Brushy Creek Municipal Utility District

Well #6 at Sam Bass Field
Issued for Bid

Construction Documents
Project Manual

August 2016

HDR Project No. 272124

Prepared by:

HDR Engineering, Inc.
Texas P.E. Firm Registration No. F-754
4401 West Gate Blvd., Suite 400
Austin, TX 78745
512-912-5100
www.hdrinc.com

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DIVISION 16 - ELECTRICAL

The following specifications were prepared by me or under my direction:

DIVISION 16 - ELECTRICAL

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SECTION C-111-ADVERTISEMENT FOR BIDS FOR CONSTRUCTION CONTRACTS

Prepared by

EJCDC
ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

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Brushy Creek Municipal Utility District
Round Rock, Texas
Well #6 at Sam Bass Field

ADVERTISEMENT FOR BIDS

Sealed Bids for the construction of the Well#6 at Sam Bass Field will be received from Bidders only, by Brushy Creek Municipal Utility District, at 16318 Great Oaks Drive, Round Rock, TX 78681, until 1:00 PM local time on January 23, 2017 at which time the Bids received will be publicly opened and read. The Project consists of constructing a municipal water supply well in the immediate vicinity of the District's well field on Sam Bass Road.

Bidding Documents also may be examined at the office of the Engineer, [HDR Engineering, Inc. 4401 West Gate Blvd, Suite 400, Austin, TX, 78745], on Mondays through Fridays between the hours of 8 AM to 5 PM.

A pre-bid conference will be held at 1:00 PM local time on January 11, 2017 at the construction site 2100 Sam Bass Road, Round Rock, TX (North end of Atumn Lane). Attendance at the pre-bid conference is highly encouraged but is not mandatory.

Bids will be received for a single prime Contract. Bids shall be on a lump sum and unit price basis, with deduct bid items as indicated in the Bid Form.

Printed and digital copies of the Bidding Documents will be provided by the Engineer to Bidders.

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

Owner: **Brushy Creek Municipal Utility District**

By: **Joey Miller**

Title: **Utility Systems Coordinator**

Electronic copies of the bid package and information can be requested for a fee of $25. Check or money order is the only acceptable form of payment. Checks shall be made payable to HDR Engineering. To purchase, contact:

HDR Inc.
Attn: Lisa Singer
4401 West Gate Blvd
Suite 400
Austin, TX 78745-1469
512-912-5100

+ + END OF ADVERTISEMENT FOR BIDS + +

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SECTION C-200-INSTRUCTIONS TO BIDDERS FOR CONSTRUCTION CONTRACTS

Prepared by

EJCDC
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INSTRUCTIONS TO BIDDERS

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ARTICLE 1 – DEFINED TERMS

1.01 Terms used in these Instructions to Bidders have the meanings indicated in the General Conditions and Supplementary Conditions. Additional terms used in these Instructions to Bidders have the meanings indicated below:

A. *Issuing Office* – The office from which the Bidding Documents are to be issued.

ARTICLE 2 – COPIES OF BIDDING DOCUMENTS

2.01 Complete sets of the Bidding Documents may be obtained from the Issuing Office or the Engineer in the number and format stated in the advertisement or invitation to bid.

2.02 Complete sets of Bidding Documents shall be used in preparing Bids; neither Owner nor Engineer assumes any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.

2.03 Owner and Engineer, in making copies of Bidding Documents available on the above terms, do so only for the purpose of obtaining Bids for the Work and do not authorize or confer a license for any other use.

ARTICLE 3 – QUALIFICATIONS OF BIDDERS

3.01 Bidder shall complete and submit Bidder's Questionnaire in Section 00303.

3.02 A Bidder's failure to submit required qualification information within the times indicated may disqualify Bidder from receiving an award of the Contract.

3.03 No requirement in this Article 3 to submit information will prejudice the right of Owner to seek additional pertinent information regarding Bidder's qualifications.

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

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

4.01 *Site and Other Areas*

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

4.02 *Existing Site Conditions*

A. Subsurface and Physical Conditions; Hazardous Environmental Conditions

1. There are no known hazardous subsurface, physical or environmental conditions.

B. Underground Facilities:

1. As shown on the Drawings the raw water line will: (1) cross a residential water line, (2) a residential sewer line, and (3) connect to an exiting water transmission pipeline.

2. No underground utilities occur at the well site.

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

4.03 *Site Visit by Bidders*

A. See Section 6.1 below.

4.04 *Owner's Safety Program*

A. Site visits and work at the Site may be governed by an Owner safety program. As the General Conditions indicate, if an Owner safety program exists, it will be noted in the Supplementary Conditions.

4.05 *Other Work at the Site*

A. No other work will be ongoing at the work site.

ARTICLE 5 – BIDDER'S REPRESENTATIONS

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

A. examine and carefully study the Bidding Documents, and any data and reference items identified in the Bidding Documents;

B. visit the Site, conduct a thorough, alert visual examination of the Site and adjacent areas, and become familiar with and satisfy itself as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work;

C. become familiar with and satisfy itself as to all Laws and Regulations that may affect cost, progress, and performance of the Work;

D. carefully study reports of explorations and tests of subsurface conditions at or adjacent to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings,

E. consider the information known to Bidder itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and the Site-related reports and drawings identified in the Bidding Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder; and (3) Bidder's safety precautions and programs;

F. agree, based on the information and observations referred to in the preceding paragraph, that at the time of submitting its Bid no further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of its Bid for performance of the Work at the price bid and within the times required, and in accordance with the other terms and conditions of the Bidding Documents;

G. become aware of the general nature of the work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents;

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

I. determine that the Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance and furnishing of the Work; and

J. agree that the submission of a Bid will constitute an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article, that without exception the Bid and all prices in the Bid are premised upon performing and furnishing the Work required by the Bidding Documents.

ARTICLE 6 – PRE-BID CONFERENCE

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

ARTICLE 7 – INTERPRETATIONS AND ADDENDA

7.01 All questions about the meaning or intent of the Bidding Documents are to be submitted to Engineer in writing. Interpretations or clarifications considered necessary by Engineer in response to such questions will be issued by Addenda delivered to all parties recorded as having received the Bidding Documents. Questions received less than seven (7) calendar days prior to the date for opening of Bids may not be answered. Only questions answered by Addenda will be binding. Oral and other interpretations or clarifications will be without legal effect.

7.02 Addenda may be issued to clarify, correct, supplement, or change the Bidding Documents.

ARTICLE 8 – BID SECURITY

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

8.02 The Bid security of the apparent Successful Bidder will be retained until Owner awards the contract to such Bidder, and such Bidder has executed the Contract Documents, furnished the required contract security, and met the other conditions of the Notice of Award, whereupon the Bid security will be released. If the Successful Bidder fails to execute and deliver the Contract Documents and furnish the required contract security within fifteen (15) calendar days after the Notice of Award, Owner may consider Bidder to be in default, annul the Notice of Award, and the Bid security of that Bidder will be forfeited. Such forfeiture shall be Owner's exclusive remedy if Bidder defaults.

8.03 The Bid security of other Bidders that Owner believes to have a reasonable chance of receiving the award may be retained by Owner until the earlier of seven (7) calendar days after the Effective Date of the Contract or sixty-one (61) calendar days after the Bid opening, whereupon Bid security furnished by such Bidders will be released.

8.04 Bid security of other Bidders that Owner believes do not have a reasonable chance of receiving the award will be released within seven (7) calendar days after the Bid opening.

ARTICLE 9 – CONTRACT TIMES

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

ARTICLE 10 – LIQUIDATED DAMAGES

10.01 Provisions for liquidated damages, if any, for failure to timely attain a substantial completion and completion of the Work in readiness for final payment, are set forth in the Agreement.

ARTICLE 11 – SUBSTITUTE AND "OR-EQUAL" ITEMS

11.01 The Contract for the Work, as awarded, will be on the basis of materials and equipment specified or described in the Bidding Documents without consideration during the bidding and Contract award process of possible substitute or "or-equal" items. In cases in which the Contract allows the Contractor to request that Engineer authorize the use of a substitute or "or-equal" item of material or equipment, application for such acceptance may not be made to and will not be considered by Engineer until after the Effective Date of the Contract.

11.02 All prices that Bidder sets forth in its Bid shall be based on the presumption that the Contractor will furnish the materials and equipment specified or described in the Bidding Documents, as supplemented by Addenda. Any assumptions regarding the possibility of post-Bid approvals of "or-equal" or substitution requests are made at Bidder's sole risk.

ARTICLE 12 – SUBCONTRACTORS, SUPPLIERS, AND OTHERS

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

12.02 Subsequent to the submittal of the Bid, Owner may not require the Successful Bidder or Contractor to retain any Subcontractor, Supplier, or other individual or entity against which Contractor has reasonable objection.

12.03 The apparent Successful Bidder, and any other Bidder so requested, shall within five (5) calendar days after Bid opening, submit to Owner a list of the Subcontractors or Suppliers proposed for the Work.

If requested by Owner, such list shall be accompanied by an experience statement with pertinent information regarding similar projects and other evidence of qualification for each such Subcontractor, Supplier, or other individual or entity. If Owner or Engineer, after due investigation, has reasonable objection to any proposed Subcontractor, Supplier, individual, or entity, Owner may, before the Notice of Award is given, request apparent Successful Bidder to

submit an acceptable substitute, in which case apparent Successful Bidder shall submit a substitute, Bidder's Bid price will be increased (or decreased) by the difference in cost occasioned by such substitution, and Owner may consider such price adjustment in evaluating Bids and making the Contract award.

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

ARTICLE 13 – PREPARATION OF BID

13.01 The Bid Form is included with the Bidding Documents.

A. All blanks on the Bid Form shall be completed in ink and the Bid Form signed in ink. Erasures or alterations shall be initialed in ink by the person signing the Bid Form. A Bid price shall be indicated for each section, Bid item, alternate, adjustment unit price item, and unit price item listed therein.

B. If the Bid Form expressly indicates that submitting pricing on a specific alternate item is optional, and Bidder elects to not furnish pricing for such optional alternate item, then Bidder may enter the words "No Bid" or "Not Applicable."

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

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

13.04 A Bid by a limited liability company shall be executed in the name of the firm by a member or other authorized person and accompanied by evidence of authority to sign. The state of formation of the firm and the firm's address for receiving notices shall be shown.

13.05 A Bid by an individual shall show the Bidder's name and address for receiving notices.

13.06 A Bid by a joint venture shall be executed by an authorized representative of each joint venturer in the manner indicated on the Bid Form. The joint venture's address for receiving notices shall be shown.

13.07 All names shall be printed in ink below the signatures.

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

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

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

ARTICLE 14 – BASIS OF BID

14.01 *Unit and Lump Prices*

A. Bidders shall submit a Bid on a unit or lump sum price basis for each item of Work listed of the Bid Form.

B. The unit price Bid items will be the total of the product of the estimated quantity (which Owner or its representative has set forth in the Bid Form) for the item and the corresponding bid unit price offered by the Bidder.

C. The lump sum price Bid items will be the total of each lump sum item.

D. The total bid price will be the sum of all unit and all lump sum prices. Such total will be used by Owner for Bid comparison purposes. The final quantities and Contract Price will be determined in accordance with Paragraph 13.03 of the General Conditions.

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

ARTICLE 15 – SUBMITTAL OF BID

15.01 With each copy of the Bidding Documents, a Bidder is furnished one separate unbound copy of the Bid Form, and, if required, the Bid Bond Form. The unbound copy of the Bid Form is to be completed and submitted with the Bid security and the other documents required to be submitted under the terms of Article 7 of the Bid Form.

15.02 A Bid shall be received no later than the date and time prescribed and at the place indicated in the advertisement or invitation to bid and shall be enclosed in a plainly marked package with the Project title (and, if applicable, the designated portion of the Project for which the Bid is submitted), the name and address of Bidder, and shall be accompanied by the Bid security and other required documents. If a Bid is sent by mail or other delivery system, the sealed envelope containing the Bid shall be enclosed in a separate package plainly marked on the outside with the notation "BID ENCLOSED." A mailed Bid shall be addressed to: Brushy Creek Municipal Utility District, at 16318 Great Oaks Drive, Round Rock, TX 78681.

15.03 Bids received after the date and time prescribed for the opening of bids, or not submitted at the correct location or in the designated manner, will not be accepted and will be returned to the Bidder unopened.

ARTICLE 16 – MODIFICATION AND WITHDRAWAL OF BID

16.01 A Bid may be withdrawn by an appropriate document duly executed in the same manner that a Bid must be executed and delivered to the place where Bids are to be submitted prior to the date and time for the opening of Bids. Upon receipt of such notice, the unopened Bid will be returned to the Bidder.

16.02 If a Bidder wishes to modify its Bid prior to Bid opening, Bidder must withdraw its initial Bid in the manner specified in Paragraph 16.01 and submit a new Bid prior to the date and time for the opening of Bids.

16.03 If within 24 hours after Bids are opened any Bidder files a duly signed written notice with Owner and promptly thereafter demonstrates to the reasonable satisfaction of Owner that there was a material and substantial mistake in the preparation of its Bid, that Bidder may withdraw its Bid,

and the Bid security will be returned. Thereafter, if the Work is rebid, that Bidder will be disqualified from further bidding on the Work.

ARTICLE 17 – OPENING OF BIDS

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

ARTICLE 18 – BIDS TO REMAIN SUBJECT TO ACCEPTANCE

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

ARTICLE 19 – EVALUATION OF BIDS AND AWARD OF CONTRACT

19.01 Owner reserves the right to reject any or all Bids, including without limitation, nonconforming, nonresponsive, unbalanced, or conditional Bids. Owner will reject the Bid of any Bidder that Owner finds, after reasonable inquiry and evaluation, to not be responsible. If Bidder purports to add terms or conditions to its Bid, takes exception to any provision of the Bidding Documents, or attempts to alter the contents of the Contract Documents for purposes of the Bid, then the Owner will reject the Bid as nonresponsive; provided that Owner also reserves the right to waive all minor informalities not involving price, time, or changes in the Work.

19.02 If Owner awards the contract for the Work, such award shall be to the responsible Bidder submitting the lowest responsive Bid.

19.03 Evaluation of Bids

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

B. In the comparison of Bids, alternates will be applied in the same order of priority as listed in the Bid Form. To determine the Bid prices for purposes of comparison, Owner shall announce to all bidders a "Base Bid plus alternates" budget after receiving all Bids, but prior to opening them. For comparison purposes alternates will be accepted, following the order of priority established in the Bid Form, until doing so would cause the budget to be exceeded. After determination of the Successful Bidder based on this comparative process and on the responsiveness, responsibility, and other factors set forth in these Instructions, the award may be made to said Successful Bidder on its base Bid and any combination of its additive alternate Bids for which Owner determines funds will be available at the time of award.

19.04 In evaluating whether a Bidder is responsible, Owner will consider the qualifications of the Bidder and may consider the qualifications and experience of Subcontractors and Suppliers proposed for those portions of the Work for which the identity of Subcontractors and Suppliers must be submitted as provided in the Bidding Documents.

19.05 Owner may conduct such investigations as Owner deems necessary to establish the responsibility, qualifications, and financial ability of Bidders and any proposed Subcontractors or Suppliers.

ARTICLE 20 – BONDS AND INSURANCE

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

ARTICLE 21 – SIGNING OF AGREEMENT

21.01 When Owner issues a Notice of Award to the Successful Bidder, it shall be accompanied by the unexecuted counterparts of the Agreement along with the other Contract Documents as identified in the Agreement. Within fifteen (15) calendar days thereafter, Successful Bidder shall execute and deliver the required number of counterparts of the Agreement (and any bonds and insurance documentation required to be delivered by the Contract Documents) to Owner. Within ten (10) calendar days thereafter, Owner shall deliver one fully executed counterpart of the Agreement to Successful Bidder, together with printed and electronic copies of the Contract Documents as stated in Paragraph 2.02 of the General Conditions.

ARTICLE 22 – SALES AND USE TAXES

22.01 Owner is exempt from Texas state sales and use taxes on materials and equipment to be incorporated in the Work. Owner will furnish the required certificates of tax exemption to Contractor. Said taxes shall not be included in the Bid. Refer to Paragraph SC-7.09 of the Supplementary Conditions for additional information.

ARTICLE 23 – CONTRACTS TO BE ASSIGNED

23.01 None.

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SECTION 00303

BIDDER'S QUESTIONNAIRE

The following information is required for evaluation of the low Bidder's qualifications and experience.

Complete this form and return it with your Proposal.

1. Bidder Name: _____

2. Years in business under present business name: _____

3. Attach a list of five similar projects completed in the past five years. Provide the name of Owner for each project and include the name and telephone number of the contact person for each Owner. Also, include a description of the project.

