory Authorized Representative shall visit the Site for not less than 0.5 Days on-site to instruct the OWNER's personnel in the

operation and maintenance of the equipment including step-by-step troubleshooting procedures with necessary test equipment.

- END OF SECTION -

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SECTION 43 25 02 - TRIPLE OFFSET BUTTERFLY VALVES

PART 1 -- GENERAL

1.1 SUMMARY

- A. **Valves described in this Section are generally outdoor valves which shall be Owner Furnished – Contractor Installed (OFCI).**
- B. The Valve Supplier shall provide butterfly valves and appurtenances, complete and operable, in accordance with the Contract Documents.
- C. The requirements of Section 44 05 00 – Equipment General Provisions apply to this Section.
- D. The requirements of Section 43 25 00 - Valves, General apply to this Section.
- E. The requirements of Section 43 25 01 - Valve Actuators apply to this Section.
- F. Valves shall conform to the lay length standard dimensions set forth in AWWA C504 Short Body and shall be supplied with integral stainless-steel flanges as specified.

1.2 CONTRACTOR SUBMITTALS

- A. The Valve Supplier shall furnish submittals in accordance with Section 01 33 00 – Contractor Submittals and as follows.
- B. Shop Drawings
 - 1. Complete Shop Drawings of butterfly valves and actuators.
 - 2. Drawings showing valve port diameter complete with dimensions, part numbers, and materials of construction.
 - 3. Dynamic seating and unseating torque for motor actuated valves.
 - 4. Certified statement of proof-of-design tests from the valve manufacturer. Valve manufacturer shall state that the valves proposed for this project will be manufactured with identical basic type of seat design and materials of construction to the prototype evaluated under the proof of design testing.
 - 5. Manufacturer's certification that the valve complies with applicable provisions of AWWA C519-18 – High Performance Waterworks Butterfly Valves.

1.3 QUALITY ASSURANCE

- A. Valves shall be subjected to performance, leakage, and hydrostatic tests in accordance with procedures and acceptance criteria established by AWWA C504, as a minimum.
- B. Manufacturer and Valve Supplier shall acknowledge that valve shall be designed for

higher velocities (up to 18 ft/sec) and higher pressures (up to 550 psig cold working pressure) than that of standard AWWA C504B butterfly valves.

- C. Manufacture shall be ISO 9001:2008, accredited and certified. Manufacture must have minimum 5-years' experience in the production of double eccentric Butterfly Valves.

PART 2 -- PRODUCTS

2.1 TRIPLE OFF-SET BUTTERFLY VALVES, 550 PSI SERVICE (AWWA C519-18)

- A. **General:** Butterfly valves for steady-state water working pressures and steady-state differential pressure up to 550 psig for brief periods of operation (up to 2 minutes while valve is being opened or closed). Valve shall be designed for raw (unfiltered) fresh water service having a pH range from 6 to 10 and temperature range from 35 to 55 degrees F shall meet and exceed all requirements of AWWA C519-18 - High Performance Waterworks Butterfly Valves, according to the specification requirements as identified below.

1. Valves shall be designed and manufactured suitable for maximum approach velocity of 18 ft/sec (class C) and minimum hydrostatic design pressure of 550 psig (valve fully closed).
2. Position-seated and interference fit sealing designs shall not be acceptable. Valves shall be designed so that the disc can never be rotated through the seat.
3. Butterfly valves (V-201 and V-202) shall be rated for working pressures of no less than 550 PSI and shall provide zero leakage at full rated pressure.

- B. **Design and Construction:** The butterfly valve shall be of a double offset design whereby the centerline of the disc is horizontally and vertically offset from the body seat and where the elastomeric seat releases compression only after a few degrees of the opening. Unless otherwise indicated, materials of construction shall be in accordance with the requirements below, and suitable for the service and design pressures as indicated herein

1. Valves shall be of the body type, pressure class, end joint, and actuator indicated on the Valve Schedule (Contract Drawing GM003).
2. Valve Body and Disc: Carbon Steel ASTM A216-16
 - a. Valve discs shall be secured to the valve shaft using mechanically retained stainless steel shaft locking bolts. Tangential pins that penetrate the front of the disc shall not be allowed.
 - b. Valve body interior shall be epoxy coat primed and finished with a minimum of 13 mils of fusion bonded epoxy coating, per requirements of AWWA C213.
 - c. Valve body exterior shall be epoxy coat primed and finished with a minimum of 13 mils of epoxy coating, per requirements of ST-PC1, AWWA C210 or equal.
3. Valve Flanged Ends: Ends shall be flanged per ANSI B16.5 for stainless steel

bodied valves. Class rating of flanges shall be Class C (for flow velocities up to 24 ft/sec) and flange pressure classes shall be as specified in the Valve Schedule

4. The valve size, pressure rating, year of manufacture, and manufacturer's name and model shall be cast onto the valve body or be on a permanently attached nameplate.
5. Lifting lugs: Predrilled lifting hole lugs shall be provided integrally in each flange to assist in installation and removal of valve into piping works.
6. Valve Disc Seats: Disc elastomeric seats shall be EPDM mounted on the valve disc with a AISI 316 stainless steel seat retainer. The seat retainer shall be counter bored and drilled. Seat retaining fasteners shall be AISI 316 Stainless Steel and shall not extrude above the seat retaining ring. Seat shall be field replaceable and adjustable with common tools.
7. Valve Body Metallic Seats: The metallic body seat shall be 316L NiCr Stainless Steel and applied to the valve body by means of a machined weld overlay process eliminating the possibility of leakage through the body/seat joint.
8. Valve Shafts: Both shafts shall be made of high strength ASTM 2205 Duplex grade Stainless Steel, or approved equal.
 - a. Valve shaft shall be one-piece construction with long length stainless steel bearings. Two-piece shafts are not permitted.
 - b. Shaft shall conform to API 609 anti-blowout protection. Allowable stresses shall be limited to 33 percent of ultimate tensile strength and 67 percent of yield strength in accordance with ASME, Sec. III, Case N62.6.
9. Shaft Bearings: Valve shaft bearings shall be corrosion resistant, self-lubricating sleeve type and made of bronze. Non-metallic shaft bearings are not allowed. Top and bottom bearing flush taps shall be provided to prevent ingress of particulates or contaminants to the bearing area.
 - a. Where specified in the Valve Schedule, valves shall have hardened stainless steel press-fit shaft bearings with replaceable inboard bearing protectors.
10. Shaft Seals: The shaft seals shall ensure the upper and lower valve shafts remain non-wetted and prevent pressurized system water from entering the uncoated valve disc hub and valve body shaft bore. The outer shaft seals shall consist of five O-rings in a removable bronze cartridge bolted to the valve body and not retained by the valve actuator. Neither pull down packing glands nor braided compression V-type packing are allowed. Back shaft shall be positively fixed to the disc, eliminating the risk of blow out.
 - a. Valve shaft seal shall be by adjustable packing box. Packing gland shall have minimum of 4 retaining bolts for even packing compression
11. All bolts and retaining rings shall be 304 or 316 stainless steel unless otherwise specified.