4. Have you ever failed to complete any work awarded to you in the last year?
   No _____ Yes _____ If yes, explain: _____
   _____
   _____

5. Are you presently involved in any litigation or lawsuits involving construction work of any type?
   No _____ Yes _____ If yes, explain: _____
   _____
   _____

6. Identify the individuals you proposed to serve in the following functions and list the project and contract value of the most recent project they served in the same capacity on:
   Project Superintendent: _____
   Project Driller: _____

7. Identify your bonding company/agent: _____
   Contact Person: _____ Phone: _____

8. Volume of gross construction business during the last three years:
   2013 $ _____
   2014 $ _____
   2015 $ _____

9. Has the company received an OSHA citation during the most recent 12 months?
   No _____ Yes _____ If yes, explain: _____
   _____
   _____

THIS FORM MUST BE RETURNED WITH YOUR PROPOSAL

END OF SECTION

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SECTION C-410-BID FORM
FOR CONSTRUCTION CONTRACTS

Prepared by

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NOTE: EJCDC publications may be purchased at www.ejcdc.org, or from any of the sponsoring organizations above.

BID FORM

Well #6 at Sam Bass Field

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ARTICLE 1 – BID RECIPIENT

1.01 This Bid is submitted to:

Brushy Creek Municipal Utility District

16318 Great Oaks Drive

Round Rock, TX 78681

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

ARTICLE 2 – BIDDER'S ACKNOWLEDGEMENTS

2.01 Bidder accepts all of the terms and conditions of the Instructions to Bidders, including without limitation those dealing with the disposition of Bid security. This Bid will remain subject to acceptance for sixty (60) calendar days after the Bid opening, or for such longer period of time that Bidder may agree to in writing upon request of Owner.

2.02 BIDDER will sign and deliver the required number of counterparts of the AGREEMENT with the Bonds and other documents required by the Bidding Requirements within fifteen (15) calendar days after the date of OWNER's Notice of Award.

ARTICLE 3 – BIDDER'S REPRESENTATIONS

3.01 In submitting this Bid, Bidder represents that:

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

Addendum No.	Addendum, Date

B. Bidder has visited the Site, conducted a thorough, alert visual examination of the Site and adjacent areas, and become familiar with and satisfied itself as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.

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

D. Bidder has carefully studied reports of explorations and tests of subsurface conditions at or adjacent to the Site.

E. Bidder has considered the information known to Bidder itself; information commonly known to contractors doing business in the locality of the Site; information and

observations obtained from visits to the Site; the Bidding Documents; and any Site-related reports and drawings identified in the Bidding Documents.

F. Bidder agrees, based on the information and observations referred to in the preceding paragraph, that no further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of this Bid for performance of the Work at the price bid and within the times required, and in accordance with the other terms and conditions of the Bidding Documents.

G. Bidder is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents.

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

I. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance and furnishing of the Work.

J. The submission of this Bid constitutes an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article, and that without exception the Bid and all prices in the Bid are premised upon performing and furnishing the Work required by the Bidding Documents.

ARTICLE 4 – BIDDER'S CERTIFICATION

4.01 Bidder certifies that:

A. This Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any collusive agreement or rules of any group, association, organization, or corporation;

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

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

D. Bidder has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract. For the purposes of this Paragraph 4.01.D:

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

2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process to the detriment of Owner, (b) to establish bid prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;

3. "collusive practice" means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish bid prices at artificial, non-competitive levels; and

4. "coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the e execution of the Contract.

ARTICLE 5 – BASIS OF BID

5.01 The bid includes: (1) a Base Bid for a project with a nominal 1,000 gallon per minute (gpm) well, (2) a Bid Deduct for a nominal 600 gpm well, and (3) a Bid Deduct for a nominal 300 gpm well. An Alternative Bid is included in case the planned well's expected production is less than a target minimum discharge rate.

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

Bid Item	Description	Quantity	Units	Unit Price	Total Price
BASE BID					
1	**Mobilization, Drilling Rig Setup**: Mobilizing equipment and supplies to Site in preparation to Work (maximum 5% of total bid).	1	LS		
2	**Drill Pilot Test Hole and Log:** Drill a nominal 7 IN pilot test hole and run geophysical logs. Planning depth is 180 ft.	180	LF		
3	**Ream Pilot Test Hole and Set Casing**: Ream test hole to nominal 20 IN, install 16 IN Steel Casing, and Grout. Planning depth is 60 ft.	60	LF		
4	**Ream Pilot Test Hole to Total Depth**: Ream test hole to nominal 16 IN from bottom of casing to total depth. Planning Length of ream is 90 ft.	90	LF		
5	**Well Development, Performance Testing, and Disinfection:** Develop well for at least 4 HRS. Install and operate test pump for 6 HR step pumping test. Measure water levels. Disinfect well.	1	LS		
6	**Install Submersible Pump and Motor, Discharge Column, PVC Water Level Monitoring Tube, Electrical Cables, Concrete Pad, Well Head, Connection to Pipeline at First Bend Below Ground, and Conduct Pumping Test and Collect Water Samples**: The equipment is designed is for a 1,000 gpm well. Well head extends to the discharge piping including surface valves and meters to the first bend below grade. Pumping test is	1	LS		

	for 36 HRS at a design capacity. Collect water samples.				
7	**Install Pipeline and Make Connection to Existing Collection Pipeline:** Includes trench safety, asphalt repair.	1	LF		
8	**Electrical:** Includes running underground power line from power pole to power panel, running underground power to well motor, and ductbank to SCADA interface at Well#3.	1	LS		
9	**Chain Link Fence, Barb Wire Fence and Gate**	1	LS		
10	**All –Weather Access Road**	1	LS		
11	**Final Clean-up, Grading and Restoration**	1	LS		
12	**Silt Fence**	1	LF		
13	**Contract Administration, Driller Report, and Reporting:** Includes preparing and submitting drillers report, and preparing and submitting well data and pumping test data to Engineer.	1	LS		
Total Amount for Base Bid					
DEDUCTION FOR Base Bid Item 6					
6a	**Reduce Size of Vertical Turbine, Submersible Electric Motor, Discharge Column, and Well Head Components:** The reduction in size is for 600 gpm well instead of a 1,000 gpm well in the Base Bid. All other bid items are unchanged.	1	LS		
Total Amount for Deduction 6a					
DEDUCTION FOR Base Bid Item 6					
6b	**Reduce Size of Vertical Turbine, Submersible Electric Motor, Discharge Column, and Well Head Components:** The reduction in size is for 300 gpm well instead of a 1,000 gpm well in the Base Bid. All other bid items are unchanged.	1	LS		

Total Amount for Deduction 6b					
ALTERNATIVE BID					
A.1	**Mobilization and Drilling Rig Setup**: Mobilizing equipment and supplies to Site in preparation to Work.	1	LS		
A.2	**Drill Pilot Test Hole and Log:** Drill a nominal 7 IN pilot test hole and run geophysical logs. Planning depth is 180 ft.	180	LF		
A.3	**Plug Test Hole with Grout with Gravel Pack thru Edwards Section**	1	LS		
A.4	**Final Clean-up, Grading and Restoration**	1	LS		
A.5	**Contract Administration, Driller Report, and Reporting:** Includes preparing and submitting drillers report, and preparing and submitting well data and pumping test data to Engineer.	1	LS		
Total Amount for Alternative Bid					

ARTICLE 6 – TIME OF COMPLETION

6.01 Bidder agrees that the Work will be substantially complete and will be completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions on or before the dates or within the number of calendar days indicated in the Agreement.

6.02 Bidder accepts the provisions of the Agreement as to liquidated damages.

ARTICLE 7 – ATTACHMENTS TO THIS BID

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

A. Required Bid security;

B. List of Proposed Subcontractors;

C. List of Proposed Suppliers;

D. Evidence of authority to do business in the state of the Project; or a written covenant to obtain such license within the time for acceptance of Bids;

E. Description of proposed control of drilling fluids, cuttings and other than clean water; and

F. Contractor's License No.

ARTICLE 8 – DEFINED TERMS

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

ARTICLE 9 – BID SUBMITTAL

BIDDER:

_____

By:
[Signature] _____

[Printed name] _____

Attest:
[Signature] _____

[Printed name] _____

Title: _____

Submittal Date: _____

Address for giving notices:

_____

_____

_____

Telephone Number: _____

Fax Number: _____

Contact Name and e-mail address: _____

_____

Bidder's License No.: _____
(where applicable)

SECTION C-430-BID BOND

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

BIDDER *(Name and Address)*:

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

OWNER *(Name and Address)*:

BID

Bid Due Date:

Description *(Project Name— Include Location)*:

BOND

Bond Number:

Date:

Penal sum _____ $ _____

(Words) (Figures)

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

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

Note: Addresses are to be used for giving any required notice.
Provide execution by any additional parties, such as joint venturers, if necessary.

1. Bidder and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to pay to Owner upon default of Bidder the penal sum set forth on the face of this Bond. Payment of the penal sum is the extent of Bidder's and Surety's liability. Recovery of such penal sum under the terms of this Bond shall be Owner's sole and exclusive remedy upon default of Bidder.

2. Default of Bidder shall occur upon the failure of Bidder to deliver within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents.

3. This obligation shall be null and void if:

3.1 Owner accepts Bidder's Bid and Bidder delivers within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents, or

3.2 All Bids are rejected by Owner, or

3.3 Owner fails to issue a Notice of Award to Bidder within the time specified in the Bidding Documents (or any extension thereof agreed to in writing by Bidder and, if applicable, consented to by Surety when required by Paragraph 5 hereof).

4. Payment under this Bond will be due and payable upon default of Bidder and within thirty (30) calendar days after receipt by Bidder and Surety of written notice of default from Owner, which notice will be given with reasonable promptness, identifying this Bond and the Project and including a statement of the amount due.

5. Surety waives notice of any and all defenses based on or arising out of any time extension to issue Notice of Award agreed to in writing by Owner and Bidder, provided that the total time for issuing Notice of Award including extensions shall not in the aggregate exceed one hundred twenty (120) calendar days from the Bid due date without Surety's written consent.

6. No suit or action shall be commenced under this Bond prior to thirty (30) calendar days after the notice of default required in Paragraph 4 above is received by Bidder and Surety and in no case later than one year after the Bid due date.

7. Any suit or action under this Bond shall be commenced only in a court of competent jurisdiction located in the state in which the Project is located.

8. Notices required hereunder shall be in writing and sent to Bidder and Surety at their respective addresses shown on the face of this Bond. Such notices may be sent by personal delivery, commercial courier, or by United States Registered or Certified Mail, return receipt requested, postage pre-paid, and shall be deemed to be effective upon receipt by the party concerned.

9. Surety shall cause to be attached to this Bond a current and effective Power of Attorney evidencing the authority of the officer, agent, or representative who executed this Bond on behalf of Surety to execute, seal, and deliver such Bond and bind the Surety thereby.

10. This Bond is intended to conform to all applicable statutory requirements. Any applicable requirement of any applicable statute that has been omitted from this Bond shall be deemed to be included herein as if set forth at length. If any provision of this Bond conflicts with any applicable statute, then the provision of said statute shall govern and the remainder of this Bond that is not in conflict therewith shall continue in full force and effect.

11. The term "Bid" as used herein includes a Bid, offer, or proposal as applicable.

SECTION C-520-AGREEMENT
BETWEEN OWNER AND CONTRACTOR FOR
CONSTRUCTION CONTRACT (STIPULATED PRICE)

Prepared by

EJCDC®
ENGINEERS JOINT CONTRACT
DOCUMENTS COMMITTEE

Issued and Published Jointly by

ACEC
American Council of Engineering Companies

ASCE
American Society of Civil Engineers

National Society of
Professional Engineers®

AGREEMENT
BETWEEN OWNER AND CONTRACTOR
FOR CONSTRUCTION CONTRACT (STIPULATED PRICE)

THIS AGREEMENT is by and between Brushy Creek Municipal Utility District ("Owner") and _____ ("Contractor").

Owner and Contractor hereby agree as follows:

ARTICLE 1 – WORK

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

ARTICLE 2 – THE PROJECT

2.01 The Project, of which the Work under the Contract Documents is a part, is generally described as follows: Construction of Well#6 in the vicinity of the Sam Bass Road Well Field

ARTICLE 3 – ENGINEER

3.01 The part of the Project that pertains to the Work has been designed by HDR Engineering, Inc, 4401 West Gate Blvd, Suite 400, Austin, TX 78745.

3.02 The Owner has retained HDR Engineering, Inc. ("Engineer") to act as Owner's representative, assume all duties and responsibilities, and have the rights and authority assigned to Engineer in the Contract Documents in connection with the completion of the Work in accordance with the Contract Documents.

ARTICLE 4 – CONTRACT TIMES

4.01 *Time of the Essence*

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

4.02 *Contract Times: Calendar Days*

A. The Work will be substantially completed within seventy-five (75) calendar days 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 ninty (90) calendar days after the date when the Contract Times commence to run. Substantially completed and completed times will be extended in the event of unusual delays in deliveries of equipment such as pumps, motors and valves.

4.03 *Liquidated Damages*

A. Contractor and Owner recognize that time is of the essence as stated in Paragraph 4.01 above and that Owner will suffer financial and other losses if the Work is not completed and Milestones not achieved within the times specified in Paragraph 4.02 above, plus any

extensions thereof allowed in accordance with the Contract. The parties also recognize the delays, expense, and difficulties involved in proving in a legal 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 $200 for each day that expires after the time (as duly adjusted pursuant to the Contract) specified in Paragraph 4.02.A above for Substantial Completion until the Work is substantially complete.

2. Completion of Remaining Work: After Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Times (as duly adjusted pursuant to the Contract) for completion and readiness for final payment, Contractor shall pay Owner $200 for each day that expires after such time until the Work is completed and ready for final payment.

3. Liquidated damages for failing to timely attain Substantial Completion and final completion are not additive and will not be imposed concurrently.

4.04 *Special Damages*

A. In addition to the amount provided for liquidated damages, 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.

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, 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 account of the Contract Price on the basis of Contractor's Applications for Payment on or about the last 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.

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. Ninety (90) percent of Work completed (with the balance being retainage). If the Work has been 50 percent 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. Ninety (90) 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 ninety (90) percent of the Work completed, less such amounts set off by Owner pursuant to Paragraph 15.01.E of the General Conditions, and less ninety (90) 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 in accordance with Paragraph 15.06 of the General Conditions, Owner shall pay the remainder of the Contract Price as recommended by Engineer as provided in said Paragraph 15.06.

ARTICLE 7 – INTEREST

7.01 All amounts not paid when due shall bear interest at the rate of 5 percent per annum.

ARTICLE 8 – CONTRACTOR'S REPRESENTATIONS

8.01 In order to induce Owner to enter into this Contract, Contractor makes the following representations:

A. Contractor has examined and carefully studied the Contract Documents, and any data and reference items identified in the Contract Documents.

B. Contractor has visited the Site, conducted a thorough, alert visual examination of the Site and adjacent areas, and become familiar with and is satisfied as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.

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

D. Contractor has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or adjacent to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings, and (2) reports and drawings relating to Hazardous Environmental Conditions, if

any, at or adjacent to the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings.

E. Contractor has considered the information known to Contractor itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Contract Documents; and the Site-related reports and drawings identified in the Contract Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor; and (3) Contractor's safety precautions and programs.

F. Based on the information and observations referred to in the preceding paragraph, Contractor agrees that no further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract.

G. Contractor is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Contract Documents.

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

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

J. Contractor's entry into this Contract constitutes an incontrovertible representation by Contractor that without exception all prices in the Agreement are premised upon performing and furnishing the Work required by the Contract Documents.

ARTICLE 9 – CONTRACT DOCUMENTS

9.01 *Contents*

A. The Contract Documents consist of the following:

1. This Agreement (pages 1 to ___, inclusive).
2. Performance bond (pages ____to ____inclusive).
3. General Conditions (pages ____to ___, inclusive).
4. Specifications and Drawings.
5. Addenda (numbers ___ to ___, inclusive).
6. Exhibits to this Agreement (enumerated as follows):
    a. Contractor's Bid (pages ___ to ___, inclusive).
7. The following which may be delivered or issued on or after the Effective Date of the Contract and are not attached hereto:
    a. Notice to Proceed.
    b. Work Change Directives.
    c. Change Orders.
    d. Field Orders.

B. The documents listed in Paragraph 9.01.A are attached to this Agreement (except as expressly noted otherwise above).

C. There are no Contract Documents other than those listed above in this Article 9.

D. The Contract Documents may only be amended, modified, or supplemented as provided in the General Conditions.

ARTICLE 10 – MISCELLANEOUS

10.01 *Terms*

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

10.02 *Assignment of Contract*

A. Unless expressly agreed to elsewhere in the Contract, no assignment by a party hereto of any rights under or interests in the Contract will be binding on another party hereto 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 Documents.

10.03 *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.

10.04 *Severability*

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

10.05 *Contractor's Certifications*

A. Contractor certifies that it has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for or in executing the Contract. For the purposes of this Paragraph 10.05:

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

2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process or the execution of the Contract to the detriment of Owner, (b) to establish Bid or Contract prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;

3. "collusive practice" means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish Bid prices at artificial, non-competitive levels; and

4. "coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

10.06 *Other Provisions*

A. Owner stipulates that if the General Conditions that are made a part of this Contract are based on EJCDC® C-700, Standard General Conditions for the Construction Contract, 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 _____ (which is the Effective Date of the Contract).