- C. **Seal Rings.** Valves shall have a field-replaceable laminated or elastomeric seal ring retained in the body or on the disc. The seal ring shall be constructed of laminates of stainless steel and graphite, or may be elastomeric material when specified. Seal ring design shall also include the following parameters:
1. The seal ring shall be accessible (replaceable) by positioning the disc in a proper orientation and removing an adjacent pipe spool piece without removing or disassembling the valve.
 2. The seal ring shall be machined in an inclined conical shape to match the companion surface in the body or on the disc, as appropriate. The overall geometry of the seal ring shall be formed into an elliptical shape to provide resilient seating.
 3. Each seal ring shall be identical and interchangeable for valves of the same size.
 4. The seal ring shall be held securely in place by a retaining ring bolted in place. Seal ring and bolt material shall be stainless steel.
 5. A spiral wound gasket shall be provided to prevent leakage around the seal ring. Flat static gaskets shall not be acceptable.
 6. The seal ring shall be indexed and keyed to assure exact and proper installation or reinstallation without shims.
 7. No special tools shall be required to install the seal ring.
- D. **Flanges:** Valve shall conform to lay length standard dimensions set forth in AWWA C519-18. Valve flanges shall be as set forth on the Valve Schedule and shall be per ASME B16.5 Class 300 or 400 flanges for all high pressure applications where hydrostatic pressure is above 150 psig. Valve flanges shall be suitable for mating to steel pipe with ASME B16.5 Class 300 / 400 flanges.
- E. **Factory Inspection and Testing**
1. Each valve shall be supplied with a factory inspection certificate outlining body pressure test, leakage test, valve size, valve serial number, pressure rating, body heat no., disc heat no., stem heat no. seat material, and seat heat no.
 2. One prototype for each size of valve to be provided shall be subjected to proof-of-design tests in accordance with, at a minimum, procedures established by AWWA C504.
 3. Results of proof-of-design tests and certification by a company officer shall be submitted to the ENGINEER with the Shop Drawings.
- F. **Manual Actuators:** Unless otherwise indicated, manually-actuated butterfly valves shall conform to ANSI/AWWA C540, subject to the following requirements.
1. All actuators shall be self-locking worm gear type and shall hold the valve disc in the closed, open, and any intermediate position without creeping or fluttering and be supplied from known and reputable gear manufacturer.

2. Manual actuators shall be of handwheel design and include a position indicator. Screw-type (traveling nut) actuators will not be permitted for valves 10-inches in diameter and larger
- G. **Worm Gear Actuators:** Valves 10-inches and larger, as well as submerged and buried valves, shall be equipped with worm-gear actuators, lubricated and sealed to prevent entry of dirt or water into the housing.
- H. **Electric Actuator (for Valve V-202):** Electric actuators shall meet the requirements of AWWA C540 and Section 43 25 01 – Valve Actuators. Actuators shall be modulating service furnished for 3-phase, 480 volt AC electric service, 60-hertz. Electric actuators shall be rated to produce output torque as follows:
1. For valves in open/close service, produce output torque of at least 1.5 times the required valve maximum seating or maximum dynamic torque, whichever is greater.
 - a. The torque switch shall be field set at no greater than 60 percent of the maximum actuator rated torque for open/close service.
 2. For valves in modulating service with dynamic torque exceeding the seating torque (including valve V-202), the rated output torque of the actuator shall be twice the dynamic torque required by the valve. Actuator rated torque is defined as pullout torque rated at 10 percent below the rated voltage of the motor.
 - a. The torque switch shall be field set at no greater than 50 percent of the maximum actuator rated torque for modulating service.
 3. After plant startup, the manufacturer shall prepare a certification including a torque curve to demonstrate that the torque requirements have been met.
- I. **Manufacturers, or Equal**
1. Adams Valve Company
 2. AV-Tek, *AWWA DEX* Butterfly Valve,
 3. DeZurik Water Controls, Corporation
 4. Orton
 5. Vanessa, by Emerson

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. Exposed butterfly valves shall be installed with a means of removing the complete valve assembly without dismantling the valve or operator. Installation shall be in accordance with Section 43 25 00 – Valves, General.

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SECTION 43 25 03 – BUTTERFLY VALVES (AWWA C504 MODIFIED)

PART 1 -- GENERAL

1.1 SUMMARY

- A. The CONTRACTOR shall provide butterfly valves and appurtenances, complete and operable, in accordance with the Contract Documents.
- B. The requirements of Section 43 25 00 - Valves, General apply to this Section.
- C. The requirements of Section 43 25 01 - Valve Actuators apply to this Section.

1.2 CONTRACTOR SUBMITTALS

- A. Furnish submittals in accordance with Section 01 33 00 – Contractor Submittals.
- B. Shop Drawings
 - 1. Complete Shop Drawings of butterfly valves and actuators.
 - 2. Drawings showing valve port diameter complete with dimensions, part numbers, and materials of construction.
 - 3. Dynamic seating and unseating torque for motor actuated valves.
 - 4. Certified statement of proof-of-design tests from the valve manufacturer. Valve manufacturer shall state that the valves proposed for this project will be manufactured with identical basic type of seat design and materials of construction to the prototype evaluated under the proof of design testing.
 - 5. Manufacturer's certification that the valve complies with applicable provisions of AWWA C504 – Rubber-Seated Butterfly Valves.

1.3 QUALITY ASSURANCE

- A. Valves shall be subjected to performance, leakage, and hydrostatic tests in accordance with procedures and acceptance criteria established by AWWA C504.

PART 2 -- PRODUCTS

2.1 RUBBER SEATED BUTTERFLY VALVES 25 TO 150 PSI (AWWA)

- A. **General:** Butterfly valves for steady-state water working pressures and steady-state differential pressure up to 150 psi (Pressure Class 150B) and for freshwater service having a pH range from 6 to 10 and temperature range from 33 to 125 degrees F shall conform to AWWA C504 and be as indicated.
 - 1. Valves subjected to steady state working pressures and steady state differential pressures up to 150 psi in sizes 3-inches through 24-inches shall be rated for Class 150B with actuator sized for Class 150B.

- B. **Valve Schedule.** Valves of 4-inch diameter and larger shall be of the body type, pressure class, end joint, and actuator type as indicated on the valve schedule on **Contract Sheet GM-004**. If the operating conditions such as flow, velocity, and differential pressures are not indicated, the valve body and shaft shall be sized for the pressure class rating of the valve.
- C. **Construction:** Unless otherwise indicated, materials of construction shall be in accordance with AWWA C504, suitable for the service. Seats shall be positively clamped or bonded into the disc or body of the valve, but cartridge-type seats that rely on a high coefficient of friction for retention shall not be acceptable. Seat material shall be guaranteed to last for at least 75 percent of the number of cycles in the AWWA C504 proof-of-design test without premature damage.

Description	Material Standards
Valve bodies	Ductile iron, ASTM A 536, grade 65-45-12 or 70-50-05
End flanges	Same material as valve bodies
Valve shafts	Stainless steel ASTM A 240 or A 276, Type 304
Valve discs	Same material as valve bodies.
Rubber seats	New natural or synthetic rubber
Seat mating surfaces	Stainless steel, ASTM A 240 or A 276, Type 316
Clamps and retaining rings	Type 316 retaining rings and cap screws.
Valve bearings	Self lubricating materials per AWWA C504
Shaft seals	Resilient non-metallic materials suitable for service
Painting and coating	Fusion Bonded Epoxy, per AWWA C550.