OWNER:	CONTRACTOR:
_____	_____
By: _____	By: _____
Title: _____	Title: _____
	(If Contractor is a corporation, a partnership, or a joint venture, attach evidence of authority to sign.)
Attest: _____	Attest: _____
Title: _____	Title: _____
Address for giving notices:	Address for giving notices:
_____	_____
_____	_____
_____	_____
	License No.: _____ *(where applicable)*
(If Owner is a corporation, attach evidence of authority to sign. If Owner is a public body, attach evidence of authority to sign and resolution or other documents authorizing execution of this Agreement.)	*NOTE TO USER: Use in those states or other jurisdictions where applicable or required.*

1 THIS PAGE INTENTIONALLY LEFT BLANK

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

EJCDC®
ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

Issued and Published Jointly by

ACEC
AMERICAN COUNCIL OF ENGINEERING COMPANIES

ASCE
AMERICAN SOCIETY OF CIVIL ENGINEERS

National Society of Professional Engineers®

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

To prepare supplementary conditions that are coordinated with the General Conditions, use EJCDC's Guide to the Preparation of Supplementary Conditions (EJCDC® C-800, 2013 Edition). The full EJCDC Construction series of documents is discussed in the Commentary on the 2013 EJCDC Construction Documents (EJCDC® C-001, 2013 Edition).

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STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

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ARTICLE 1 – DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

A. Wherever used in the Bidding Requirements or Contract Documents, a term printed with initial capital letters, including the term's singular and plural forms, will have the meaning indicated in the definitions below. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.

1. *Addenda*—Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the proposed Contract Documents.

2. *Agreement*—The written instrument, executed by Owner and Contractor, that sets forth the Contract Price and Contract Times, identifies the parties and the Engineer, and designates the specific items that are Contract Documents.

3. *Application for Payment*—The form acceptable to Engineer which is to be used by Contractor during the course of the Work in requesting progress or final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.

4. *Bid*—The offer of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

5. *Bidder*—An individual or entity that submits a Bid to Owner.

6. *Bidding Documents*—The Bidding Requirements, the proposed Contract Documents, and all Addenda.

7. *Bidding Requirements*—The advertisement or invitation to bid, Instructions to Bidders, Bid Bond or other Bid security, if any, the Bid Form, and the Bid with any attachments.

8. *Change Order*—A document which is signed by Contractor and Owner and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, or other revision to the Contract, issued on or after the Effective Date of the Contract.

9. *Change Proposal*—A written request by Contractor, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment in Contract Price or Contract Times, or both; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; challenging a set-off against payments due; or seeking other relief with respect to the terms of the Contract.

10. *Claim*—(a) A demand or assertion by Owner directly to Contractor, duly submitted in compliance with the procedural requirements set forth herein: seeking an adjustment of Contract Price or Contract Times, or both; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; contesting Engineer's decision regarding a Change Proposal; seeking resolution of a contractual issue that Engineer has declined to address; or seeking other relief with respect to the terms of the Contract; or (b) a demand or assertion by Contractor directly to Owner, duly submitted in compliance with the procedural requirements set forth herein, contesting Engineer's decision regarding a Change Proposal; or seeking resolution of a contractual issue that Engineer

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

11. *Constituent of Concern*—Asbestos, petroleum, radioactive materials, polychlorinated biphenyls (PCBs), hazardous waste, and any substance, product, waste, or other material of any nature whatsoever that is or becomes listed, regulated, or addressed pursuant to (a) the Comprehensive Environmental Response, Compensation and Liability Act, 42 U.S.C. §§9601 et seq. ("CERCLA"); (b) the Hazardous Materials Transportation Act, 49 U.S.C. §§5101 et seq.; (c) the Resource Conservation and Recovery Act, 42 U.S.C. §§6901 et seq. ("RCRA"); (d) the Toxic Substances Control Act, 15 U.S.C. §§2601 et seq.; (e) the Clean Water Act, 33 U.S.C. §§1251 et seq.; (f) the Clean Air Act, 42 U.S.C. §§7401 et seq.; or (g) any other federal, state, or local statute, law, rule, regulation, ordinance, resolution, code, order, or decree regulating, relating to, or imposing liability or standards of conduct concerning, any hazardous, toxic, or dangerous waste, substance, or material.

12. *Contract*—The entire and integrated written contract between the Owner and Contractor concerning the Work.

13. *Contract Documents*—Those items so designated in the Agreement, and which together comprise the Contract.

14. *Contract Price*—The money that Owner has agreed to pay Contractor for completion of the Work in accordance with the Contract Documents. .

15. *Contract Times*—The number of days or the dates by which Contractor shall: (a) achieve Milestones, if any; (b) achieve Substantial Completion; and (c) complete the Work.

16. *Contractor*—The individual or entity with which Owner has contracted for performance of the Work.

17. *Cost of the Work*—See Paragraph 13.01 for definition.

18. *Drawings*—The part of the Contract that graphically shows the scope, extent, and character of the Work to be performed by Contractor.

19. *Effective Date of the Contract*—The date, indicated in the Agreement, on which the Contract becomes effective.

20. *Engineer*—The individual or entity named as such in the Agreement.

21. *Field Order*—A written order issued by Engineer which requires minor changes in the Work but does not change the Contract Price or the Contract Times.

22. *Hazardous Environmental Condition*—The presence at the Site of Constituents of Concern in such quantities or circumstances that may present a danger to persons or property exposed thereto. The presence at the Site of materials that are necessary for the execution of the Work, or that are to be incorporated in the Work, and that are controlled and contained pursuant to industry practices, Laws and Regulations, and the requirements of the Contract, does not establish a Hazardous Environmental Condition.

23. *Laws and Regulations; Laws or Regulations*—Any and all applicable laws, statutes, rules, regulations, ordinances, codes, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.

24. *Liens*—Charges, security interests, or encumbrances upon Contract-related funds, real property, or personal property.

25. *Milestone*—A principal event in the performance of the Work that the Contract requires Contractor to achieve by an intermediate completion date or by a time prior to Substantial Completion of all the Work.

26. *Notice of Award*—The written notice by Owner to a Bidder of Owner's acceptance of the Bid.

27. *Notice to Proceed*—A written notice by Owner to Contractor fixing the date on which the Contract Times will commence to run and on which Contractor shall start to perform the Work.

28. *Owner*—The individual or entity with which Contractor has contracted regarding the Work, and which has agreed to pay Contractor for the performance of the Work, pursuant to the terms of the Contract.

29. *Progress Schedule*—A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising the Contractor's plan to accomplish the Work within the Contract Times.

30. *Project*—The total undertaking to be accomplished for Owner by engineers, contractors, and others, including planning, study, design, construction, testing, commissioning, and start-up, and of which the Work to be performed under the Contract Documents is a part.

31. *Project Manual*—The written documents prepared for, or made available for, procuring and constructing the Work, including but not limited to the Bidding Documents or other construction procurement documents, geotechnical and existing conditions information, the Agreement, bond forms, General Conditions, Supplementary Conditions, and Specifications. The contents of the Project Manual may be bound in one or more volumes.

32. *Resident Project Representative*—The authorized representative of Engineer assigned to assist Engineer at the Site. As used herein, the term Resident Project Representative or "RPR" includes any assistants or field staff of Resident Project Representative.

33. *Samples*—Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and that establish the standards by which such portion of the Work will be judged.

34. *Schedule of Submittals*—A schedule, prepared and maintained by Contractor, of required submittals and the time requirements for Engineer's review of the submittals and the performance of related construction activities.

35. *Schedule of Values*—A schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

36. *Shop Drawings*—All drawings, diagrams, illustrations, schedules, and other data or information that are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work. Shop Drawings, whether approved or not, are not Drawings and are not Contract Documents.

37. *Site*—Lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements, and such other lands furnished by Owner which are designated for the use of Contractor.

38. *Specifications*—The part of the Contract that consists of written requirements for materials, equipment, systems, standards, and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable to the Work.

39. *Subcontractor*—An individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work.

40. *Substantial Completion*—The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion thereof.

41. *Successful Bidder*—The Bidder whose Bid the Owner accepts, and to which the Owner makes an award of contract, subject to stated conditions.

42. *Supplementary Conditions*—The part of the Contract that amends or supplements these General Conditions.

43. *Supplier*—A manufacturer, fabricator, supplier, distributor, materialman, or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or a Subcontractor.

44. *Technical Data*—Those items expressly identified as Technical Data in the Supplementary Conditions, with respect to either (a) subsurface conditions at the Site, or physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities) or (b) Hazardous Environmental Conditions at the Site. If no such express identifications of Technical Data have been made with respect to conditions at the Site, then the data contained in boring logs, recorded measurements of subsurface water levels, laboratory test results, and other factual, objective information regarding conditions at the Site that are set forth in any geotechnical or environmental report prepared for the Project and made available to Contractor are hereby defined as Technical Data with respect to conditions at the Site under Paragraphs 5.03, 5.04, and 5.06.

45. *Underground Facilities*—All underground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments, and any encasements containing such facilities, including but not limited to those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, fiber optic transmissions, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other control systems.

46. *Unit Price Work*—Work to be paid for on the basis of unit prices.

47. *Work*—The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction; furnishing, installing, and incorporating all materials and equipment into such construction; and may include related services such as testing, start-up, and commissioning, all as required by the Contract Documents.

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

1.02 *Terminology*

A. The words and terms discussed in the following paragraphs are not defined but, when used in the Bidding Requirements or Contract Documents, have the indicated meaning.

B. *Intent of Certain Terms or Adjectives*:

1. The Contract Documents include the terms "as allowed," "as approved," "as ordered," "as directed" or terms of like effect or import to authorize an exercise of professional judgment by Engineer. In addition, the adjectives "reasonable," "suitable," "acceptable," "proper," "satisfactory," or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Work. It is intended that such exercise of professional judgment, action, or determination will be solely to evaluate, in general, the Work for compliance with the information in the Contract Documents and with the design concept of the Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective is not intended to and shall not be effective to assign to Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility contrary to the provisions of Article 10 or any other provision of the Contract Documents.

C. *Day*:

1. The word "day" means a calendar day of 24 hours measured from midnight to the next midnight.

D. *Defective*:

1. The word "defective," when modifying the word "Work," refers to Work that is unsatisfactory, faulty, or deficient in that it:

a. does not conform to the Contract Documents; or

b. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents; or

c. has been damaged prior to Engineer's recommendation of final payment (unless responsibility for the protection thereof has been assumed by Owner at Substantial Completion in accordance with Paragraph 15.03 or 15.04).

E. *Furnish, Install, Perform, Provide*:

1. The word "furnish," when used in connection with services, materials, or equipment, shall mean to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.

2. The word "install," when used in connection with services, materials, or equipment, shall mean to put into use or place in final position said services, materials, or equipment complete and ready for intended use.

3. The words “perform” or “provide,” when used in connection with services, materials, or equipment, shall mean to furnish and install said services, materials, or equipment complete and ready for intended use.

4. If the Contract Documents establish an obligation of Contractor with respect to specific services, materials, or equipment, but do not expressly use any of the four words “furnish,” “install,” “perform,” or “provide,” then Contractor shall furnish and install said services, materials, or equipment complete and ready for intended use.

F. Unless stated otherwise in the Contract Documents, words or phrases that have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

ARTICLE 2 – PRELIMINARY MATTERS

2.01 *Delivery of Bonds and Evidence of Insurance*

A. *Bonds*: When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner such bonds as Contractor may be required to furnish.

B. *Evidence of Contractor’s Insurance*: When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner, with copies to each named insured and additional insured (as identified in the Supplementary Conditions or elsewhere in the Contract), the certificates and other evidence of insurance required to be provided by Contractor in accordance with Article 6.

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

2.02 *Copies of Documents*

A. Owner shall furnish to Contractor four printed copies of the Contract (including one fully executed counterpart of the Agreement), and one copy in electronic portable document format (PDF). Additional printed copies will be furnished upon request at the cost of reproduction.

B. Owner shall maintain and safeguard at least one original printed record version of the Contract, including Drawings and Specifications signed and sealed by Engineer and other design professionals. Owner shall make such original printed record version of the Contract available to Contractor for review. Owner may delegate the responsibilities under this provision to Engineer.

2.03 *Before Starting Construction*

A. *Preliminary Schedules*: Within 10 days after the Effective Date of the Contract (or as otherwise specifically required by the Contract Documents), Contractor shall submit to Engineer for timely review:

1. a preliminary Progress Schedule indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract;

2. a preliminary Schedule of Submittals; and

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

2.04 *Preconstruction Conference; Designation of Authorized Representatives*

A. Before any Work at the Site is started, a conference attended by Owner, Contractor, Engineer, and others as appropriate will be held to establish a working understanding among the parties as to the Work and to discuss the schedules referred to in Paragraph 2.03.A, procedures for handling Shop Drawings, Samples, and other submittals, processing Applications for Payment, electronic or digital transmittals, and maintaining required records.

B. At this conference Owner and Contractor each shall designate, in writing, a specific individual to act as its authorized representative with respect to the services and responsibilities under the Contract. Such individuals shall have the authority to transmit and receive information, render decisions relative to the Contract, and otherwise act on behalf of each respective party.

2.05 *Initial Acceptance of Schedules*

A. At least 10 days before submission of the first Application for Payment a conference, attended by Contractor, Engineer, and others as appropriate, will be held to review for acceptability to Engineer as provided below the schedules submitted in accordance with Paragraph 2.03.A. Contractor shall have an additional 10 days to make corrections and adjustments and to complete and resubmit the schedules. No progress payment shall be made to Contractor until acceptable schedules are submitted to Engineer.

1. The Progress Schedule will be acceptable to Engineer if it provides an orderly progression of the Work to completion within the Contract Times. Such acceptance will not impose on Engineer responsibility for the Progress Schedule, for sequencing, scheduling, or progress of the Work, nor interfere with or relieve Contractor from Contractor's full responsibility therefor.

2. Contractor's Schedule of Submittals will be acceptable to Engineer if it provides a workable arrangement for reviewing and processing the required submittals.

3. Contractor's Schedule of Values will be acceptable to Engineer as to form and substance if it provides a reasonable allocation of the Contract Price to the component parts of the Work.

2.06 *Electronic Transmittals*

A. Except as otherwise stated elsewhere in the Contract, the Owner, Engineer, and Contractor may transmit, and shall accept, Project-related correspondence, text, data, documents, drawings, information, and graphics, including but not limited to Shop Drawings and other submittals, in electronic media or digital format, either directly, or through access to a secure Project website.

B. If the Contract does not establish protocols for electronic or digital transmittals, then Owner, Engineer, and Contractor shall jointly develop such protocols.

C. When transmitting items in electronic media or digital format, the transmitting party makes no representations as to long term compatibility, usability, or readability of the items resulting from the recipient's use of software application packages, operating systems, or

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

ARTICLE 3 – DOCUMENTS: INTENT, REQUIREMENTS, REUSE

3.01 *Intent*

A. The Contract Documents are complementary; what is required by one is as binding as if required by all.

B. It is the intent of the Contract Documents to describe a functionally complete project (or part thereof) to be constructed in accordance with the Contract Documents.

C. Unless otherwise stated in the Contract Documents, if there is a discrepancy between the electronic or digital versions of the Contract Documents (including any printed copies derived from such electronic or digital versions) and the printed record version, the printed record version shall govern.

D. The Contract supersedes prior negotiations, representations, and agreements, whether written or oral.

E. Engineer will issue clarifications and interpretations of the Contract Documents as provided herein.

3.02 *Reference Standards*

A. Standards Specifications, Codes, Laws and Regulations

1. Reference in the Contract Documents to standard specifications, manuals, reference standards, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, shall mean the standard specification, manual, reference standard, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Contract if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.

2. No provision of any such standard specification, manual, reference standard, or code, or any instruction of a Supplier, shall be effective to change the duties or responsibilities of Owner, Contractor, or Engineer, or any of their subcontractors, consultants, agents, or employees, from those set forth in the part of the Contract Documents prepared by or for Engineer. No such provision or instruction shall be effective to assign to Owner, Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the part of the Contract Documents prepared by or for Engineer.

3.03 *Reporting and Resolving Discrepancies*

A. *Reporting Discrepancies*:

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

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

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

3. Contractor shall not be liable to Owner or Engineer for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless Contractor had actual knowledge thereof.

B. *Resolving Discrepancies*:

1. Except as may be otherwise specifically stated in the Contract Documents, the provisions of the part of the Contract Documents prepared by or for Engineer shall take precedence in resolving any conflict, error, ambiguity, or discrepancy between such provisions of the Contract Documents and:

a. the provisions of any standard specification, manual, reference standard, or code, or the instruction of any Supplier (whether or not specifically incorporated by reference as a Contract Document); or

b. the provisions of any Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

3.04 *Requirements of the Contract Documents*

A. During the performance of the Work and until final payment, Contractor and Owner shall submit to the Engineer all matters in question concerning the requirements of the Contract Documents (sometimes referred to as requests for information or interpretation—RFIs), or relating to the acceptability of the Work under the Contract Documents, as soon as possible after such matters arise. Engineer will be the initial interpreter of the requirements of the Contract Documents, and judge of the acceptability of the Work thereunder.