- D. **Manual Actuators:** Unless otherwise indicated, manually-actuated butterfly valves of 8-inch diameter and larger shall be equipped with a handwheel operator, a 2-inch square actuating nut (where shown), and a valve position indicator. Screw-type (traveling nut) actuators will not be permitted for valves 30-inches in diameter and larger.
- E. **Ferrous Surface Coating:** All corrosive ferrous surfaces of valves 3-inches and larger, exclusive of flange faces, shall be properly primed and fusion epoxy-coated, per AWWA C550, for both above grade and buried service.
- F. **Manufacturers, or Equal**
1. Clow / M & H Valve Company
 2. DeZURIK Water Controls, Corporation

3. Henry Pratt / Mueller Company. (Series 2FI1 for valves 20" dia and smaller indoors. Series "Groundhog" for all buried valves.)
4. Kennedy Valve
5. Val Matic / American Darling. (Series 2000 for valves 20" dia and smaller above grade)

2.2 RUBBER SEATED BUTTERFLY VALVES, 250 PSI SERVICE (AWWA)

- A. **General:** Butterfly valves for steady-state water working pressures and steady-state differential pressure up to 250 psig (pressure class 250B) and for freshwater service having a pH range from 6 to 10 and actual service temperature range from 33 to 60 degrees F shall conform to AWWA C504. Valves shall be designed and manufactured in accordance with the intent of AWWA C504 except valves shall be suitable for 250 psi service and as indicated herein.
- B. **Valve Schedule.** Valves of 4-inch diameter and larger shall be of the body type, pressure class, end joint, and actuator type as indicated on the valve schedule on **Contract Sheet GM-004**. If the operating conditions such as flow, velocity, and differential pressures are not indicated, the valve body and shaft shall be sized for the pressure class rating of the valve
- C. **Construction:** Unless otherwise indicated, materials of construction shall be in accordance with AWWA C504, suitable for the service. The seats shall be positively clamped or bonded into the disc or body of the valve, but cartridge-type seats that rely on a high coefficient of friction for retention shall not be acceptable. Seat material shall be guaranteed to last for at least 75 percent of the number of cycles in the AWWA C504 proof-of-design test without premature damage.

Designation	Materials Standards
Valve Bodies	Ductile iron, ASTM A 536, grade 65-45-12 or 70-50-05
End flanges	Same material as valve bodies
Valve shafts	Stainless steel ASTM A 240 or A 276, Type 316
Valve discs	Same material as valve bodies.
Rubber seats	New natural or synthetic rubber
Seat mating surfaces	Stainless steel, ASTM A 240 or A 276, Type 316
Clamps and retaining rings	Type 316 retaining rings and cap screws.
Valve bearings	Self lubricating materials per AWWA C504
Shaft seals	Resilient non-metallic materials suitable for service

Painting and coating	Fusion Bonded Epoxy, per AWWA C550.
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- D. **Manual Actuators:** Unless otherwise indicated, manually-actuated butterfly valves of 8-inch diameter and larger shall be equipped with a handwheel operator, a 2-inch square actuating nut (where shown), and a valve position indicator. Screw-type (traveling nut) actuators will not be permitted for valves 30-inches in diameter and larger.
- E. **Ferrous Surface Coating:** All corrosive ferrous surfaces of valves 3-inches and larger, exclusive of flange faces, shall be properly primed and fusion epoxy-coated, per AWWA C550, for both above grade and buried service.
- F. **Manufacturers, or Equal**
1. DeZURIK Water Controls, Corporation
 2. Henry Pratt / Mueller Company. (Series 2FI1 for valves 20" dia and smaller indoors. Series "Groundhog" for all buried valves.)
 3. Kennedy Valve
 4. Val Matic / American Darling. (Series 2000 for valves 20" dia and smaller above grade)

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. Exposed butterfly valves shall be installed with a means of removing the complete valve assembly without dismantling the valve or operator. Installation shall be in accordance with Section 43 25 00 – Valves, General.

- END OF SECTION -

SECTION 43 25 04 – HIGH PRESSURE BALL VALVES

PART 1 -- GENERAL

1.1 SUMMARY

- A. The CONTRACTOR shall provide ball valves and appurtenances, complete and operable, in accordance with the Contract Documents.
- B. The requirements of Section 43 25 00 - Valves, General apply to this Section.
- C. The requirements of Section 43 25 01 - Valve and Gate Actuators apply to this Section.

1.2 CONTRACTOR SUBMITTALS

- A. Furnish submittals in accordance with Section 01 33 00 – Contractor Submittals and with Section 43 25 00 - Valves, General.

PART 2 -- PRODUCTS

2.1 HIGH PRESSURE ISOLATION BALL VALVE (6-INCH TO 12-INCH)

- A. **Construction:** The valve body and cover shall be of cast steel to ASTM A 216; - Steel Castings, Carbon, Suitable for Fusion Welding for High-Temperature Service, Grade WCB, or of cast steel to ASTM A 27 - Steel Castings, Carbon, for General Application, GR65-35, or of fabricated steel to ASTM A 516 - Pressure Vessel Plates, Carbon Steel, for Moderate - and Lower-Temperature Service, Grade 70 with Class 300 / 400 / 600 flanged ends to ASME B16.5 - Pipe Flanges and Flanged Fittings, as specified in the Valve Schedule tables. Valves shall be suitable for velocities up to 18 fps, temperatures up to 80 degrees F, and differential pressures up to 600 psi. The balls shall trunnion-mounted, with tight shut-off, single or double seat, and full bore.
 - 1. The body and cone seats shall be electrically fused monel rings raised above the body. The ball shall be fully skirted with integral trunnions and of the same material as the valve body. The trunnion bearings shall be bronze to ASTM B 584 - Copper Alloy Sand Castings for General Applications, mating with bronze bearings in the body and head.
 - 2. The valve shaft shall be Type 630 stainless steel with a minimum yield strength of 125,000 psi.
 - 3. Valve seats shall be capable of withstanding operation from fully closed position to fully open position (and vice-versa) at the pressure and velocity characteristics listed above, without becoming dislodged or creeping into the flow path. Valves designed to open with full water pressure differential and atmospheric pressure only (air) on the downstream side of the valve.
- B. **Actuators:** Unless otherwise indicated, ball valves shall have right-angle gear box and manual actuators with handwheel and position indicator. Handwheels and gear box shall be as specified under Section 43 25 01 - Valve and Gate Actuators.

- C. **Coating:** Ferrous surfaces, exclusive of stainless steel surfaces, in the water passage of the valve shall be coated with a Fusion Bonded Epoxy coating with a total dry film thickness (DFT) of no less than 15-mils. Flange faces shall not be coated. The valve manufacturer shall certify in writing that such coating has been applied and tested in the plant in accordance with these Specifications prior to shipment.
- D. Manufacturers, or Equal
 - 1. **Apco/Willamette**
 - 2. **GA Industries, Inc.**
 - 3. **Orton**
 - 4. **Rodney Hunt (Rotovalue)**
 - 5. **Henry Pratt Company**
 - 6. **TB Hydro**

2.2 OPERATING CONDITIONS

- A. The valves shall be designed to operate under the following conditions as specified in the Valve Schedule on Contract Drawing GM-004.

2.3 FACTORY TEST

- A. **Test:** The valve body and head shall be hydrostatically tested at one and one-half times the maximum static working pressure for a period of one hour with no leakage or other evidence of distress. The fully-assembled valve shall be tested in the shop for leakage. The valve shall show a maximum of 0.4 oz. per minute per inch of valve diameter leakage under a test pressure equal to the maximum static operating head.

2.4 VALVE ACTUATORS

- A. **General:** The main valve and the bypass valve shall have manufacturer sized right-angle gear box and manual actuators, as indicated. The actuators shall be provided with manual devices for locking the valves in the closed position. The devices shall be capable of withstanding the full force of the valve actuators to positively prevent the opening of the valves under any condition. A hand-wheel actuator shall be provided with the valve.

PART 3 -- EXECUTION

3.1 GENERAL

- A. Valves shall be installed in accordance with Section 43 25 00 -Valves General. Care shall be taken that valves 6-inch and larger are well supported on each side of the valve.

3.2 SERVICES OF MANUFACTURER

- A. **Inspection, Startup, and Field Adjustments:** The service representative of the valve manufacturer shall be present at the Site for one Day (1) to assist the CONTRACTOR in the installation and adjustment of the valve system.
- B. **Instruction of OWNER's Personnel:** The training representative of the valve manufacturer shall be present at the Site for one (1) Day to instruct the personnel in the operation, adjustment, and maintenance of the valve system.
- C. For purposes of this paragraph, a Day is defined as an 8-hour period, excluding travel time.