B. Engineer will, with reasonable promptness, render a written clarification, interpretation, or decision on the issue submitted, or initiate an amendment or supplement to the Contract Documents. Engineer's written clarification, interpretation, or decision will be final and binding on Contractor, unless it appeals by submitting a Change Proposal, and on Owner, unless it appeals by filing a Claim.

C. If a submitted matter in question concerns terms and conditions of the Contract Documents that do not involve (1) the performance or acceptability of the Work under the Contract Documents, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, then Engineer will promptly give written notice to Owner and Contractor that Engineer is unable to provide a decision or interpretation. If Owner and Contractor are unable to agree on resolution of such a matter in question, either party may pursue resolution as provided in Article 12.

3.05 *Reuse of Documents*

A. Contractor and its Subcontractors and Suppliers shall not:

1. have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or its consultants, including electronic media editions, or reuse any such Drawings, Specifications, other documents, or copies thereof on extensions of the Project or any other project without written consent of Owner and Engineer and specific written verification or adaptation by Engineer; or

2. have or acquire any title or ownership rights in any other Contract Documents, reuse any such Contract Documents for any purpose without Owner's express written consent, or violate any copyrights pertaining to such Contract Documents.

B. The prohibitions of this Paragraph 3.05 will survive final payment, or termination of the Contract. Nothing herein shall preclude Contractor from retaining copies of the Contract Documents for record purposes.

ARTICLE 4 – COMMENCEMENT AND PROGRESS OF THE WORK

4.01 *Commencement of Contract Times; Notice to Proceed*

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

4.02 *Starting the Work*

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

4.03 *Reference Points*

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

4.04 *Progress Schedule*

A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.05 as it may be adjusted from time to time as provided below.

1. Contractor shall submit to Engineer for acceptance (to the extent indicated in Paragraph 2.05) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times.

2. Proposed adjustments in the Progress Schedule that will change the Contract Times shall be submitted in accordance with the requirements of Article 11.

B. Contractor shall carry on the Work and adhere to the Progress Schedule during all disputes or disagreements with Owner. No Work shall be delayed or postponed pending resolution of any disputes or disagreements, or during any appeal process, except as permitted by Paragraph 16.04, or as Owner and Contractor may otherwise agree in writing.

4.05 *Delays in Contractor's Progress*

A. If Owner, Engineer, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in the Contract Times and Contract Price. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.

B. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delay, disruption, or interference caused by or within the control of Contractor. Delay, disruption, and interference attributable to and within the control of a Subcontractor or Supplier shall be deemed to be within the control of Contractor.

C. If Contractor's performance or progress is delayed, disrupted, or interfered with by unanticipated causes not the fault of and beyond the control of Owner, Contractor, and those for which they are responsible, then Contractor shall be entitled to an equitable adjustment in Contract Times. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times. Such an adjustment shall be Contractor's sole and exclusive remedy for the delays, disruption, and interference described in this paragraph. Causes of delay, disruption, or interference that may give rise to an adjustment in Contract Times under this paragraph include but are not limited to the following:

1. severe and unavoidable natural catastrophes such as fires, floods, epidemics, and earthquakes;

2. abnormal weather conditions;

3. acts or failures to act of utility owners (other than those performing other work at or adjacent to the Site by arrangement with the Owner, as contemplated in Article 8); and

4. acts of war or terrorism.

D. Delays, disruption, and interference to the performance or progress of the Work resulting from the existence of a differing subsurface or physical condition, an Underground Facility that was not shown or indicated by the Contract Documents, or not shown or indicated with reasonable accuracy, and those resulting from Hazardous Environmental Conditions, are governed by Article 5.

E. Paragraph 8.03 governs delays, disruption, and interference to the performance or progress of the Work resulting from the performance of certain other work at or adjacent to the Site.

F. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for any delay, disruption, or interference if such delay is concurrent with a delay, disruption, or interference caused by or within the control of Contractor.

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

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

5.01 *Availability of Lands*

A. Owner shall furnish the Site. Owner shall notify Contractor of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work.

B. Upon reasonable written request, Owner shall furnish Contractor with a current statement of record legal title and legal description of the lands upon which permanent improvements are to be made and Owner's interest therein as necessary for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.

C. Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

5.02 *Use of Site and Other Areas*

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

1. Contractor shall confine construction equipment, temporary construction facilities, the storage of materials and equipment, and the operations of workers to the Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and such other adjacent areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for (a) damage to the Site; (b) damage to any such other adjacent areas used for Contractor's operations; (c) damage to any other adjacent land or areas; and (d) for injuries and losses sustained by the owners or occupants of any such land or areas; provided that such damage or injuries result from the performance of the Work or from other actions or conduct of the Contractor or those for which Contractor is responsible.

2. If a damage or injury claim is made by the owner or occupant of any such land or area because of the performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible, Contractor shall (a) take immediate corrective or remedial action as required by Paragraph 7.12, or otherwise; (b) promptly attempt to settle the claim as to all parties through negotiations with such owner or occupant, or otherwise resolve the claim by arbitration or other dispute resolution proceeding, or at law; and (c) to the fullest extent permitted by Laws and Regulations, indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against any such claim, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against Owner, Engineer, or any other party indemnified hereunder to the extent caused directly or indirectly, in whole or in part

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

B. *Removal of Debris During Performance of the Work*: During the progress of the Work the Contractor shall keep the Site and other adjacent areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris shall conform to applicable Laws and Regulations.

C. *Cleaning*: Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the Work Contractor shall remove from the Site and adjacent areas all tools, appliances, construction equipment and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.

D. *Loading of Structures*: Contractor shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall Contractor subject any part of the Work or adjacent structures or land to stresses or pressures that will endanger them.

5.03 *Subsurface and Physical Conditions*

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

1. those reports known to Owner of explorations and tests of subsurface conditions at or adjacent to the Site;

2. those drawings known to Owner of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities); and

3. Technical Data contained in such reports and drawings.

B. *Reliance by Contractor on Technical Data Authorized*: Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely upon the accuracy of the Technical Data (as defined in Article 1) contained in any geotechnical or environmental report prepared for the Project and made available to Contractor. Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto; or

2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or

3. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions, or information.

5.04 *Differing Subsurface or Physical Conditions*

A. *Notice by Contractor*: If Contractor believes that any subsurface or physical condition that is uncovered or revealed at the Site either:

1. is of such a nature as to establish that any Technical Data on which Contractor is entitled to rely as provided in Paragraph 5.03 is materially inaccurate; or

2. is of such a nature as to require a change in the Drawings or Specifications; or

3. differs materially from that shown or indicated in the Contract Documents; or

4. is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents;

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

B. *Engineer's Review*: After receipt of written notice as required by the preceding paragraph, Engineer will promptly review the subsurface or physical condition in question; determine the necessity of Owner's obtaining additional exploration or tests with respect to the condition; conclude whether the condition falls within any one or more of the differing site condition categories in Paragraph 5.04.A above; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding the Contractor's resumption of Work in connection with the subsurface or physical condition in question and the need for any change in the Drawings or Specifications; and advise Owner in writing of Engineer's findings, conclusions, and recommendations.

C. *Owner's Statement to Contractor Regarding Site Condition*: After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the subsurface or physical condition in question, addressing the resumption of Work in connection with such condition, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations, in whole or in part.

D. *Possible Price and Times Adjustments*:

1. Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times, or both, to the extent that the existence of a differing subsurface or physical condition, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:

a. such condition must fall within any one or more of the categories described in Paragraph 5.04.A;

b. with respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03; and,

c. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.

2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times with respect to a subsurface or physical condition if:

a. Contractor knew of the existence of such condition at the time Contractor made a commitment to Owner with respect to Contract Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract, or otherwise; or

b. the existence of such condition reasonably could have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas expressly required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such commitment; or

c. Contractor failed to give the written notice as required by Paragraph 5.04.A.

3. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, or both, then any such adjustment shall be set forth in a Change Order.

4. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, or both, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the subsurface or physical condition in question.

5.05 *Underground Facilities*

A. *Contractor's Responsibilities*: The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or adjacent to the Site is based on information and data furnished to Owner or Engineer by the owners of such Underground Facilities, including Owner, or by others. Unless it is otherwise expressly provided in the Supplementary Conditions:

1. Owner and Engineer do not warrant or guarantee the accuracy or completeness of any such information or data provided by others; and

2. the cost of all of the following will be included in the Contract Price, and Contractor shall have full responsibility for:

a. reviewing and checking all information and data regarding existing Underground Facilities at the Site;

b. locating all Underground Facilities shown or indicated in the Contract Documents as being at the Site;

c. coordination of the Work with the owners (including Owner) of such Underground Facilities, during construction; and

d. the safety and protection of all existing Underground Facilities at the Site, and repairing any damage thereto resulting from the Work.

B. *Notice by Contractor*: If Contractor believes that an Underground Facility that is uncovered or revealed at the Site was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy, then Contractor shall, promptly after

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

C. *Engineer's Review*: Engineer will promptly review the Underground Facility and conclude whether such Underground Facility was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding the Contractor's resumption of Work in connection with the Underground Facility in question; determine the extent, if any, to which a change is required in the Drawings or Specifications to reflect and document the consequences of the existence or location of the Underground Facility; and advise Owner in writing of Engineer's findings, conclusions, and recommendations. During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.

D. *Owner's Statement to Contractor Regarding Underground Facility*: After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the Underground Facility in question, addressing the resumption of Work in connection with such Underground Facility, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations in whole or in part.

E. *Possible Price and Times Adjustments*:

1. Contractor shall be entitled to an equitable adjustment in the Contract Price or Contract Times, or both, to the extent that any existing Underground Facility at the Site that was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:

    a. Contractor did not know of and could not reasonably have been expected to be aware of or to have anticipated the existence or actual location of the Underground Facility in question;

    b. With respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03;

    c. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times; and

    d. Contractor gave the notice required in Paragraph 5.05.B.

2. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, or both, then any such adjustment shall be set forth in a Change Order.

3. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, or both, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the Underground Facility in question.

5.06 *Hazardous Environmental Conditions at Site*

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

1. those reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site; and

2. Technical Data contained in such reports and drawings.

B. *Reliance by Contractor on Technical Data Authorized*: Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely on the accuracy of the Technical Data (as defined in Article 1) contained in any geotechnical or environmental report prepared for the Project and made available to Contractor. Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures of construction to be employed by Contractor and safety precautions and programs incident thereto; or

2. other data, interpretations, opinions and information contained in such reports or shown or indicated in such drawings; or

3. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions or information.

C. Contractor shall not be responsible for removing or remediating any Hazardous Environmental Condition encountered, uncovered, or revealed at the Site unless such removal or remediation is expressly identified in the Contract Documents to be within the scope of the Work.

D. Contractor shall be responsible for controlling, containing, and duly removing all Constituents of Concern brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible, and for any associated costs; and for the costs of removing and remediating any Hazardous Environmental Condition created by the presence of any such Constituents of Concern.

E. If Contractor encounters, uncovers, or reveals a Hazardous Environmental Condition whose removal or remediation is not expressly identified in the Contract Documents as being within the scope of the Work, or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, then Contractor shall immediately: (1) secure or otherwise isolate such condition; (2) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 7.15); and (3) notify Owner and Engineer (and promptly thereafter confirm such notice in writing). Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such condition or take corrective action, if any. Promptly after consulting with Engineer, Owner shall take such actions as are necessary to permit Owner to timely obtain required permits and provide Contractor the written notice required by Paragraph 5.06.F. If Contractor or anyone for whom Contractor is responsible created the Hazardous Environmental Condition in question, then Owner may remove and remediate the Hazardous Environmental Condition, and impose a set-off against payments to account for the associated costs.

F. Contractor shall not resume Work in connection with such Hazardous Environmental Condition or in any affected area until after Owner has obtained any required permits related thereto, and delivered written notice to Contractor either (1) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work, or (2) specifying any special conditions under which such Work may be resumed safely.

G. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, or both, as a result of such Work stoppage or such special conditions under which Work is agreed to be resumed by Contractor, then within 30 days of Owner's written notice regarding the resumption of Work, Contractor may submit a Change Proposal, or Owner may impose a set-off.

H. If after receipt of such written notice Contractor does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special conditions, then Owner may order the portion of the Work that is in the area affected by such condition to be deleted from the Work, following the contractual change procedures in Article 11. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 8.

I. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition (1) was not shown or indicated in the Drawings, Specifications, or other Contract Documents, identified as Technical Data entitled to limited reliance pursuant to Paragraph 5.06.B, or identified in the Contract Documents to be included within the scope of the Work, and (2) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.I shall obligate Owner to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

J. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the failure to control, contain, or remove a Constituent of Concern brought to the Site by Contractor or by anyone for whom Contractor is responsible, or to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.J shall obligate Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

K. The provisions of Paragraphs 5.03, 5.04, and 5.05 do not apply to the presence of Constituents of Concern or to a Hazardous Environmental Condition uncovered or revealed at the Site.

ARTICLE 6 – BONDS AND INSURANCE

6.01 *Performance, Payment, and Other Bonds*

A. Contractor shall furnish a performance bond and a payment bond, each in an amount at least equal to the Contract Price, as security for the faithful performance and payment of all of Contractor's obligations under the Contract. These bonds shall remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 15.08, whichever is later, except as provided otherwise by Laws or Regulations, the Supplementary Conditions, or other specific provisions of the Contract. Contractor shall also furnish such other bonds as are required by the Supplementary Conditions or other specific provisions of the Contract.

B. All bonds shall be in the form prescribed by the Contract except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (as amended and supplemented) by the Financial Management Service, Surety Bond Branch, U.S. Department of the Treasury. A bond signed by an agent or attorney-in-fact must be accompanied by a certified copy of that individual's authority to bind the surety. The evidence of authority shall show that it is effective on the date the agent or attorney-in-fact signed the accompanying bond.

C. Contractor shall obtain the required bonds from surety companies that are duly licensed or authorized in the jurisdiction in which the Project is located to issue bonds in the required amounts.

D. If the surety on a bond furnished by Contractor is declared bankrupt or becomes insolvent, or its right to do business is terminated in any state or jurisdiction where any part of the Project is located, or the surety ceases to meet the requirements above, then Contractor shall promptly notify Owner and Engineer and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which shall comply with the bond and surety requirements above.

E. If Contractor has failed to obtain a required bond, Owner may exclude the Contractor from the Site and exercise Owner's termination rights under Article 16.

F. Upon request, Owner shall provide a copy of the payment bond to any Subcontractor, Supplier, or other person or entity claiming to have furnished labor or materials used in the performance of the Work.

6.02 *Insurance—General Provisions*

A. Owner and Contractor shall obtain and maintain insurance as required in this Article and in the Supplementary Conditions.

B. All insurance required by the Contract to be purchased and maintained by Owner or Contractor shall be obtained from insurance companies that are duly licensed or authorized, in the state or jurisdiction in which the Project is located, to issue insurance policies for the required limits and coverages. Unless a different standard is indicated in the Supplementary Conditions, all companies that provide insurance policies required under this Contract shall have an A.M. Best rating of A-VII or better.

C. Contractor shall deliver to Owner, with copies to each named insured and additional insured (as identified in this Article, in the Supplementary Conditions, or elsewhere in the Contract), certificates of insurance establishing that Contractor has obtained and is

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

D. Owner shall deliver to Contractor, with copies to each named insured and additional insured (as identified in this Article, the Supplementary Conditions, or elsewhere in the Contract), certificates of insurance establishing that Owner has obtained and is maintaining the policies, coverages, and endorsements required of Owner by the Contract (if any). Upon request by Contractor or any other insured, Owner shall also provide other evidence of such required insurance (if any), including but not limited to copies of policies and endorsements, and documentation of applicable self-insured retentions and deductibles. Owner may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.

E. Failure of Owner or Contractor to demand such certificates or other evidence of the other party's full compliance with these insurance requirements, or failure of Owner or Contractor to identify a deficiency in compliance from the evidence provided, shall not be construed as a waiver of the other party's obligation to obtain and maintain such insurance.

F. If either party does not purchase or maintain all of the insurance required of such party by the Contract, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage.

G. If Contractor has failed to obtain and maintain required insurance, Owner may exclude the Contractor from the Site, impose an appropriate set-off against payment, and exercise Owner's termination rights under Article 16.

H. Without prejudice to any other right or remedy, if a party has failed to obtain required insurance, the other party may elect to obtain equivalent insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and the Contract Price shall be adjusted accordingly.

I. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor or Contractor's interests.

J. The insurance and insurance limits required herein shall not be deemed as a limitation on Contractor's liability under the indemnities granted to Owner and other individuals and entities in the Contract.

6.03 *Contractor's Insurance*

A. *Workers' Compensation*: Contractor shall purchase and maintain workers' compensation and employer's liability insurance for:

1. claims under workers' compensation, disability benefits, and other similar employee benefit acts.

2. United States Longshoreman and Harbor Workers' Compensation Act and Jones Act coverage (if applicable).

3. claims for damages because of bodily injury, occupational sickness or disease, or death of Contractor's employees (by stop-gap endorsement in monopolist worker's compensation states).