- END OF SECTION -

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SECTION 43 25 26 - FIXED SLEEVE VALVES

PART 1 -- GENERAL

1.1 SUMMARY

- A. **Fixed Sleeve Valves described in this Section are generally outdoor valves which shall be Owner Furnished – Contractor Installed (OFCl).** The CONTRACTOR is responsible to furnish all valves and associated actuators that are of 6-inch diameter and smaller as called for on the Contract Documents.
- B. The Sleeve Valve Manufacturer shall provide fixed orifice sleeve-type valves, valve sleeve outer housing and accessories, complete and operable, in accordance with the Contract Documents.
- C. The two fixed sleeve valves shall be designed by the Sleeve Valve Manufacturer to pass a maximum design flow of 14.0 cfs across the entire assembly at the design pressures provided in Part 2.1 below.
 - 1. Some minor upstream throttling may be performed by the OWNER with a high-performance double offset butterfly valve (C-202), but only to the extent that minor pressure drops occur and flow rates may drop from 14 cfs to about 12.5 cfs. No flow rates below this level may be performed by the OWNER, on this bypass piping system.
 - 2. Preliminary design sizing has shown that a 16.0-inch outer housing diameter appears to be near optimal for the new dual sleeve valve assembly. Sleeve Valve Manufacturer shall alert ENGINEER if their calculations show that a different size or length of outer housing is necessary for the dual fixed sleeve valve assembly.

1.2 CONTRACTOR SUBMITTALS

- A. The Sleeve Valve Manufacturer shall furnish submittals in accordance with Section 01 33 00 - Contractor Submittals and with Section 43 25 00 – Valves General.
- B. **Shop Drawings:** Shop Drawings shall contain the following information:
 - 1. Valve name, size, Cv factor, cavitation sigma calculations, pressure rating, identification number (if any), and specification section number.
 - 2. Complete information on valve, including size, manufacturer, model number, and mounting design.
 - 3. Cavitation limits for control valves or pressure reduction valves including complete sigma calculations, at both maximum and minimum inlet pressure conditions.
 - 4. Calculations of expected noise levels for valves operating in an outdoor environment under maximum and minimum expected flow conditions. (See Part 2.1 requirements below.)
 - 5. Assembly or fabrication drawings showing part nomenclature, materials, dimensions, weights, tolerances and relationships of valve handles, handwheels,

position indicators, limit switches, integral control systems, needle valves, and control systems, where applicable.

- C. **Technical Manual:** The Technical Manual shall contain the required information for each valve.
- D. **Factory Test Data:** Where indicated, signed, dated, and certified factory test data for each valve requiring certification shall be submitted before shipment of the valve. The data shall also include certification of quality and test results for factory-applied coatings, where applicable.
- E. With the Shop Drawings, submit certified test data from the Sleeve Valve Manufacturer, showing the successful operation of similar valves, over a period of at least 10 years.

1.3 QUALITY ASSURANCE

- A. The valve supplier shall have designed and manufactured equipment that has been successfully operated for at least 10 years, comparable to the equipment required.

PART 2 -- PRODUCTS

2.1 OPERATING REQUIREMENTS

- A. **Performance:** The Sleeve Valve Manufacturer shall be design and guarantee for at least five (5) years the supplied system to operate throughout its range without cavitation damage, excessive noise or vibration, for the conditions stated below.

Valve identification No.	V-204 & V-205
See Contract Drawing for Piping Arrangement	C121
Sleeve Orientation / Location	Horizontal / outdoors
Service medium	Water, Unfiltered and screened to 3 inches
ANSI B16.5 Flange Working Pressure Class, psig	300
Steel Pipe Sleeve Outside Diameter, inches	16.0
Approach pipe outside diameter, inches	12.75
Sleeve Valve Flange Bolt Hole Pattern	ASME B16.5 Class 300 Flange for 16" Steel Pipe
Minimum Interior nozzle / orifice openings for both sleeve valves, inches (See Note 1)	0.50
Minimum sleeve steel thickness (See Note 2), inches	0.375

Maximum Design Inlet Pressure to Sleeve Valves, psig	525
Minimum Design Inlet Pressure to Sleeve Valves, psig	510
Outlet / Downstream Pressure Range (See Note 3), psig	10 to 12.5
Design Flow at Max. Design Inlet Pressure and Max. Design Outlet Pressure, cfs	14.0
Max allowable noise level @ max. design flow (dba measured at a distance of 10-ft away from the valve)	96
Max. Allowable Interior Velocity thru Sleeve open port, fps	36
Minimum length of fixed sleeve, (from flange to dished head of interior sleeve) inches	26

(1) The 0.50 inch opening is to help the sleeve valves pass small solids thru the system. Valve Supplier shall notify ENGINEER if they believe that smaller diameter openings are required on the sleeve valves to achieve the overall pressure drop needed in the system.

(2) Material stresses shall not exceed 20 percent of the ultimate strength or 33 percent of the yield strength of the material, under all pressure and flow range conditions. If required, sleeve thickness shall be more than the minimum shown to meet these stress requirements.

(3) Note that the outlet side pressure of the valve is controlled by downstream piping head loss and a restricted orifice plate in the discharge pipe configuration.

B. **Material Requirements:** All valve components, including the mounting flange, shall be manufactured of 304 stainless steel of either ASTM A358, A276 or A240.

C. **Orifice Size and Pattern Design.** The number, size and spacing of the required orifices shall be determined by the Sleeve Valve Manufacturer for each of the two sleeve valves to achieve the overall pressure drop requirements at the maximum design flow of 14.0 cfs. The valve manufacturer shall design the dual valve system in order to insure against cavitation on the downstream side of both valves.

1. Note that an orifice plate is being furnished by CONTRACTOR to provide an approximate 12.5 psig pressure on the downstream side of the second sleeve valve (V-205). This back pressure is to help the system prevent damaging cavitation on the 2nd sleeve valve.
2. It is desired that hole size on the fixed sleeve valves be at least 0.5 inches in diameter, if possible, to help pass any small solids thru the system
3. Design shall be such to minimize noise levels caused by the energy dissipation function of the valve and to optimize on the pressure drop obtained across each of the two valves.

D. **Mounting Flange and Lifting Eyes.** The fixed sleeve valve shall be supplied and shop welded to a mounting flange of minimum 3/4-inch thickness designed to mount in-between

two ASME / ANSI B16.5 Class 300 flanges that are part of the 16-inch x 5-ft long pipe spool (by Valve Supplier). The valve supplier shall provide two tapped holes with thread-in lifting eyes furnished with the valve; or alternatively two (2) stainless steel lifting eyes welded on opposite sides (180 degrees apart) of the stainless-steel flange. The lifting eyes shall be made of 304 stainless steel bar.

- E. **16" OD x 5.0-ft Long 304 Stainless Steel Pipe Spool for Sleeve Valves.** The sleeve valves shall be housed inside of a 16.0-inch OD, 304 stainless steel pipe spool that is 5.0-ft long, furnished by the sleeve valve Supplier. (See Contract Drawing C121). The pipe spool shall be flanged on both ends with ASME / ANSI B16.5 Class 300, 304 stainless steel mating flanges.
1. The 16.0-inch diameter pipe spool shall have a minimum wall thickness of 0.25-inches.
 2. This pipe spool assembly shall include recommended gaskets (total of four) at the flanges to properly mate and seal with the fixed sleeve valve flanges.
 3. The stainless-steel pipe spool assembly shall be furnished by the fixed sleeve valve supplier, as part of their Bid.

2.2 EQUIPMENT REQUIREMENTS

- A. **Valve Components:** Each sleeve valve assembly shall consist essentially of a supporting flange, a cylindrical sleeve section with orifice hole design, and a dished head on the interior end of the sleeve section.
- B. The vertical section of the valve shall consist of the fixed cylinder, the lower part of which shall be provided with a series of fixed orifice nozzles that reduce in size from the larger outside entrance to the nozzle to the smaller inside discharge end of the nozzles. The fixed cylindrical sleeve shall be continuously welded to a mounting flange at the end of the valve, designed to mount between a pair of ASME B16.5 Class 300 steel flanges. The water shall flow from the outside of the fixed sleeve, in a symmetrical radial pattern towards the centerline of the sleeve valve. The valve shall be custom designed such that the radial thrust components of the small jet streams counter-act and balance each other, across the longitudinal axis of the valve.
- C. **Interior Head Design.** The interior end of the sleeve shall be designed to resist a water differential pressure across the two valves of no less than 525 psig. Each valve end shall be designed as either a dished stainless-steel head or flat plate head that shall have a deflection of no more than $L/160$ or ~0.10 inches maximum, whichever is less, under the maximum pressure differential.

2.3 SLEEVE VALVE MANUFACTURER

- A. Bailey Valve Inc., Model B16 with Model B-14 Sleeve Configuration
- B. Or Equal.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. Valve installation shall be in strict accordance with the manufacturer's printed recommendations and the Contract Documents including Section 43 25 00 – Valves General. The valve shall be firmly anchored in- between AWWA flanges as shown on the Contract Documents.

3.2 WORKMANSHIP

- A. Valves shall be free from manufacturing defects. Welds shall conform to ASME Section VIII or IX standards for pressure vessels and shall be free of mill scale.

3.3 FIELD TESTING AND PERFORMANCE

- A. Valves shall be field tested by the CONTRACTOR under the operating conditions as provided for by the Blind Slough Hydroelectric project existing penstock. The pressure drop across the valves as well as noise levels shall be measured to insure the valves are free of obstruction and noise levels are less than that specified under Part 2.1 of this Section.
- B. Any excessive noise or vibration of the valve when installed in the installation orientation as shown in the Contract Drawings (see Contract Drawings C121 and C123) shall be resolved and corrected by the sleeve valve manufacturer, including possible replacement of the valve at the Manufacturer's expense, including shipping and handling of valve to the project site. Reinstallation of the new valve / valve assembly shall be performed by the CONTRACTOR, at the CONTRACTOR's expense.

- END OF SECTION -

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SECTION 43 25 42 - MISCELLANEOUS VALVES

PART 1 -- GENERAL

1.1 SUMMARY

- A. The CONTRACTOR shall provide miscellaneous valves and appurtenances, complete and operable, in accordance with the Contract Documents.
- B. The requirements of Section 43 25 00 - Valves, General, apply to this Section.

1.2 CONTRACTOR SUBMITTALS

- A. Furnish submittals in accordance with Section 01 33 00 – Contractor Submittals.

PART 2 -- PRODUCTS

2.1 AIR-RELEASE VALVES

- A. **Air-Release Valves:** Air-release valves shall vent accumulating air while system is in service under pressure and be of the size indicated on Contract Drawing **GM-004** - Air Vacuum (AV) Air Release (AR) Valve Schedule. Valves shall meet the same general requirements as indicated for air vacuum – air-relief valves indicated in Part 2.2 below.

1. Valves shall be designed for a minimum water-working pressures as shown on the Air and Vacuum Release Valve schedule.
2. The diameter of the air-release orifice shall be as shown on the Air Vacuum (AV) Air Release (AR) Valve Schedule.
3. Valves shall have a resilient seat with Buna-N seals.
4. All ferrous metal parts of the valve body shall be coated with fusion bonded epoxy, per AWWA C550

- B. **Manufacturers, or Equal**

1. APCO (Valve and Primer Corporation)
2. Crispin - Multiplex Manufacturing Company
3. Val-Matic (Valve and Manufacturing Corporation), Style 38.2 & 38.6

2.2 AIR VACUUM (AV) AIR-RELEIF (AR) VALVE FOR GRADE CHANGES IN PENSTOCK

- A. **Purpose and Background.** A vacuum relief / air inlet valve shall be installed at the top of high points on the penstock profile where shown on the Civil Plan and Profile sheets.
 1. The intent of the vacuum valve is to protect the downstream pipe system from excessive vacuum pressures in the case of a penstock pipe failure or other downstream abnormally high flow rate event.

2. The vacuum relief/air inlet valve shall be normally closed, capable of admitting large quantities of air into the system immediately should the system gauge pressure become negative caused during either draining, pipeline rupture, or water column separation in the penstock.
- B. **AVAR Schedule.** Contract Drawing GM-004 has a Air Vacuum (AV) Air Release (AR) Valve Schedule which provides the sizes, venting capacity requirements, cold-working pressure ratings (minimum), valve type and end configuration, and materials of construction of each valve.
- C. **Spring-Loaded Combination Air Valve.** The valves shall prevent absolute pipeline pressures from dropping below 10 psia. The plug shall be normally closed by means of a stainless-steel spring and shall open when a vacuum/pressure differential exceeds 0.25 psi or less
- D. Construction of the valve shall be as follows:
1. The valve shall be of the size indicated, with flanged ends to match piping connections and pressure class indicated. Bodies shall be of high-strength ductile iron (ASTM A536).
 2. Valves shall be designed for minimum water-working pressure as defined in the schedule on Contract Drawing GM-004., unless otherwise indicated.
 3. Each valve shall be furnished with an optional steel hood assembly to prevent birds and other large insects from entering the valve inlet zone.
 4. The float, seat, spring, and moving parts shall be constructed of ASTM A313, type 316 stainless steel.
 5. The internal valve-plug and seat shall be ASTM B584, Alloy C87600 heavy cast bronze.
 6. Seat seal shall be of Buna-N providing a drip-tight seal.
 7. All ferrous metal parts of the valve body shall be coated with fusion bonded epoxy, per AWWA C550.
- E. **Manufacturers, or Equal**
1. APCO (Valve and Primer Corporation)
 2. Val-Matic (Valve and Manufacturing Corporation)

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. Backflow preventers shall be installed in potable water lines where required by applicable codes or regulations, wherever there is any danger of contamination, and where indicated.

- B. Valves shall be installed in accordance with the manufacturer's printed recommendations, and with Section 43 25 00.
- C. Backflow preventers, as well as air and vacuum release valves, shall have piped outlets to the nearest acceptable drain, firmly supported, and installed in such a way as to avoid splashing and wetting of floors and obstruction of traffic.

- END OF SECTION -

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SECTION 48 13 01 - INSTALLATION OF OWNER FURNISHED EQUIPMENT

PART 1 -- GENERAL

1.1 SUMMARY

- A. Receive, unload, maneuver, align, install, and flush Owner-Furnished hydroelectric equipment, then prepare that equipment for commissioning. Such equipment includes, but is not limited to:
 - a. Turbine:
 - i. Housing;
 - ii. Runner;
 - iii. Needle valves;
 - iv. Deflectors
 - v. Inlet piping, with dismantling joint;
 - vi. Inlet piping 4-way pressure taps;
 - b. Turbine Inlet Valve (TIV);
 - c. Generator
 - i. sole plates;
 - ii. rotor and stator;
 - d. Generator bearings;
 - e. Generator Lube oil unit (LPU) skid;
 - f. High pressure hydraulic unit (HPU) skid;
 - g. Equipment listed in Section 26 02 00 – Owner-Furnished Electrical Equipment, to which the work of this Section applies;
 - h. Owner-furnished, CONTRACTOR-Installed (OFCl) appurtenances needed for a complete and operable hydroelectric power plant.