4. Foreign voluntary worker compensation (if applicable).

B. *Commercial General Liability—Claims Covered*: Contractor shall purchase and maintain commercial general liability insurance, covering all operations by or on behalf of Contractor, on an occurrence basis, against:

1. claims for damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees.

2. claims for damages insured by reasonably available personal injury liability coverage.

3. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom.

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

1. Products and completed operations coverage:

a. Such insurance shall be maintained for three years after final payment.

b. Contractor shall furnish Owner and each other additional insured (as identified in the Supplementary Conditions or elsewhere in the Contract) evidence of continuation of such insurance at final payment and three years thereafter.

2. Blanket contractual liability coverage, to the extent permitted by law, including but not limited to coverage of Contractor's contractual indemnity obligations in Paragraph 7.18.

3. Broad form property damage coverage.

4. Severability of interest.

5. Underground, explosion, and collapse coverage.

6. Personal injury coverage.

7. Additional insured endorsements that include both ongoing operations and products and completed operations coverage through ISO Endorsements CG 20 10 10 01 and CG 20 37 10 01 (together); or CG 20 10 07 04 and CG 20 37 07 04 (together); or their equivalent.

8. For design professional additional insureds, ISO Endorsement CG 20 32 07 04, "Additional Insured—Engineers, Architects or Surveyors Not Engaged by the Named Insured" or its equivalent.

D. *Automobile liability*: Contractor shall purchase and maintain automobile liability insurance against claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance, or use of any motor vehicle. The automobile liability policy shall be written on an occurrence basis.

E. *Umbrella or excess liability*: Contractor shall purchase and maintain umbrella or excess liability insurance written over the underlying employer's liability, commercial general liability, and automobile liability insurance described in the paragraphs above. Subject to industry-standard exclusions, the coverage afforded shall follow form as to each and every one of the underlying policies.

F. *Contractor's pollution liability insurance*: Contractor shall purchase and maintain a policy covering third-party injury and property damage claims, including clean-up costs, as a result

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

G. *Additional insureds*: The Contractor's commercial general liability, automobile liability, umbrella or excess, and pollution liability policies shall include and list as additional insureds Owner and Engineer, and any individuals or entities identified in the Supplementary Conditions; include coverage for the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of all such additional insureds; and the insurance afforded to these additional insureds shall provide primary coverage for all claims covered thereby (including as applicable those arising from both ongoing and completed operations) on a non-contributory basis. Contractor shall obtain all necessary endorsements to support these requirements.

H. *Contractor's professional liability insurance*: If Contractor will provide or furnish professional services under this Contract, through a delegation of professional design services or otherwise, then Contractor shall be responsible for purchasing and maintaining applicable professional liability insurance. This insurance shall provide protection against claims arising out of performance of professional design or related services, and caused by a negligent error, omission, or act for which the insured party is legally liable. It shall be maintained throughout the duration of the Contract and for a minimum of two years after Substantial Completion. If such professional design services are performed by a Subcontractor, and not by Contractor itself, then the requirements of this paragraph may be satisfied through the purchasing and maintenance of such insurance by such Subcontractor.

I. *General provisions*: The policies of insurance required by this Paragraph 6.03 shall:

1. include at least the specific coverages provided in this Article.

2. be written for not less than the limits of liability provided in this Article and in the Supplementary Conditions, or required by Laws or Regulations, whichever is greater.

3. contain a provision or endorsement that the coverage afforded will not be canceled, materially changed, or renewal refused until at least 10 days prior written notice has been given to Contractor. Within three days of receipt of any such written notice, Contractor shall provide a copy of the notice to Owner, Engineer, and each other insured under the policy.

4. remain in effect at least until final payment (and longer if expressly required in this Article) and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work as a warranty or correction obligation, or otherwise, or returning to the Site to conduct other tasks arising from the Contract Documents.

5. be appropriate for the Work being performed and provide protection from claims that may arise out of or result from Contractor's performance of the Work and Contractor's other obligations under the Contract Documents, whether it is to be performed by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable.

J. The coverage requirements for specific policies of insurance must be met by such policies, and not by reference to excess or umbrella insurance provided in other policies.

6.04 *Owner's Liability Insurance*

A. In addition to the insurance required to be provided by Contractor under Paragraph 6.03, Owner, at Owner's option, may purchase and maintain at Owner's expense Owner's own liability insurance as will protect Owner against claims which may arise from operations under the Contract Documents.

B. Owner's liability policies, if any, operate separately and independently from policies required to be provided by Contractor, and Contractor cannot rely upon Owner's liability policies for any of Contractor's obligations to the Owner, Engineer, or third parties.

6.05 *Property Insurance*

A. *Builder's Risk*: Unless otherwise provided in the Supplementary Conditions, Contractor shall purchase and maintain builder's risk insurance upon the Work on a completed value basis, in the amount of the full insurable replacement cost thereof (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). This insurance shall:

1. include the Owner and Contractor as named insureds, and all Subcontractors, and any individuals or entities required by the Supplementary Conditions to be insured under such builder's risk policy, as insureds or named insureds. For purposes of the remainder of this Paragraph 6.05, Paragraphs 6.06 and 6.07, and any corresponding Supplementary Conditions, the parties required to be insured shall collectively be referred to as "insureds."

2. be written on a builder's risk "all risk" policy form that shall at least include insurance for physical loss or damage to the Work, temporary buildings, falsework, and materials and equipment in transit, and shall insure against at least the following perils or causes of loss: fire; lightning; windstorm; riot; civil commotion; terrorism; vehicle impact; aircraft; smoke; theft; vandalism and malicious mischief; mechanical breakdown, boiler explosion, and artificially generated electric current; earthquake; volcanic activity, and other earth movement; flood; collapse; explosion; debris removal; demolition occasioned by enforcement of Laws and Regulations; water damage (other than that caused by flood); and such other perils or causes of loss as may be specifically required by the Supplementary Conditions. If insurance against mechanical breakdown, boiler explosion, and artificially generated electric current; earthquake; volcanic activity, and other earth movement; or flood, are not commercially available under builder's risk policies, by endorsement or otherwise, such insurance may be provided through other insurance policies acceptable to Owner and Contractor.

3. cover, as insured property, at least the following: (a) the Work and all materials, supplies, machinery, apparatus, equipment, fixtures, and other property of a similar nature that are to be incorporated into or used in the preparation, fabrication, construction, erection, or completion of the Work, including Owner-furnished or assigned property; (b) spare parts inventory required within the scope of the Contract; and (c) temporary works which are not intended to form part of the permanent constructed Work but which are intended to provide working access to the Site, or to the Work under construction, or which are intended to provide temporary support for the Work under construction, including scaffolding, form work, fences, shoring, falsework, and temporary structures.

4. cover expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects).

5. extend to cover damage or loss to insured property while in temporary storage at the Site or in a storage location outside the Site (but not including property stored at the premises of a manufacturer or Supplier).

6. extend to cover damage or loss to insured property while in transit.

7. allow for partial occupation or use of the Work by Owner, such that those portions of the Work that are not yet occupied or used by Owner shall remain covered by the builder's risk insurance.

8. allow for the waiver of the insurer's subrogation rights, as set forth below.

9. provide primary coverage for all losses and damages caused by the perils or causes of loss covered.

10. not include a co-insurance clause.

11. include an exception for ensuing losses from physical damage or loss with respect to any defective workmanship, design, or materials exclusions.

12. include performance/hot testing and start-up.

13. be maintained in effect, subject to the provisions herein regarding Substantial Completion and partial occupancy or use of the Work by Owner, until the Work is complete.

B. *Notice of Cancellation or Change*: All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained in accordance with this Paragraph 6.05 will contain a provision or endorsement that the coverage afforded will not be canceled or materially changed or renewal refused until at least 10 days prior written notice has been given to the purchasing policyholder. Within three days of receipt of any such written notice, the purchasing policyholder shall provide a copy of the notice to each other insured.

C. *Deductibles*: The purchaser of any required builder's risk or property insurance shall pay for costs not covered because of the application of a policy deductible.

D. *Partial Occupancy or Use by Owner*: If Owner will occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work as provided in Paragraph 15.04, then Owner (directly, if it is the purchaser of the builder's risk policy, or through Contractor) will provide notice of such occupancy or use to the builder's risk insurer. The builder's risk insurance shall not be canceled or permitted to lapse on account of any such partial use or occupancy; rather, those portions of the Work that are occupied or used by Owner may come off the builder's risk policy, while those portions of the Work not yet occupied or used by Owner shall remain covered by the builder's risk insurance.

E. *Additional Insurance*: If Contractor elects to obtain other special insurance to be included in or supplement the builder's risk or property insurance policies provided under this Paragraph 6.05, it may do so at Contractor's expense.

F. *Insurance of Other Property*: If the express insurance provisions of the Contract do not require or address the insurance of a property item or interest, such as tools, construction equipment, or other personal property owned by Contractor, a Subcontractor, or an employee of Contractor or a Subcontractor, then the entity or individual owning such property item will be responsible for deciding whether to insure it, and if so in what amount.

6.06 *Waiver of Rights*

A. All policies purchased in accordance with Paragraph 6.05, expressly including the builder's risk policy, shall contain provisions to the effect that in the event of payment of any loss or damage the insurers will have no rights of recovery against any insureds thereunder, or against Engineer or its consultants, or their officers, directors, members, partners, employees, agents, consultants, or subcontractors. Owner and Contractor waive all rights against each other and the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work; and, in addition, waive all such rights against Engineer, its consultants, all Subcontractors, all individuals or entities identified in the Supplementary Conditions as insureds, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, under such policies for losses and damages so caused. None of the above waivers shall extend to the rights that any party making such waiver may have to the proceeds of insurance held by Owner or Contractor as trustee or fiduciary, or otherwise payable under any policy so issued.

B. Owner waives all rights against Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, for:

1. loss due to business interruption, loss of use, or other consequential loss extending beyond direct physical loss or damage to Owner's property or the Work caused by, arising out of, or resulting from fire or other perils whether or not insured by Owner; and

2. loss or damage to the completed Project or part thereof caused by, arising out of, or resulting from fire or other insured peril or cause of loss covered by any property insurance maintained on the completed Project or part thereof by Owner during partial occupancy or use pursuant to Paragraph 15.04, after Substantial Completion pursuant to Paragraph 15.03, or after final payment pursuant to Paragraph 15.06.

C. Any insurance policy maintained by Owner covering any loss, damage or consequential loss referred to in Paragraph 6.06.B shall contain provisions to the effect that in the event of payment of any such loss, damage, or consequential loss, the insurers will have no rights of recovery against Contractor, Subcontractors, or Engineer, or the officers, directors, members, partners, employees, agents, consultants, or subcontractors of each and any of them.

D. Contractor shall be responsible for assuring that the agreement under which a Subcontractor performs a portion of the Work contains provisions whereby the Subcontractor waives all rights against Owner, Contractor, all individuals or entities identified in the Supplementary Conditions as insureds, the Engineer and its consultants, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, relating to, or resulting from any of the perils or causes of loss covered by builder's risk insurance and any other property insurance applicable to the Work.

6.07 *Receipt and Application of Property Insurance Proceeds*

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

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

B. Proceeds for such insured losses may be made payable by the insurer either jointly to multiple insureds, or to the named insured that purchased the policy in its own right and as fiduciary for other insureds, subject to the requirements of any applicable mortgage clause. A named insured receiving insurance proceeds under the builder's risk and other policies of insurance required by Paragraph 6.05 shall distribute such proceeds in accordance with such agreement as the parties in interest may reach, or as otherwise required under the dispute resolution provisions of this Contract or applicable Laws and Regulations.

C. If no other special agreement is reached, the damaged Work shall be repaired or replaced, the money so received applied on account thereof, and the Work and the cost thereof covered by Change Order, if needed.

ARTICLE 7 – CONTRACTOR'S RESPONSIBILITIES

7.01 *Supervision and Superintendence*

A. Contractor shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction.

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

7.02 *Labor; Working Hours*

A. Contractor shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. Contractor shall at all times maintain good discipline and order at the Site.

B. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site shall be performed during regular working hours, Monday through Friday. Contractor will not perform Work on a Saturday, Sunday, or any legal holiday. Contractor may perform Work outside regular working hours or on Saturdays, Sundays, or legal holidays only with Owner's written consent, which will not be unreasonably withheld.

7.03 *Services, Materials, and Equipment*

A. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start up, and completion of the Work, whether or not such items are specifically called for in the Contract Documents.

B. All materials and equipment incorporated into the Work shall be of good quality and new, except as otherwise provided in the Contract Documents. All special warranties and

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

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

7.04 *"Or Equals"*

A. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the Contract Price has been based upon Contractor furnishing such item as specified. The specification or description of such an item is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or equal" item is permitted, Contractor may request that Engineer authorize the use of other items of material or equipment, or items from other proposed suppliers under the circumstances described below.

1. If Engineer in its sole discretion determines that an item of material or equipment proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, Engineer shall deem it an "or equal" item. For the purposes of this paragraph, a proposed item of material or equipment will be considered functionally equal to an item so named if:

a. in the exercise of reasonable judgment Engineer determines that:

1) it is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;

2) it will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole;

3) it has a proven record of performance and availability of responsive service; and

4) it is not objectionable to Owner.

b. Contractor certifies that, if approved and incorporated into the Work:

1) there will be no increase in cost to the Owner or increase in Contract Times; and

2) it will conform substantially to the detailed requirements of the item named in the Contract Documents.

B. *Contractor's Expense*: Contractor shall provide all data in support of any proposed "or equal" item at Contractor's expense.

C. *Engineer's Evaluation and Determination*: Engineer will be allowed a reasonable time to evaluate each "or-equal" request. Engineer may require Contractor to furnish additional data about the proposed "or-equal" item. Engineer will be the sole judge of acceptability. No "or-equal" item will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an "or-equal", which will be evidenced by an approved Shop Drawing or other written communication. Engineer will advise Contractor in writing of any negative determination.

D. *Effect of Engineer's Determination*: Neither approval nor denial of an "or-equal" request shall result in any change in Contract Price. The Engineer's denial of an "or-equal" request shall be final and binding, and may not be reversed through an appeal under any provision of the Contract Documents.

E. *Treatment as a Substitution Request*: If Engineer determines that an item of material or equipment proposed by Contractor does not qualify as an "or-equal" item, Contractor may request that Engineer considered the proposed item as a substitute pursuant to Paragraph 7.05.

7.05 *Substitutes*

A. Unless the specification or description of an item of material or equipment required to be furnished under the Contract Documents contains or is followed by words reading that no substitution is permitted, Contractor may request that Engineer authorize the use of other items of material or equipment under the circumstances described below. To the extent possible such requests shall be made before commencement of related construction at the Site.

1. Contractor shall submit sufficient information as provided below to allow Engineer to determine if the item of material or equipment proposed is functionally equivalent to that named and an acceptable substitute therefor. Engineer will not accept requests for review of proposed substitute items of material or equipment from anyone other than Contractor.

2. The requirements for review by Engineer will be as set forth in Paragraph 7.05.B, as supplemented by the Specifications, and as Engineer may decide is appropriate under the circumstances.

3. Contractor shall make written application to Engineer for review of a proposed substitute item of material or equipment that Contractor seeks to furnish or use. The application:

a. shall certify that the proposed substitute item will:

1) perform adequately the functions and achieve the results called for by the general design,

2) be similar in substance to that specified, and

3) be suited to the same use as that specified.

b. will state:

1) the extent, if any, to which the use of the proposed substitute item will necessitate a change in Contract Times,

2) whether use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for other work on the Project) to adapt the design to the proposed substitute item, and

3) whether incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty.

c. will identify:

1) all variations of the proposed substitute item from that specified, and

2) available engineering, sales, maintenance, repair, and replacement services.

d. shall contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including but not limited to changes in Contract Price, shared savings, costs of redesign, and claims of other contractors affected by any resulting change.

B. *Engineer's Evaluation and Determination*: Engineer will be allowed a reasonable time to evaluate each substitute request, and to obtain comments and direction from Owner. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No substitute will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an acceptable substitute. Engineer's determination will be evidenced by a Field Order or a proposed Change Order accounting for the substitution itself and all related impacts, including changes in Contract Price or Contract Times. Engineer will advise Contractor in writing of any negative determination.

C. *Special Guarantee*: Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any substitute.

D. *Reimbursement of Engineer's Cost*: Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor. Whether or not Engineer approves a substitute so proposed or submitted by Contractor, Contractor shall reimburse Owner for the reasonable charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the reasonable charges of Engineer for making changes in the Contract Documents (or in the provisions of any other direct contract with Owner) resulting from the acceptance of each proposed substitute.

E. *Contractor's Expense*: Contractor shall provide all data in support of any proposed substitute at Contractor's expense.

F. *Effect of Engineer's Determination*: If Engineer approves the substitution request, Contractor shall execute the proposed Change Order and proceed with the substitution. The Engineer's denial of a substitution request shall be final and binding, and may not be reversed through an appeal under any provision of the Contract Documents. Contractor may challenge the scope of reimbursement costs imposed under Paragraph 7.05.D, by timely submittal of a Change Proposal.