1.2 DESCRIPTION OF WORK

- A. OWNER will furnish installation procedures and forms (for recording inspections and measurements) developed by the turbine generator equipment supplier for CONTRACTORS use.

- B. Prior to start of equipment erection the CONTRACTOR shall submit to the ENGINEER his quality assurance program which will include a description of the quality assurance to be used in this work.
- C. The ENGINEER will review the CONTRACTOR's methods, procedures, and processes for compliance to the quality assurance program and the quality standards of this specification.
- D. The scope of activities in this section includes:
 - 1. Unloading.
 - 2. Storing.
 - 3. Setting.
 - 4. Grouting.
 - 5. Aligning.
 - 6. Doweling.
 - 7. Checking and servicing.

1.3 QUALITY ASSURANCE

- A. Prior to setting of base plates, sole plates, and equipment the CONTRACTOR shall submit to the OWNER's Representative evidence that the foundations have been placed in accordance with the Drawings and specifications as provided by the OWNER and the OWNER's Representative. The CONTRACTOR will supply the necessary personnel and equipment to demonstrate to the satisfaction of the OWNER that alignment of all components is correct within accepted standards for each type of equipment or within the manufacturer's requirements when provided.
- B. The OWNER's representative shall conduct and interpret tests on work as considered necessary. These tests, may include, but are not limited to, alignment, tolerance, welding, painting, materials, and connections.
- C. The OWNER's representative may inspect embedded parts supplied or placed by the CONTRACTOR prior to being incorporated into the work and reserves the right to reject material not complying with specified requirements at any time.
- D. The CONTRACTOR shall correct deficiencies in embedded parts which inspections and laboratory test reports have indicated to be not in compliance with requirements. The OWNER's representative shall perform additional tests, at the CONTRACTOR's expense as may be necessary to reconfirm any noncompliance of the original work and as may be necessary to show compliance of corrected work.

- E. Refer to turbine generator equipment supplier shop drawings for details on OWNER furnished and CONTRACTOR installed equipment (see Appendix).

1.4 SUBMITTALS

- A. Submit the following, in accordance with Section 01 33 00 – Contractor Submittals:
 - a. Shop drawings, installation and inspection procedures and forms for recording inspections and alignment measurements
 - b. Baseplate and Sole plate setting dimensions, prior to grouting those items;
 - c. CONTRACTOR'S quality assurance program;
 - d. Hydraulic oil piping flushing procedure;
 - e. Lube oil piping flushing procedure;
 - f. Crane operators' qualifications;
 - g. Blank critical measurement worksheets, prior to taking those measurements;
 - h. Filled out and signed critical measurement worksheets, after taking those measurements.
 - i. Completed inspection and alignment forms.

PART 2 -- MATERIALS

2.1 TURBINE-GENERATOR PIPING SYSTEMS

- A. These systems shall be OWNER furnished, and OWNER installed. Systems include turbine inlet valve piping/tubing, lube oil and high-pressure hydraulic system piping and tubing and associated fittings and instrumentation.
- B. Approximate routing will be as indicated on Turbine generator Equipment Supplier Shop Drawings.
- C. Pipe or tubing size will be as indicated on Turbine Generator Equipment Supplier Shop Drawings.

2.2 TURBINE EQUIPMENT

- A. Turbine case, runner, branch piping, needle assemblies with actuators, and deflector assemblies shall be OWNER furnished and CONTRACTOR installed systems.
- B. The existing turbine pit liner will be re-used, and turbine concrete foundations modified as shown on the drawings.

- C. The turbine inlet valve and associated equipment shall be OWNER furnished and CONTRACTOR installed systems.
- D. Turbine equipment includes the hydraulic pressure unit (HPU) and associated devices which shall be OWNER furnished and CONTRACTOR installed systems. As mentioned above, high pressure hydraulic piping will be installed by OWNER.
- E. All turbine equipment electrical devices shall be OWNER furnished and CONTRACTOR installed.

2.3 GENERATOR EQUIPMENT

- A. Generator housing/stator, rotor and shaft, flywheel, and soleplate assemblies shall be OWNER furnished and CONTRACTOR installed systems.
- B. Remove existing generator foundation and provide new foundation as shown on the drawings.
- C. Generator equipment includes the OWNER furnished and CONTRACTOR installed lube oil module (LPU) and associated devices. As mentioned above, lube oil piping will be installed by Owner.
- D. Generator equipment includes OWNER furnished and CONTRACTOR installed high impedance neutral grounding equipment and other miscellaneous equipment (Refer to Turbine Generator Equipment Supplier shop drawings).
- E. All generator equipment electrical devices shall be OWNER furnished and CONTRACTOR installed.

2.4 TURBINE ISOLATION VALVE EQUIPMENT

- A. Turbine isolation valve (TIV), and support stand operator shall be OWNER furnished and CONTRACTOR installed.
- B. Hydraulic tubing and fittings to from the HPU to the TIV shall be furnished and installed by OWNER.
- C. All TIV electrical devices shall be OWNER furnished and CONTRACTOR installed.
- D. Modifications to the powerhouse floor shall be made by CONTRACTOR to install the TIV,

PART 3 -- EXECUTION

3.1 EQUIPMENT AND MATERIALS RECEIPT, STORAGE AND HANDLING

- A. **Receiving Procedures:**

1. OWNER will give timely notice to the CONTRACTOR of the delivery of equipment and material, including but not limited to turbine/generator equipment and electrical equipment, as listed as "OWNER-furnished" in Section 01 11 00 – SUMMARY OF WORK.
 2. The CONTRACTOR will be responsible for unloading and storage of equipment and materials furnished by the OWNER, and will accept and sign for such equipment and material.
 3. CONTRACTOR shall receive all Owner furnished equipment in good working condition, and must inspect equipment for obvious damage and report to OWNER immediately any concerns.
 4. OWNER may inspect deliveries and institute over, short, or damage reports, delivering a copy of same to the CONTRACTOR for distribution within 24 hours of receipt.
- B. The inspection and checking of deliveries may be witnessed by the OWNER or ENGINEER.
- C. The CONTRACTOR will make out the appropriate material receiving report on the item.
- D. Before signing the freight receipt, the OWNER and CONTRACTOR will inspect the item for external signs of damage. If such signs exist, the CONTRACTOR will note them on the freight receipt and have the deliverer sign under the note. If, upon further inspection, actual damage of the item is found, a Report of Unsatisfactory Materials shall be made out. CONTRACTOR shall forward copies to the OWNER's Representative within 24 hours. The OWNER will notify the vendor and call in the shipper's claim representative who will handle the issuing of the proper documents (carrier inspection report) to file the claim. If no real damage occurred, no further action is taken. The CONTRACTOR will attach the freight receipt to the packing list and completely check off items received on the packing list and forward a copy to the Project Manager.
- E. To actually receive the item the CONTRACTOR will complete the packing list as follows:
1. Date of receipt of the material.
 2. Purchase order number.
 3. Quantity received - this will be filled in only after the shipment has been unpacked and checked.
 4. Received via the delivery carrier.
 5. Pro number - freight delivery receipt number.
 6. Freight charge - pre-paid charges will be noted.
 7. Number of pieces received.

8. Weight of the shipment.
9. Indicate whether the shipment was complete or partial.
10. Received by - signature of the CONTRACTOR's representative.
11. Storage location.

F. Returns - For returns, the following are to be used:

1. Shipping notice.
2. Shipping notice register.

G. Unloading and Storage:

1. Equipment will be unloaded using the right combination of rigging expertise and tools. Extreme care should be exercised to eliminate equipment damage and to handle with respect to personnel safety.
2. Equipment shall be stored in OWNER-approved areas and/or on approved floor slabs in accordance with the manufacturer's instructions. Any special anti-rust lubricants, compounds and coatings required shall be applied by the CONTRACTOR as required.