7.06 *Concerning Subcontractors, Suppliers, and Others*

A. Contractor may retain Subcontractors and Suppliers for the performance of parts of the Work. Such Subcontractors and Suppliers must be acceptable to Owner.

B. Contractor shall retain specific Subcontractors, Suppliers, or other individuals or entities for the performance of designated parts of the Work if required by the Contract to do so.

C. Subsequent to the submittal of Contractor's Bid or final negotiation of the terms of the Contract, Owner may not require Contractor to retain any Subcontractor, Supplier, or other individual or entity to furnish or perform any of the Work against which Contractor has reasonable objection.

D. Prior to entry into any binding subcontract or purchase order, Contractor shall submit to Owner the identity of the proposed Subcontractor or Supplier (unless Owner has already deemed such proposed Subcontractor or Supplier acceptable, during the bidding process or otherwise). Such proposed Subcontractor or Supplier shall be deemed acceptable to Owner unless Owner raises a substantive, reasonable objection within five days.

E. Owner may require the replacement of any Subcontractor, Supplier, or other individual or entity retained by Contractor to perform any part of the Work. Owner also may require Contractor to retain specific replacements; provided, however, that Owner may not require a replacement to which Contractor has a reasonable objection. If Contractor has submitted the identity of certain Subcontractors, Suppliers, or other individuals or entities for acceptance by Owner, and Owner has accepted it (either in writing or by failing to make written objection thereto), then Owner may subsequently revoke the acceptance of any such Subcontractor, Supplier, or other individual or entity so identified solely on the basis of substantive, reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor, Supplier, or other individual or entity.

F. If Owner requires the replacement of any Subcontractor, Supplier, or other individual or entity retained by Contractor to perform any part of the Work, then Contractor shall be entitled to an adjustment in Contract Price or Contract Times, or both, with respect to the replacement; and Contractor shall initiate a Change Proposal for such adjustment within 30 days of Owner's requirement of replacement.

G. No acceptance by Owner of any such Subcontractor, Supplier, or other individual or entity, whether initially or as a replacement, shall constitute a waiver of the right of Owner to the completion of the Work in accordance with the Contract Documents.

H. On a monthly basis Contractor shall submit to Engineer a complete list of all Subcontractors and Suppliers having a direct contract with Contractor, and of all other Subcontractors and Suppliers known to Contractor at the time of submittal.

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

J. Contractor shall be solely responsible for scheduling and coordinating the work of Subcontractors, Suppliers, and all other individuals or entities performing or furnishing any of the Work.

K. Contractor shall restrict all Subcontractors, Suppliers, and such other individuals or entities performing or furnishing any of the Work from communicating with Engineer or Owner, except through Contractor or in case of an emergency, or as otherwise expressly allowed herein.

L. The divisions and sections of the Specifications and the identifications of any Drawings shall not control Contractor in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.

M. All Work performed for Contractor by a Subcontractor or Supplier shall be pursuant to an appropriate contractual agreement that specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of Owner and Engineer.

N. Owner may furnish to any Subcontractor or Supplier, to the extent practicable, information about amounts paid to Contractor on account of Work performed for Contractor by the particular Subcontractor or Supplier.

O. Nothing in the Contract Documents:

1. shall create for the benefit of any such Subcontractor, Supplier, or other individual or entity any contractual relationship between Owner or Engineer and any such Subcontractor, Supplier, or other individual or entity; nor

2. shall create any obligation on the part of Owner or Engineer to pay or to see to the payment of any money due any such Subcontractor, Supplier, or other individual or entity except as may otherwise be required by Laws and Regulations.

7.07 *Patent Fees and Royalties*

A. Contractor shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product, or device which is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product, or device is specified in the Contract Documents for use in the performance of the Work and if, to the actual knowledge of Owner or Engineer, its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by Owner in the Contract Documents.

B. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, and its officers, directors, members, partners, employees, agents, consultants, and subcontractors from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device specified in the Contract Documents, but not identified as being subject to payment of any license fee or royalty to others required by patent rights or copyrights.

C. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device not specified in the Contract Documents.

7.08 *Permits*

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

7.09 *Taxes*

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

7.10 *Laws and Regulations*

A. Contractor shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither Owner nor Engineer shall be responsible for monitoring Contractor's compliance with any Laws or Regulations.

B. If Contractor performs any Work or takes any other action knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all resulting costs and losses, and shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work or other action. It shall not be Contractor's responsibility to make certain that the Work described in the Contract Documents is in accordance with Laws and Regulations, but this shall not relieve Contractor of Contractor's obligations under Paragraph 3.03.

C. Owner or Contractor may give notice to the other party of any changes after the submission of Contractor's Bid (or after the date when Contractor became bound under a negotiated contract) in Laws or Regulations having an effect on the cost or time of performance of the Work, including but not limited to changes in Laws or Regulations having an effect on procuring permits and on sales, use, value-added, consumption, and other similar taxes. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times resulting from such changes, then within 30 days of such notice Contractor may submit a Change Proposal, or Owner may initiate a Claim.

7.11 *Record Documents*

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

7.12 *Safety and Protection*

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

1. all persons on the Site or who may be affected by the Work;

2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and

3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, other work in progress, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.

B. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection. Contractor shall notify Owner; the owners of adjacent property, Underground Facilities, and other utilities; and other contractors and utility owners performing work at or adjacent to the Site, when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property or work in progress.

C. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. The Supplementary Conditions identify any Owner's safety programs that are applicable to the Work.

D. Contractor shall inform Owner and Engineer of the specific requirements of Contractor's safety program with which Owner's and Engineer's employees and representatives must comply while at the Site.

E. All damage, injury, or loss to any property referred to in Paragraph 7.12.A.2 or 7.12.A.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor at its expense (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).

F. Contractor's duties and responsibilities for safety and protection shall continue until such time as all the Work is completed and Engineer has issued a notice to Owner and Contractor in accordance with Paragraph 15.06.B that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).

G. Contractor's duties and responsibilities for safety and protection shall resume whenever Contractor or any Subcontractor or Supplier returns to the Site to fulfill warranty or correction obligations, or to conduct other tasks arising from the Contract Documents.

7.13 *Safety Representative*

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

7.14 *Hazard Communication Programs*

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

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

7.15 *Emergencies*

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

7.16 *Shop Drawings, Samples, and Other Submittals*

A. *Shop Drawing and Sample Submittal Requirements*:

1. Before submitting a Shop Drawing or Sample, Contractor shall have:

a. reviewed and coordinated the Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;

b. determined and verified all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;

c. determined and verified the suitability of all materials and equipment offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and

d. determined and verified all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto.

2. Each submittal shall bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review of that submittal, and that Contractor approves the submittal.

3. With each submittal, Contractor shall give Engineer specific written notice of any variations that the Shop Drawing or Sample may have from the requirements of the Contract Documents. This notice shall be set forth in a written communication separate from the Shop Drawings or Sample submittal; and, in addition, in the case of Shop Drawings by a specific notation made on each Shop Drawing submitted to Engineer for review and approval of each such variation.

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

1. *Shop Drawings*:

a. Contractor shall submit the number of copies required in the Specifications.

b. Data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Contractor proposes to

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

2. *Samples*:

   a. Contractor shall submit the number of Samples required in the Specifications.

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

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

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

D. *Engineer's Review*:

1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the Schedule of Submittals acceptable to Engineer. Engineer's review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.

2. Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction or to safety precautions or programs incident thereto.

3. Engineer's review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

4. Engineer's review and approval of a Shop Drawing or Sample shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 7.16.A.3 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer will document any such approved variation from the requirements of the Contract Documents in a Field Order.

5. Engineer's review and approval of a Shop Drawing or Sample shall not relieve Contractor from responsibility for complying with the requirements of Paragraph 7.16.A and B.

6. Engineer's review and approval of a Shop Drawing or Sample, or of a variation from the requirements of the Contract Documents, shall not, under any circumstances, change the Contract Times or Contract Price, unless such changes are included in a Change Order.

7. Neither Engineer's receipt, review, acceptance or approval of a Shop Drawing, Sample, or other submittal shall result in such item becoming a Contract Document.

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

E. *Resubmittal Procedures*:

1. Contractor shall make corrections required by Engineer and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review and approval. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Engineer on previous submittals.

2. Contractor shall furnish required submittals with sufficient information and accuracy to obtain required approval of an item with no more than three submittals. Engineer will record Engineer's time for reviewing a fourth or subsequent submittal of a Shop Drawings, sample, or other item requiring approval, and Contractor shall be responsible for Engineer's charges to Owner for such time. Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges.

3. If Contractor requests a change of a previously approved submittal item, Contractor shall be responsible for Engineer's charges to Owner for its review time, and Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges, unless the need for such change is beyond the control of Contractor.

7.17 *Contractor's General Warranty and Guarantee*

A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective. Engineer and its officers, directors, members, partners, employees, agents, consultants, and subcontractors shall be entitled to rely on Contractor's warranty and guarantee.

B. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:

1. abuse, modification, or improper maintenance or operation by persons other than Contractor, Subcontractors, Suppliers, or any other individual or entity for whom Contractor is responsible; or

2. normal wear and tear under normal usage.

C. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents or a release of Contractor's obligation to perform the Work in accordance with the Contract Documents:

1. observations by Engineer;

2. recommendation by Engineer or payment by Owner of any progress or final payment;

3. the issuance of a certificate of Substantial Completion by Engineer or any payment related thereto by Owner;

4. use or occupancy of the Work or any part thereof by Owner;

5. any review and approval of a Shop Drawing or Sample submittal;

6. the issuance of a notice of acceptability by Engineer;

7. any inspection, test, or approval by others; or

8. any correction of defective Work by Owner.

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

7.18 *Indemnification*

A. To the fullest extent permitted by Laws and Regulations, and in addition to any other obligations of Contractor under the Contract or otherwise, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the performance of the Work, provided that any such claim, cost, loss, or damage is attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom but only to the extent caused by any negligent act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work or anyone for whose acts any of them may be liable.

B. In any and all claims against Owner or Engineer or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 7.18.A shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.

C. The indemnification obligations of Contractor under Paragraph 7.18.A shall not extend to the liability of Engineer and Engineer's officers, directors, members, partners, employees, agents, consultants and subcontractors arising out of:

1. the preparation or approval of, or the failure to prepare or approve maps, Drawings, opinions, reports, surveys, Change Orders, designs, or Specifications; or

2. giving directions or instructions, or failing to give them, if that is the primary cause of the injury or damage.

7.19 *Delegation of Professional Design Services*

A. Contractor will not be required to provide professional design services unless such services are specifically required by the Contract Documents for a portion of the Work or unless such services are required to carry out Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. Contractor shall not be required to provide professional services in violation of applicable Laws and Regulations.

B. If professional design services or certifications by a design professional related to systems, materials, or equipment are specifically required of Contractor by the Contract Documents, Owner and Engineer will specify all performance and design criteria that such services must satisfy. Contractor shall cause such services or certifications to be provided by a properly licensed professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, and other submittals prepared by such professional. Shop

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

C. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy, and completeness of the services, certifications, or approvals performed by such design professionals, provided Owner and Engineer have specified to Contractor all performance and design criteria that such services must satisfy.

D. Pursuant to this paragraph, Engineer's review and approval of design calculations and design drawings will be only for the limited purpose of checking for conformance with performance and design criteria given and the design concept expressed in the Contract Documents. Engineer's review and approval of Shop Drawings and other submittals (except design calculations and design drawings) will be only for the purpose stated in Paragraph 7.16.D.1.

E. Contractor shall not be responsible for the adequacy of the performance or design criteria specified by Owner or Engineer.

ARTICLE 8 – OTHER WORK AT THE SITE

8.01 *Other Work*

A. In addition to and apart from the Work under the Contract Documents, the Owner may perform other work at or adjacent to the Site. Such other work may be performed by Owner's employees, or through contracts between the Owner and third parties. Owner may also arrange to have third-party utility owners perform work on their utilities and facilities at or adjacent to the Site.

B. If Owner performs other work at or adjacent to the Site with Owner's employees, or through contracts for such other work, then Owner shall give Contractor written notice thereof prior to starting any such other work. If Owner has advance information regarding the start of any utility work at or adjacent to the Site, Owner shall provide such information to Contractor.

C. Contractor shall afford each other contractor that performs such other work, each utility owner performing other work, and Owner, if Owner is performing other work with Owner's employees, proper and safe access to the Site, and provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering such work; provided, however, that Contractor may cut or alter others' work with the written consent of Engineer and the others whose work will be affected.

D. If the proper execution or results of any part of Contractor's Work depends upon work performed by others under this Article 8, Contractor shall inspect such other work and promptly report to Engineer in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of Contractor's Work. Contractor's failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work.

8.02 *Coordination*

A. If Owner intends to contract with others for the performance of other work at or adjacent to the Site, to perform other work at or adjacent to the Site with Owner's employees, or to arrange to have utility owners perform work at or adjacent to the Site, the following will be set forth in the Supplementary Conditions or provided to Contractor prior to the start of any such other work:

1. the identity of the individual or entity that will have authority and responsibility for coordination of the activities among the various contractors;

2. an itemization of the specific matters to be covered by such authority and responsibility; and

3. the extent of such authority and responsibilities.

B. Unless otherwise provided in the Supplementary Conditions, Owner shall have sole authority and responsibility for such coordination.

8.03 *Legal Relationships*

A. If, in the course of performing other work at or adjacent to the Site for Owner, the Owner's employees, any other contractor working for Owner, or any utility owner for whom the Owner is responsible causes damage to the Work or to the property of Contractor or its Subcontractors, or delays, disrupts, interferes with, or increases the scope or cost of the performance of the Work, through actions or inaction, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Times, or both. Contractor must submit any Change Proposal seeking an equitable adjustment in the Contract Price or the Contract Times under this paragraph within 30 days of the damaging, delaying, disrupting, or interfering event. The entitlement to, and extent of, any such equitable adjustment shall take into account information (if any) regarding such other work that was provided to Contractor in the Contract Documents prior to the submittal of the Bid or the final negotiation of the terms of the Contract. When applicable, any such equitable adjustment in Contract Price shall be conditioned on Contractor assigning to Owner all Contractor's rights against such other contractor or utility owner with respect to the damage, delay, disruption, or interference that is the subject of the adjustment. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.

B. Contractor shall take reasonable and customary measures to avoid damaging, delaying, disrupting, or interfering with the work of Owner, any other contractor, or any utility owner performing other work at or adjacent to the Site. If Contractor fails to take such measures and as a result damages, delays, disrupts, or interferes with the work of any such other contractor or utility owner, then Owner may impose a set-off against payments due to Contractor, and assign to such other contractor or utility owner the Owner's contractual rights against Contractor with respect to the breach of the obligations set forth in this paragraph.

C. When Owner is performing other work at or adjacent to the Site with Owner's employees, Contractor shall be liable to Owner for damage to such other work, and for the reasonable direct delay, disruption, and interference costs incurred by Owner as a result of Contractor's failure to take reasonable and customary measures with respect to Owner's other work. In response to such damage, delay, disruption, or interference, Owner may impose a set-off against payments due to Contractor.

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

ARTICLE 9 – OWNER'S RESPONSIBILITIES

9.01 *Communications to Contractor*

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

9.02 *Replacement of Engineer*

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

9.03 *Furnish Data*

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

9.04 *Pay When Due*

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

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

A. Owner's duties with respect to providing lands and easements are set forth in Paragraph 5.01.

B. Owner's duties with respect to providing engineering surveys to establish reference points are set forth in Paragraph 4.03.

C. Article 5 refers to Owner's identifying and making available to Contractor copies of reports of explorations and tests of conditions at the Site, and drawings of physical conditions relating to existing surface or subsurface structures at the Site.

9.06 *Insurance*

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

9.07 *Change Orders*

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

9.08 *Inspections, Tests, and Approvals*

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

9.09 *Limitations on Owner's Responsibilities*

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

9.10 *Undisclosed Hazardous Environmental Condition*

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

9.11 *Evidence of Financial Arrangements*

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

9.12 *Safety Programs*

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

B. Owner shall furnish copies of any applicable Owner safety programs to Contractor.

ARTICLE 10 – ENGINEER'S STATUS DURING CONSTRUCTION

10.01 *Owner's Representative*

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

10.02 *Visits to Site*

A. Engineer will make visits to the Site at intervals appropriate to the various stages of construction as Engineer deems necessary in order to observe as an experienced and qualified design professional the progress that has been made and the quality of the various aspects of Contractor's executed Work. Based on information obtained during such visits and observations, Engineer, for the benefit of Owner, will determine, in general, if the Work is proceeding in accordance with the Contract Documents. Engineer will not be required to make exhaustive or continuous inspections on the Site to check the quality or quantity of the Work. Engineer's efforts will be directed toward providing for Owner a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and observations, Engineer will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work.

B. Engineer's visits and observations are subject to all the limitations on Engineer's authority and responsibility set forth in Paragraph 10.08. Particularly, but without limitation, during

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

10.03 *Project Representative*

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

10.04 *Rejecting Defective Work*

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

10.05 *Shop Drawings, Change Orders and Payments*

A. Engineer's authority, and limitations thereof, as to Shop Drawings and Samples, are set forth in Paragraph 7.16.

B. Engineer's authority, and limitations thereof, as to design calculations and design drawings submitted in response to a delegation of professional design services, if any, are set forth in Paragraph 7.19.

C. Engineer's authority as to Change Orders is set forth in Article 11.

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

10.06 *Determinations for Unit Price Work*

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

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

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

10.08 *Limitations on Engineer's Authority and Responsibilities*

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

B. Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Engineer will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

C. Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.

D. Engineer's review of the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Paragraph 15.06.A will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals, that the results certified indicate compliance with the Contract Documents.

E. The limitations upon authority and responsibility set forth in this Paragraph 10.08 shall also apply to the Resident Project Representative, if any.

10.09 *Compliance with Safety Program*

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

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

11.01 *Amending and Supplementing Contract Documents*

A. The Contract Documents may be amended or supplemented by a Change Order, a Work Change Directive, or a Field Order.

1. *Change Orders*:

a. If an amendment or supplement to the Contract Documents includes a change in the Contract Price or the Contract Times, such amendment or supplement must be set forth in a Change Order. A Change Order also may be used to establish amendments and supplements of the Contract Documents that do not affect the Contract Price or Contract Times.

b. Owner and Contractor may amend those terms and conditions of the Contract Documents that do not involve (1) the performance or acceptability of the Work, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, without the recommendation of the Engineer. Such an amendment shall be set forth in a Change Order.

2. *Work Change Directives*: A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the modification ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order, following negotiations by the parties as to the Work Change Directive's effect, if any, on the Contract Price and Contract Times; or, if negotiations are unsuccessful, by a determination under the terms of the Contract Documents governing adjustments, expressly including Paragraph 11.04 regarding change of Contract Price. Contractor must submit any Change Proposal seeking an

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

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

11.02 *Owner-Authorized Changes in the Work*

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

11.03 *Unauthorized Changes in the Work*

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

11.04 *Change of Contract Price*

A. The Contract Price may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Price shall comply with the provisions of Paragraph 11.06. Any Claim for an adjustment of Contract Price shall comply with the provisions of Article 12.

B. An adjustment in the Contract Price will be determined as follows:

1. where the Work involved is covered by unit prices contained in the Contract Documents, then by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 13.03); or

2. where the Work involved is not covered by unit prices contained in the Contract Documents, then by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 11.04.C.2); or

3. where the Work involved is not covered by unit prices contained in the Contract Documents and the parties do not reach mutual agreement to a lump sum, then on

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

C. *Contractor's Fee*: When applicable, the Contractor's fee for overhead and profit shall be determined as follows:

1. a mutually acceptable fixed fee; or

2. if a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:

a. for costs incurred under Paragraphs 13.01.B.1 and 13.01.B.2, the Contractor's fee shall be 15 percent;

b. for costs incurred under Paragraph 13.01.B.3, the Contractor's fee shall be five percent;

c. where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Paragraphs 11.04.C.2.a and 11.04.C.2.b is that the Contractor's fee shall be based on: (1) a fee of 15 percent of the costs incurred under Paragraphs 13.01.A.1 and 13.01.A.2 by the Subcontractor that actually performs the Work, at whatever tier, and (2) with respect to Contractor itself and to any Subcontractors of a tier higher than that of the Subcontractor that actually performs the Work, a fee of five percent of the amount (fee plus underlying costs incurred) attributable to the next lower tier Subcontractor; provided, however, that for any such subcontracted work the maximum total fee to be paid by Owner shall be no greater than 27 percent of the costs incurred by the Subcontractor that actually performs the work;

d. no fee shall be payable on the basis of costs itemized under Paragraphs 13.01.B.4, 13.01.B.5, and 13.01.C;

e. the amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in cost will be the amount of the actual net decrease in cost plus a deduction in Contractor's fee by an amount equal to five percent of such net decrease; and

f. when both additions and credits are involved in any one change, the adjustment in Contractor's fee shall be computed on the basis of the net change in accordance with Paragraphs 11.04.C.2.a through 11.04.C.2.e, inclusive.

11.05 *Change of Contract Times*

A. The Contract Times may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Times shall comply with the provisions of Paragraph 11.06. Any Claim for an adjustment in the Contract Times shall comply with the provisions of Article 12.

B. An adjustment of the Contract Times shall be subject to the limitations set forth in Paragraph 4.05, concerning delays in Contractor's progress.

11.06 *Change Proposals*

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

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

1. *Procedures*: Contractor shall submit each Change Proposal to Engineer promptly (but in no event later than 30 days) after the start of the event giving rise thereto, or after such initial decision. The Contractor shall submit supporting data, including the proposed change in Contract Price or Contract Time (if any), to the Engineer and Owner within 15 days after the submittal of the Change Proposal. The supporting data shall be accompanied by a written statement that the supporting data are accurate and complete, and that any requested time or price adjustment is the entire adjustment to which Contractor believes it is entitled as a result of said event. Engineer will advise Owner regarding the Change Proposal, and consider any comments or response from Owner regarding the Change Proposal.

2. *Engineer's Action*: Engineer will review each Change Proposal and, within 30 days after receipt of the Contractor's supporting data, either deny the Change Proposal in whole, approve it in whole, or deny it in part and approve it in part. Such actions shall be in writing, with a copy provided to Owner and Contractor. If Engineer does not take action on the Change Proposal within 30 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of Engineer's inaction the Change Proposal is deemed denied, thereby commencing the time for appeal of the denial under Article 12.

3. *Binding Decision*: Engineer's decision will be final and binding upon Owner and Contractor, unless Owner or Contractor appeals the decision by filing a Claim under Article 12.

B. *Resolution of Certain Change Proposals*: If the Change Proposal does not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters, then Engineer will notify the parties that the Engineer is unable to resolve the Change Proposal. For purposes of further resolution of such a Change Proposal, such notice shall be deemed a denial, and Contractor may choose to seek resolution under the terms of Article 12.

11.07 *Execution of Change Orders*

A. Owner and Contractor shall execute appropriate Change Orders covering:

1. changes in the Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive;

2. changes in Contract Price resulting from an Owner set-off, unless Contractor has duly contested such set-off;

3. changes in the Work which are: (a) ordered by Owner pursuant to Paragraph 11.02, (b) required because of Owner's acceptance of defective Work under Paragraph 14.04 or Owner's correction of defective Work under Paragraph 14.07, or (c) agreed to by the parties, subject to the need for Engineer's recommendation if the change in the Work involves the design (as set forth in the Drawings, Specifications, or otherwise), or other engineering or technical matters; and

4. changes in the Contract Price or Contract Times, or other changes, which embody the substance of any final and binding results under Paragraph 11.06, or Article 12.

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

11.08 *Notification to Surety*

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

ARTICLE 12 – CLAIMS

12.01 *Claims*

A. *Claims Process*: The following disputes between Owner and Contractor shall be submitted to the Claims process set forth in this Article:

1. Appeals by Owner or Contractor of Engineer's decisions regarding Change Proposals;

2. Owner demands for adjustments in the Contract Price or Contract Times, or other relief under the Contract Documents; and

3. Disputes that Engineer has been unable to address because they do not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters.

B. *Submittal of Claim*: The party submitting a Claim shall deliver it directly to the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto; in the case of appeals regarding Change Proposals within 30 days of the decision under appeal. The party submitting the Claim shall also furnish a copy to the Engineer, for its information only. The responsibility to substantiate a Claim shall rest with the party making the Claim. In the case of a Claim by Contractor seeking an increase in the Contract Times or Contract Price, or both, Contractor shall certify that the Claim is made in good faith, that the supporting data are accurate and complete, and that to the best of Contractor's knowledge and belief the amount of time or money requested accurately reflects the full amount to which Contractor is entitled.

C. *Review and Resolution*: The party receiving a Claim shall review it thoroughly, giving full consideration to its merits. The two parties shall seek to resolve the Claim through the exchange of information and direct negotiations. The parties may extend the time for resolving the Claim by mutual agreement. All actions taken on a Claim shall be stated in writing and submitted to the other party, with a copy to Engineer.

D. *Mediation*:

1. At any time after initiation of a Claim, Owner and Contractor may mutually agree to mediation of the underlying dispute. The agreement to mediate shall stay the Claim submittal and response process.

2. If Owner and Contractor agree to mediation, then after 60 days from such agreement, either Owner or Contractor may unilaterally terminate the mediation process, and the Claim submittal and decision process shall resume as of the date of the termination. If the mediation proceeds but is unsuccessful in resolving the dispute, the Claim

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

3. Owner and Contractor shall each pay one-half of the mediator's fees and costs.

E. *Partial Approval*: If the party receiving a Claim approves the Claim in part and denies it in part, such action shall be final and binding unless within 30 days of such action the other party invokes the procedure set forth in Article 17 for final resolution of disputes.

F. *Denial of Claim*: If efforts to resolve a Claim are not successful, the party receiving the Claim may deny it by giving written notice of denial to the other party. If the receiving party does not take action on the Claim within 90 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of the inaction, the Claim is deemed denied, thereby commencing the time for appeal of the denial. A denial of the Claim shall be final and binding unless within 30 days of the denial the other party invokes the procedure set forth in Article 17 for the final resolution of disputes.

G. *Final and Binding Results*: If the parties reach a mutual agreement regarding a Claim, whether through approval of the Claim, direct negotiations, mediation, or otherwise; or if a Claim is approved in part and denied in part, or denied in full, and such actions become final and binding; then the results of the agreement or action on the Claim shall be incorporated in a Change Order to the extent they affect the Contract, including the Work, the Contract Times, or the Contract Price.

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

13.01 *Cost of the Work*

A. *Purposes for Determination of Cost of the Work*: The term Cost of the Work means the sum of all costs necessary for the proper performance of the Work at issue, as further defined below. The provisions of this Paragraph 13.01 are used for two distinct purposes:

1. To determine Cost of the Work when Cost of the Work is a component of the Contract Price, under cost-plus-fee, time-and-materials, or other cost-based terms; or

2. To determine the value of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price. When the value of any such adjustment is determined on the basis of Cost of the Work, Contractor is entitled only to those additional or incremental costs required because of the change in the Work or because of the event giving rise to the adjustment.

B. *Costs Included*: Except as otherwise may be agreed to in writing by Owner, costs included in the Cost of the Work shall be in amounts no higher than those prevailing in the locality of the Project, shall not include any of the costs itemized in Paragraph 13.01.C, and shall include only the following items:

1. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor. Such employees shall include, without limitation, superintendents, foremen, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits, which shall include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, bonuses, sick leave, and vacation and holiday pay applicable

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

2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts shall accrue to Owner. All trade discounts, rebates, and refunds and returns from sale of surplus materials and equipment shall accrue to Owner, and Contractor shall make provisions so that they may be obtained.

3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and Contractor and shall deliver such bids to Owner, who will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee shall be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 13.01.

4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed for services specifically related to the Work.

5. Supplemental costs including the following:

    a. The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.

    b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Contractor.

    c. Rentals of all construction equipment and machinery, and the parts thereof, whether rented from Contractor or others in accordance with rental agreements approved by Owner with the advice of Engineer, and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs shall be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts shall cease when the use thereof is no longer necessary for the Work.

    d. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, as imposed by Laws and Regulations.

    e. Deposits lost for causes other than negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.

    f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of property insurance established in accordance with Paragraph 6.05), provided such losses and damages have resulted from causes

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

g. The cost of utilities, fuel, and sanitary facilities at the Site.

h. Minor expenses such as communication service at the Site, express and courier services, and similar petty cash items in connection with the Work.

i. The costs of premiums for all bonds and insurance that Contractor is required by the Contract Documents to purchase and maintain.

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

1. Payroll costs and other compensation of Contractor's officers, executives, principals (of partnerships and sole proprietorships), general managers, safety managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expediters, timekeepers, clerks, and other personnel employed by Contractor, whether at the Site or in Contractor's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in Paragraph 13.01.B.1 or specifically covered by Paragraph 13.01.B.4. The payroll costs and other compensation excluded here are to be considered administrative costs covered by the Contractor's fee.

2. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.

3. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.

4. Costs due to the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.

5. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraph 13.01.B.

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

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

13.02 *Allowances*

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

B. *Cash Allowances*: Contractor agrees that:

1. the cash allowances include the cost to Contractor (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and

2. Contractor's costs for unloading and handling on the Site, labor, installation, overhead, profit, and other expenses contemplated for the cash allowances have been included in the Contract Price and not in the allowances, and no demand for additional payment on account of any of the foregoing will be valid.

C. *Contingency Allowance*: Contractor agrees that a contingency allowance, if any, is for the sole use of Owner to cover unanticipated costs.

D. Prior to final payment, an appropriate Change Order will be issued as recommended by Engineer to reflect actual amounts due Contractor on account of Work covered by allowances, and the Contract Price shall be correspondingly adjusted.

13.03 *Unit Price Work*

A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement.

B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Payments to Contractor for Unit Price Work will be based on actual quantities.

C. Each unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.

D. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review with Contractor the Engineer's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). Engineer's written decision thereon will be final and binding (except as modified by Engineer to reflect changed factual conditions or more accurate data) upon Owner and Contractor, subject to the provisions of the following paragraph.

E. Within 30 days of Engineer's written decision under the preceding paragraph, Contractor may submit a Change Proposal, or Owner may file a Claim, seeking an adjustment in the Contract Price if:

1. the quantity of any item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement;

2. there is no corresponding adjustment with respect to any other item of Work; and

3. Contractor believes that it is entitled to an increase in Contract Price as a result of having incurred additional expense or Owner believes that Owner is entitled to a decrease in Contract Price, and the parties are unable to agree as to the amount of any such increase or decrease.

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

14.01 *Access to Work*

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

14.02 *Tests, Inspections, and Approvals*

A. Contractor shall give Engineer timely notice of readiness of the Work (or specific parts thereof) for all required inspections and tests, and shall cooperate with inspection and testing personnel to facilitate required inspections and tests.

B. Owner shall retain and pay for the services of an independent inspector, testing laboratory, or other qualified individual or entity to perform all inspections and tests expressly required by the Contract Documents to be furnished and paid for by Owner, except that costs incurred in connection with tests or inspections of covered Work shall be governed by the provisions of Paragraph 14.05.

C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.

D. Contractor shall be responsible for arranging, obtaining, and paying for all inspections and tests required:

1. by the Contract Documents, unless the Contract Documents expressly allocate responsibility for a specific inspection or test to Owner;

2. to attain Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work;

3. by manufacturers of equipment furnished under the Contract Documents;

4. for testing, adjusting, and balancing of mechanical, electrical, and other equipment to be incorporated into the Work; and

5. for acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work.

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

E. If the Contract Documents require the Work (or part thereof) to be approved by Owner, Engineer, or another designated individual or entity, then Contractor shall assume full responsibility for arranging and obtaining such approvals.

F. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Engineer, Contractor shall, if requested by Engineer, uncover such Work for observation. Such uncovering shall be at Contractor's expense unless Contractor had given Engineer timely notice of Contractor's intention to

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

14.03 *Defective Work*

A. *Contractor's Obligation*: It is Contractor's obligation to assure that the Work is not defective.

B. *Engineer's Authority*: Engineer has the authority to determine whether Work is defective, and to reject defective Work.

C. *Notice of Defects*: Prompt notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor.

D. *Correction, or Removal and Replacement*: Promptly after receipt of written notice of defective Work, Contractor shall correct all such defective Work, whether or not fabricated, installed, or completed, or, if Engineer has rejected the defective Work, remove it from the Project and replace it with Work that is not defective.

E. *Preservation of Warranties*: When correcting defective Work, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.

F. *Costs and Damages*: In addition to its correction, removal, and replacement obligations with respect to defective Work, Contractor shall pay all claims, costs, losses, and damages arising out of or relating to defective Work, including but not limited to the cost of the inspection, testing, correction, removal, replacement, or reconstruction of such defective Work, fines levied against Owner by governmental authorities because the Work is defective, and the costs of repair or replacement of work of others resulting from defective Work. Prior to final payment, if Owner and Contractor are unable to agree as to the measure of such claims, costs, losses, and damages resulting from defective Work, then Owner may impose a reasonable set-off against payments due under Article 15.

14.04 *Acceptance of Defective Work*

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

14.05 *Uncovering Work*

A. Engineer has the authority to require 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, or both, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, then Contractor may submit a Change Proposal within 30 days of the determination that the Work is not defective.

14.06 *Owner May Stop the Work*

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

14.07 *Owner May Correct Defective Work*

A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work, or to remove and replace rejected Work as required by Engineer, or if Contractor fails to perform the Work in accordance with the Contract Documents, or if Contractor fails to comply with any other provision of the Contract Documents, then Owner may, after seven days written notice to Contractor, correct or remedy any such deficiency.

B. In exercising the rights and remedies under this Paragraph 14.07, Owner shall proceed expeditiously. In connection with such corrective or remedial action, Owner may exclude Contractor from all or part of the Site, take possession of all or part of the Work and suspend Contractor's services related thereto, and incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's representatives, agents and employees, Owner's other contractors, and Engineer and Engineer's consultants access to the Site to enable Owner to exercise the rights and remedies under this paragraph.