H. Back charges - To vendors:

1. When the CONTRACTOR performs work to correct OWNER-furnished machinery an account number will be assigned for such work. The assignment of account numbers can be kept to a minimum by assignment of one number for each vendor as such work is performed.
2. Authorization of work: The CONTRACTOR may not proceed with work to be back charged to a supplier without proper written authorization.
3. The following information shall be furnished:
 - a. From: (Supplier).
 - b. To:
 - c. Request No. (All work order requests shall be numbered consecutively, starting with No. 1).
 - d. Contract number.
 - e. Date.
 - f. Conditions of request:

- 1) Time and material.
- 2) Lump sum price.
- 3) Proceed immediately.
- 4) Proceed after approval of lump sum price.
- 5) Other basis (specify).

g. Description of work requested.

4. Signature of requester shall be obtained.
5. Distribution of copies shall be noted.

I. Powerhouse Crane and Schedule

1. The powerhouse crane may be used by the CONTRACTOR. This crane may be used to unload the turbine and generator components when they arrive by truck to the site and for demolition and installation work in the powerhouse. CONTRACTOR shall submit documentation of the qualifications of personnel that will operate the crane. CONTRACTORS personnel shall have training as required by the State of Alaska.

3.2 MACHINERY INSTALLATION

A. The following documents will be provided to the CONTRACTOR as soon as they are available for use in installation of the turbine equipment:

1. Turbine Supplier's guidelines for turbine/generator installation
2. Turbine Supplier's installation and alignment procedures and drawings and forms for documentation of installation and alignment,

B. Installation of turbine/generator equipment:

1. The CONTRACTOR shall completely assemble, install, clean, test, and commission one complete turbine-generator system and all auxiliary equipment as specified of this specification and Drawings. CONTRACTOR shall provide and install all cable tray and conduit, all interconnecting wiring and piping, testing, and commissioning of all systems. The equipment shall be installed by CONTRACTOR on the foundations provided by CONTRACTOR.
2. The CONTRACTOR shall provide all electricity, compressed air, service water, office space, enclosed storage or work space, toilet facilities, transportation to and from the site, security, etc. required for installation and testing of both OWNER and CONTRACTOR supplied equipment and powerhouse systems.

3. OWNER shall provide a technical erection superintendent from the turbine supplier for installation, installation supervision, and testing of all OWNER-furnished turbine/generator equipment. Such personnel shall be provided at the jobsite for a maximum of 21 consecutive days.
4. Piping and tubing shall be installed in accordance with instructions specified in 3.2A.
5. Conduit, cable tray, and wiring shall be installed as specified on the Drawings and in the specifications.
6. The CONTRACTOR shall record, at the time such measurements are taken, during erection on approved Record Forms, all critical measurements indicated in the Manufacturer's Erection Procedure. On the date each measurement is taken and recorded, CONTRACTOR shall submit to OWNER one signed copy of each measurement.
7. CONTRACTOR shall maintain a complete record of measurements submitted to OWNER and upon completion of erection, CONTRACTOR shall certify in writing on a reproducible form that all the final measurements are a true record.
8. CONTRACTOR shall ensure that the turbine, generator, and all accessory equipment are installed according to Manufacturer's recommendations and within the tolerances and clearances shown in the Manufacturers' instructions.
9. Prior to pouring of concrete or grout affected under this specification, CONTRACTOR's qualified representative shall observe and verify that anchor bolts and parts to be embedded into the foundation concrete are adequately held in place to prevent movement during the placement of the concrete/grout. CONTRACTOR shall provide all precision survey equipment and personnel required to verify all embedded parts and anchor bolt placement prior to the pouring of and immediately following the pouring of first stage concrete. CONTRACTOR shall inform OWNER immediately of any movement which is detected during the placement of concrete or grout.
10. CONTRACTOR shall install all OWNER-furnished embedded parts and anchor bolts to match the locations, elevations, and sizes necessary for subsequent turbine, generator, and accessory equipment installation. Work required to correct misalignment, deformations, deflections or displacements of parts embedded in concrete or grout shall be provided by CONTRACTOR at no expense to the OWNER.

C. Installation of miscellaneous equipment will be as follows:

1. Materials and tools furnished by CONTRACTOR:
 - a. Grouting materials.
 - b. Shims - flat type only.

- c. Grout forms.
 - d. Fasteners of all types (includes anchor bolts and leveling screws).
 - e. Threaded dowels (steel) complete with hex nuts.
 - f. Lubricants, coatings and solvents.
 - g. Gaskets, seals, etc.
 - h. Rigging materials.
 - i. Miscellaneous hardware such as keys, nails, fittings, etc.
 - j. Special tools, aside from those furnished by the manufacturers.
 - k. General supplies (i.e., solvents, rags, liquid wrench, etc.).
 - l. Small tools.
 - m. Welding equipment and supplies.
2. Equipment installation: Equipment will be mounted on concrete slabs or fabricated steel bases, leveled, aligned, grouted and anchored in place. Some of the larger equipment will require special mounting. The following is a description of the general procedures and considerations:
- a. Foundation plates - Describes the metal bases which are installed on concrete foundations and support items of equipment. They are installed by concreting or grouting into final positions on foundations and are anchored in place by foundation anchor bolts. They are usually classified as:
 - 1) Base plates - Flat plates drilled and tapped for equipment base cap screws, and leveling screws.
 - 2) Bedplates – Dome-shaped or with hollow spaces underneath will either be drilled for equipment base bolts or drilled and tapped for equipment base cap screws, and leveling screws as required.
 - 3) Soleplates - These are provided with slots or other provisions for equipment base bolts permitting horizontal adjustment of equipment. Drilling and tapping may be required for leveling screws.
 - b. Foundation anchor bolts: These bolts shall attach foundation plates to foundations only and not used to anchor bases of equipment. Foundation anchor bolts shall be drawn up tight before placing equipment on grouted foundation plates or before placing grout under the foundation plates.

- c. Manufacturer's instructions - Manufacturer's instructions and recommendations covering all phases of installation and placing in operation each item of equipment shall be strictly followed. Should Manufacturer's instructions be in conflict with these specifications, the Project Manager shall be notified.
- d. Equipment alignment - Loose shim plates to be used for alignment of equipment shall be stainless steel having a very smooth surface less than 125 micro-inches rms. A minimum number of shims shall be used.
- e. Driving shaft rotation - Direction and speed of driving shaft rotation shall be checked before connecting to driven shafts. Driving shafts having axial end play shall be run at operating speed. The running position, such as the magnetic center on motors, shall be marked using chalk and scribe or other similar method. The shafts shall be blocked in this position while setting the correct coupling gap during alignment.
- f. Grouting materials - All grouting materials, including preparation, mixing, placing and finishing shall be in conformance with the turbine-generator equipment supplier's recommendations.
- g. Alignment procedures for direct driven equipment:
 - 1) Shafts shall be leveled by use of a precision machinist level placed across the faces of the coupling halves in both the horizontal and vertical plans or as otherwise directed by the turbine generator equipment supplier.
 - 2) Angular alignment and gap shall be checked using a spacer bar equal in thickness to the gap as specified or by use of other suitable equipment at four (4) equally spaced points, 90 degrees apart around the outer edge of coupling halves or as otherwise directed by the turbine generator equipment supplier.
 - 3) After coarse alignment has been accomplished, location of holes for cap screws shall be scribed on the top surface of the grouted foundation plate and the equipment shall be removed. Holes shall then be drilled and tapped, chips removed and the equipment replaced, using the same shims in the same locations used in the coarse adjustment.
 - 4) Equipment shall then be fastened to the grouted foundation plate with OWNER provided bolts (provided by turbine generator equipment supplier). Since the bolts will permit some small latitude for fine adjustments, a recheck using a dial indicator for high accuracy shall be made. Equipment to be set to ± 0.0015 inches with indicator or other specified/approved measuring devices. Vendor furnished

shims should be used when available, otherwise CONTRACTOR shims should be used.

- 5) If driven equipment is connected to other equipment such as piping, the flanges shall be visually checked for alignment. Only if the alignment is correct, the flanged bolts shall be tightened. The driver will then be aligned to an accuracy of ± 0.0015 inches (or as otherwise indicated by turbine generator equipment supplier) with dial indicators or other specified/approved measuring devices (c) (b) above).
 - 6) Extreme care shall be exercised when tightening cap screws to insure that no torsional stresses are introduced into the equipment base. No striking (slug) wrenches shall be permitted and 12 point sockets shall be used where possible.
- h. Couplings: Coupling fits, other than the taper locked type, shall be force fits, Class FN1, per ANSI B4.1 standard latest edition. Both the shaft and coupling bore shall be micrometer checked prior to installation to check fit.
- i. Bearings:
- 1) Straight bore bearings with interference fits shall be heated by induction heaters or oil bath only to temperatures up to 250°F.
 - 2) Tapered bore bearings shall be mounted on the journals with clearance reductions, specified by the Manufacturer. Use prescribed methods of measuring the clearances prior to and after installation.
- j. Keys: The proper method of fitting keys depending on the type of key used is as follows:
- 1) Tapered sunk keys shall have a bearing on all sides.
 - 2) Straight sunk keys shall have a good bearing on the sides and can have a slight clearance or light bearing on top.
 - 3) Flat keys shall fit lightly on the sides heavily between shaft and hub throughout its entire length. The corners of all keys should be filed off to prevent a heavy bearing on these points.

3.3 LUBRICATION

- A. The CONTRACTOR shall ascertain that factory lubricated machinery components are internally clean and lubricated. CONTRACTOR shall flush all machinery components that require lubrication but are delivered dry. This includes, but is not limited to, bearings and couplings.

- B. CONTRACTOR shall flush all hydraulic and lube oil tubing/piping systems. Submit flushing procedures. Flushing shall be performed in accordance with turbine generator equipment supplier procedures. After flushing has been judged acceptable by OWNER's representative, one initial fill of lubricants and hydraulic fluids will be provided by the OWNER. The CONTRACTOR shall be responsible for seeing that the machinery is not operated until lubrication work is complete.
- C. Cleanliness of hydraulic oil shall be verified in accordance with turbine generator equipment supplier procedures.
- D. Materials used for flushing of piping systems, including suitable oil and portable flushing units, shall be supplied by the CONTRACTOR. All other material necessary for flushing the piping systems, such as temporary filters and filter elements, temporary hoses, spool pieces and miscellaneous fittings shall be supplied by the CONTRACTOR but will become the property of OWNER.
- E. Craftsmen skilled in hydraulic piping work shall conduct the testing and flushing.
- F. Temporary filters where required shall be installed in return lines. Filtration size shall be as specified by the manufacturer.
- G. Piping systems shall be flushed for the period of time specified by the machinery supplier. New filter elements shall then be installed, and flushing continue for at least 30 minutes. Successful flushing will be judged by inspection of filter elements or particle counts in accordance with the manufacturer's procedure, as witnessed by OWNER's representative.
- H. The CONTRACTOR will then fill system for service.
- I. Flushing oil shall be approved by the machinery supplier.

3.4 MACHINERY CHECKOUT

- A. The CONTRACTOR shall attach a testing check and approval tag to each piece of equipment and to each system as determined by the ENGINEER. The equipment tag shall be maintained in triplicate (one tag to be attached to the piece of equipment, one tag to be maintained in the office of the CONTRACTOR for record and one to be provided to OWNER) and shall contain the following information:
 - 1. Equipment number.
 - 2. Description.
 - 3. Alignment ready for approval.
 - 4. Alignment approved.
 - 5. Grouting OK to pour.

6. Grouting completed.
 7. Piping ready for connecting.
 8. Piping approved for connecting.
 9. Final alignment approved.
 10. Electrical ready for approval.
 11. Electrical-controls, interlocking, starter, tagging checked and approved.
 12. Rotation approved.
 13. Flushing complete ready for lubrication.
 14. Lubrication complete.
 15. Guards approved.
 16. Test run completed and approved.
- B. The CONTRACTOR shall furnish all labor of the proper jurisdiction, tools, equipment and instruments to properly test the systems included in specifications or shown on the Drawings. Tests shall include those listed elsewhere in these specifications, those required to properly adjust equipment and those necessary to verify performance requirements and proper operation. Vendor technicians shall be furnished, as required, by the CONTRACTOR, for CONTRACTOR-furnished equipment, and by OWNER, for OWNER-furnished equipment.
- C. All items subject to damage during testing such as pressure gauges, transmitters, etc., shall be removed from the lines, and openings shall be plugged before testing.
- D. OWNER will, as deemed necessary, engage the services of testing laboratories and inspectors. These inspectors will make independent tests and inspections of structural concrete, soil compaction, pressure tests and other inspection work as an independent contractor. These tests will not relieve the CONTRACTOR from his responsibility for testing the systems and equipment.
- E. Prior to operating an item of equipment for the first time, the following procedure shall be followed:
1. Direction and speed of rotation of driver shaft has been checked as described earlier.
 2. Both driver and driven unit have been checked by hand for freedom of movement where possible. Otherwise, a thorough visual inspection shall be made.
 3. Ensure that all shaft blocks, rigging, etc., has been removed.

4. Lubrication of all parts has been performed and recorded.
5. All exposed rotating equipment have been covered with Alaska OSHA approved guards.
6. Each driven, driver member has been doweled at least two points. Minimum length of bearing surface for one plate shall be two (2) times the diameter. Dowels shall be standard threaded end taper pins. Note: S.S. taper pins may be used in designated areas. Dowel pins shall be furnished and installed by CONTRACTOR.
7. When the equipment and system check-out of any item of equipment is to be supervised by a representative of the manufacturer, this representative's recommendations shall be explicitly followed. Arrangement for start-up and erecting by manufacturer's personnel will be determined by OWNER's representative. The CONTRACTOR or SUBCONTRACTOR shall give a minimum of two (2) weeks prior notice of starting equipment or the need for an erector to OWNER's representative.
8. The CONTRACTOR will establish a lock-out or tag-out procedure prior to starting a piece of equipment and it will be followed without exceptions.
9. When the equipment and system checkout of any item of equipment is to be supervised by other than the manufacturer's representative, an experienced supervisor shall perform the checkout. He shall follow all instructions and recommendations of the manufacturer regarding start-up and operation. The equipment shall be test run under no load conditions until accepted by OWNER's representative to check for misalignment, vibration, loose bolts, localized heating of any other undesirable.
10. The CONTRACTOR shall be responsible for damage to equipment prior to acceptance by the OWNER's representative.
11. All rotating equipment, other than the turbine/generator set, should be checked for vibration and shall not be accepted if the vibration is in excess of the following:
 - 3600 rpm - 0.6 mils
 - 1800 rpm - 1.0 mils
 - 900 rpm - 2.0 mils
12. The CONTRACTOR shall be responsible for the repair or replacement of any equipment malfunctioning prior to the OWNER's representative's acceptance. Cost of repair or replacement of parts damaged through no fault of CONTRACTOR shall be negotiated with OWNER.

3.5 COMMISSIONING AND START-UP

- A. After all equipment has been installed and checked out as described above, equipment is ready to begin the start-up and commissioning process as described in Section 01 91 00 – Commissioning, Startup, and Testing.

- END OF SECTION –

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