C. All claims, costs, losses, and damages incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 14.07 will be charged against Contractor as set-offs against payments due under Article 15. Such claims, costs, losses and damages will

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

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

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

15.01 *Progress Payments*

A. *Basis for Progress Payments*: The Schedule of Values established as provided in Article 2 will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to Engineer. Progress payments on account of Unit Price Work will be based on the number of units completed during the pay period, as determined under the provisions of Paragraph 13.03. Progress payments for cost-based Work will be based on Cost of the Work completed by Contractor during the pay period.

B. *Applications for Payments*:

1. At least 20 days before the date established in the Agreement for each progress payment (but not more often than once a month), Contractor shall submit to Engineer for review an Application for Payment filled out and signed by Contractor covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment shall also be accompanied by a bill of sale, invoice, or other documentation warranting that Owner has received the materials and equipment free and clear of all Liens, and evidence that the materials and equipment are covered by appropriate property insurance, a warehouse bond, or other arrangements to protect Owner's interest therein, all of which must be satisfactory to Owner.

2. Beginning with the second Application for Payment, each Application shall include an affidavit of Contractor stating that all previous progress payments received on account of the Work have been applied on account to discharge Contractor's legitimate obligations associated with prior Applications for Payment.

3. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.

C. *Review of Applications*:

1. Engineer will, within 10 days after receipt of each Application for Payment, including each resubmittal, either indicate in writing a recommendation of payment and present the Application to Owner, or return the Application to Contractor indicating in writing Engineer's reasons for refusing to recommend payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application.

2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's observations of the executed Work as an experienced and qualified design professional, and on Engineer's review of the Application for Payment and the accompanying data and schedules, that to the best of Engineer's knowledge, information and belief:

a. the Work has progressed to the point indicated;

b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, the results of any subsequent tests called for in the Contract Documents, a final determination of quantities and classifications for Unit Price Work under Paragraph 13.03, and any other qualifications stated in the recommendation); and

c. the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Work.

3. By recommending any such payment Engineer will not thereby be deemed to have represented that:

a. inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract; or

b. there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner or entitle Owner to withhold payment to Contractor.

4. Neither Engineer's review of Contractor's Work for the purposes of recommending payments nor Engineer's recommendation of any payment, including final payment, will impose responsibility on Engineer:

a. to supervise, direct, or control the Work, or

b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or

c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work, or

d. to make any examination to ascertain how or for what purposes Contractor has used the money paid on account of the Contract Price, or

e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.

5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 15.01.C.2.

6. Engineer will recommend reductions in payment (set-offs) necessary in Engineer's opinion to protect Owner from loss because:

a. the Work is defective, requiring correction or replacement;

b. the Contract Price has been reduced by Change Orders;

c. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;

d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible; or

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

D. *Payment Becomes Due*:

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

E. *Reductions in Payment by Owner*:

1. In addition to any reductions in payment (set-offs) recommended by Engineer, Owner is entitled to impose a set-off against payment based on any of the following:

a. claims have been made against Owner on account of Contractor's conduct in the performance or furnishing of the Work, or Owner has incurred costs, losses, or damages on account of Contractor's conduct in the performance or furnishing of the Work, including but not limited to claims, costs, losses, or damages from workplace injuries, adjacent property damage, non-compliance with Laws and Regulations, and patent infringement;

b. Contractor has failed to take reasonable and customary measures to avoid damage, delay, disruption, and interference with other work at or adjacent to the Site;

c. Contractor has failed to provide and maintain required bonds or insurance;

d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible;

e. Owner has incurred extra charges or engineering costs related to submittal reviews, evaluations of proposed substitutes, tests and inspections, or return visits to manufacturing or assembly facilities;

f. the Work is defective, requiring correction or replacement;

g. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;

h. the Contract Price has been reduced by Change Orders;

i. an event that would constitute a default by Contractor and therefore justify a termination for cause has occurred;

j. liquidated damages have accrued as a result of Contractor's failure to achieve Milestones, Substantial Completion, or final completion of the Work;

k. Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to Owner to secure the satisfaction and discharge of such Liens;

l. there are other items entitling Owner to a set off against the amount recommended.

2. If Owner imposes any set-off against payment, whether based on its own knowledge or on the written recommendations of Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action and the specific amount of the reduction, and promptly pay Contractor any amount

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

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

15.02 *Contractor's Warranty of Title*

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

15.03 *Substantial Completion*

A. When Contractor considers the entire Work ready for its intended use Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete and request that Engineer issue a certificate of Substantial Completion. Contractor shall at the same time submit to Owner and Engineer an initial draft of punch list items to be completed or corrected before final payment.

B. Promptly after Contractor's notification, Owner, Contractor, and Engineer shall make an inspection of the Work to determine the status of completion. If Engineer does not consider the Work substantially complete, Engineer will notify Contractor in writing giving the reasons therefor.

C. If Engineer considers the Work substantially complete, Engineer will deliver to Owner a preliminary certificate of Substantial Completion which shall fix the date of Substantial Completion. Engineer shall attach to the certificate a punch list of items to be completed or corrected before final payment. Owner shall have seven days after receipt of the preliminary certificate during which to make written objection to Engineer as to any provisions of the certificate or attached punch list. If, after considering the objections to the provisions of the preliminary certificate, Engineer concludes that the Work is not substantially complete, Engineer will, within 14 days after submission of the preliminary certificate to Owner, notify Contractor in writing that the Work is not substantially complete, stating the reasons therefor. If Owner does not object to the provisions of the certificate, or if despite consideration of Owner's objections Engineer concludes that the Work is substantially complete, then Engineer will, within said 14 days, execute and deliver to Owner and Contractor a final certificate of Substantial Completion (with a revised punch list of items to be completed or corrected) reflecting such changes from the preliminary certificate as Engineer believes justified after consideration of any objections from Owner.

D. At the time of receipt of the preliminary certificate of Substantial Completion, Owner and Contractor will confer regarding Owner's use or occupancy of the Work following Substantial Completion, review the builder's risk insurance policy with respect to the end of the builder's risk coverage, and confirm the transition to coverage of the Work under a permanent property insurance policy held by Owner. Unless Owner and Contractor agree otherwise in writing, Owner shall bear responsibility for security, operation, protection of the Work, property insurance, maintenance, heat, and utilities upon Owner's use or occupancy of the Work.

E. After Substantial Completion the Contractor shall promptly begin work on the punch list of items to be completed or corrected prior to final payment. In appropriate cases Contractor may submit monthly Applications for Payment for completed punch list items, following the progress payment procedures set forth above.

F. Owner shall have the right to exclude Contractor from the Site after the date of Substantial Completion subject to allowing Contractor reasonable access to remove its property and complete or correct items on the punch list.

15.04 *Partial Use or Occupancy*

A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which Owner, Engineer, and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by Owner for its intended purpose without significant interference with Contractor's performance of the remainder of the Work, subject to the following conditions:

1. At any time Owner may request in writing that Contractor permit Owner to use or occupy any such part of the Work that Owner believes to be substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor, Owner, and Engineer will follow the procedures of Paragraph 15.03.A through E for that part of the Work.

2. At any time Contractor may notify Owner and Engineer in writing that Contractor considers any such part of the Work substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.

3. Within a reasonable time after either such request, Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify Owner and Contractor in writing giving the reasons therefor. If Engineer considers that part of the Work to be substantially complete, the provisions of Paragraph 15.03 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.

4. No use or occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of Paragraph 6.05 regarding builder's risk or other property insurance.

15.05 *Final Inspection*

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

15.06 *Final Payment*

A. *Application for Payment*:

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

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

2. The final Application for Payment shall be accompanied (except as previously delivered) by:

   a. all documentation called for in the Contract Documents;

   b. consent of the surety, if any, to final payment;

   c. satisfactory evidence that all title issues have been resolved such that title to all Work, materials, and equipment has passed to Owner free and clear of any Liens or other title defects, or will so pass upon final payment.

   d. a list of all disputes that Contractor believes are unsettled; and

   e. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of the Work, and of Liens filed in connection with the Work.

3. In lieu of the releases or waivers of Liens specified in Paragraph 15.06.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (a) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (b) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner might in any way be responsible, or which might in any way result in liens or other burdens on Owner's property, have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien, or Owner at its option may issue joint checks payable to Contractor and specified Subcontractors and Suppliers.

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

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

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

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

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

15.07 *Waiver of Claims*

A. The making of final payment will not constitute a waiver by Owner of claims or rights against Contractor. Owner expressly reserves claims and rights arising from unsettled Liens, from defective Work appearing after final inspection pursuant to Paragraph 15.05, from Contractor's failure to comply with the Contract Documents or the terms of any special guarantees specified therein, from outstanding Claims by Owner, or from Contractor's continuing obligations under the Contract Documents.

B. The acceptance of final payment by Contractor will constitute a waiver by Contractor of all claims and rights against Owner other than those pending matters that have been duly submitted or appealed under the provisions of Article 17.

15.08 *Correction Period*

A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed by the terms of any applicable special guarantee required by the Contract Documents, or by any specific provision of the Contract Documents), any Work is found to be defective, or if the repair of any damages to the Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas used by Contractor as permitted by Laws and Regulations, is found to be defective, then Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:

1. correct the defective repairs to the Site or such other adjacent areas;

2. correct such defective Work;

3. if the defective Work has been rejected by Owner, remove it from the Project and replace it with Work that is not defective, and

4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others, or to other land or areas resulting therefrom.

B. If Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others).

C. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications.

D. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this paragraph, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.

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

ARTICLE 16 – SUSPENSION OF WORK AND TERMINATION

16.01 *Owner May Suspend Work*

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

16.02 *Owner May Terminate for Cause*

A. The occurrence of any one or more of the following events will constitute a default by Contractor and justify termination for cause:

1. Contractor's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the Progress Schedule);

2. Failure of Contractor to perform or otherwise to comply with a material term of the Contract Documents;

3. Contractor's disregard of Laws or Regulations of any public body having jurisdiction; or

4. Contractor's repeated disregard of the authority of Owner or Engineer.

B. If one or more of the events identified in Paragraph 16.02.A occurs, then after giving Contractor (and any surety) ten days written notice that Owner is considering a declaration that Contractor is in default and termination of the contract, Owner may proceed to:

1. declare Contractor to be in default, and give Contractor (and any surety) notice that the Contract is terminated; and

2. enforce the rights available to Owner under any applicable performance bond.

C. Subject to the terms and operation of any applicable performance bond, if Owner has terminated the Contract for cause, Owner may exclude Contractor from the Site, take possession of the Work, incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere, and complete the Work as Owner may deem expedient.

D. Owner may not proceed with termination of the Contract under Paragraph 16.02.B if Contractor within seven days of receipt of notice of intent to terminate begins to correct its failure to perform and proceeds diligently to cure such failure.

E. If Owner proceeds as provided in Paragraph 16.02.B, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds the cost to complete the Work, including all related claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals) sustained by Owner, such excess will be paid to Contractor. If the cost to complete the Work including such related claims, costs, losses,

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

F. Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue, or any rights or remedies of Owner against Contractor or any surety under any payment bond or performance bond. Any retention or payment of money due Contractor by Owner will not release Contractor from liability.

G. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 6.01.A, the provisions of that bond shall govern over any inconsistent provisions of Paragraphs 16.02.B and 16.02.D.

16.03 *Owner May Terminate For Convenience*

A. Upon seven days written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):

1. completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;

2. expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses; and

3. other reasonable expenses directly attributable to termination, including costs incurred to prepare a termination for convenience cost proposal.

B. Contractor shall not be paid on account of loss of anticipated overhead, profits, or revenue, or other economic loss arising out of or resulting from such termination.

16.04 *Contractor May Stop Work or Terminate*

A. If, through no act or fault of Contractor, (1) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (2) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (3) Owner fails for 30 days to pay Contractor any sum finally determined to be due, then Contractor may, upon seven days written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the contract and recover from Owner payment on the same terms as provided in Paragraph 16.03.

B. In lieu of terminating the Contract and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within 30 days after it is submitted, or Owner has failed for 30 days to pay Contractor any sum finally determined to be due, Contractor may, seven days after written notice to Owner and Engineer, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The provisions of this paragraph are not intended to preclude Contractor from submitting a Change Proposal for an adjustment in Contract Price or Contract Times or otherwise for

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

ARTICLE 17 – FINAL RESOLUTION OF DISPUTES

17.01 *Methods and Procedures*

A. *Disputes Subject to Final Resolution*: The following disputed matters are subject to final resolution under the provisions of this Article:

1. A timely appeal of an approval in part and denial in part of a Claim, or of a denial in full; and

2. Disputes between Owner and Contractor concerning the Work or obligations under the Contract Documents, and arising after final payment has been made.

B. *Final Resolution of Disputes*: For any dispute subject to resolution under this Article, Owner or Contractor may:

1. elect in writing to invoke the dispute resolution process provided for in the Supplementary Conditions; or

2. agree with the other party to submit the dispute to another dispute resolution process; or

3. if no dispute resolution process is provided for in the Supplementary Conditions or mutually agreed to, give written notice to the other party of the intent to submit the dispute to a court of competent jurisdiction.

ARTICLE 18 – MISCELLANEOUS

18.01 *Giving Notice*

A. Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if:

1. delivered in person, by a commercial courier service or otherwise, to the individual or to a member of the firm or to an officer of the corporation for which it is intended; or

2. delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the sender of the notice.

18.02 *Computation of Times*

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

18.03 *Cumulative Remedies*

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

18.04 *Limitation of Damages*

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

18.05 *No Waiver*

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

18.06 *Survival of Obligations*

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

18.07 *Controlling Law*

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

18.08 *Headings*

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

SUPPLEMENTARY CONDITIONS

Prepared by

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I. SUPPLEMENTARY CONDITIONS

A. *Caption and Introductory Statements*

Supplementary Conditions

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

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

ARTICLE 2 – PRELIMINARY MATTERS

SC-2.02 Copies of Documents

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

Owner shall furnish to Contractor [2] copies of the Contract Documents (including one fully executed counterpart of the Agreement), and one copy in electronic portable document format (PDF).

SC-2.02 Add the following new paragraph immediately after Paragraph 2.02.B:

C. Conformed documents incorporate and integrate Addenda and amendments negotiated prior to the Effective Date of the Contract. The conformed documents are produced for the convenience of the user and are not binding on the Owner nor do conformed documents take the place of the Contract Documents.

ARTICLE 3 – DOCUMENTS: INTENT, REQUIREMENTS, REUSE

SC-3.01 Intent

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

F. The Specifications may vary in form, format and style. Some specification sections are written in varying degrees of streamlined or declarative style and some sections may be relatively narrative by comparison. Omissions of such words and phrases as "the Contractor shall," "in conformity with," "as shown," or "as specified" are intentional in streamlined sections. Omitted words and phrases shall be supplied by inference. Similar types of provisions may appear in various parts of a section or articles within a part depending on the format of the section. The Contractor shall not take advantage of any variation of form, format or style in making claims for extra Work.

G. The cross referencing of specification sections under the subparagraph heading "Related Sections include but are not necessarily limited to:" and elsewhere within each specification section is provided as an aid and convenience to the Contractor. The Contractor shall not rely on the cross referencing provided and shall be responsible to coordinate the entire Work under the Contract

Documents and provide a complete Project whether or not the cross referencing is provided in each section or whether or not the cross referencing is complete.

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

SC-5.03 Subsurface and Physical Conditions

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

C. The drawings of physical conditions relating to existing surface structures at or adjacent to the Site are provided in the Drawing section.

SC-5.06 Hazardous Environmental Conditions

SC 5.06 Delete Paragraphs 5.06.A and 5.06.B in their entirety and insert the following:

A. No reports or drawings related to Hazardous Environmental Conditions at the Site are known to Owner.

B. Not Used.

ARTICLE 6 – BONDS AND INSURANCE

SC-6.02 Insurance—General Provisions

SC-6.02 Add the following paragraph immediately after Paragraph 6.02.B:

1. Contractor may obtain worker's compensation insurance from an insurance company that has not been rated by A.M. Best, provided that such company (a) is domiciled in the state in which the project is located, (b) is certified or authorized as a worker's compensation insurance provider by the appropriate state agency, and (c) has been accepted to provide worker's compensation insurance for similar projects by the state within the last 12 months.

SC-6.03 Contractor's Insurance

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

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

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

State:		**Statutory**
Federal, if applicable (e.g., Longshoreman's):		**Statutory**
Jones Act coverage, if applicable:		
Bodily injury by accident, each accident	**$**	
Bodily injury by disease, aggregate	**$**	

Employer's Liability:

Bodily injury, each accident $ _____

Bodily injury by disease, each employee $ _____

Bodily injury/disease aggregate $ _____

For work performed in monopolistic states, stop-gap liability coverage shall be endorsed to either the worker's compensation or commercial general liability policy with a minimum limit of: $ _____

Foreign voluntary worker compensation **Statutory**

2. Contractor's Commercial General Liability under Paragraphs 6.03.B and 6.03.C of the General Conditions:

General Aggregate $ _____

Products - Completed Operations Aggregate $ _____

Personal and Advertising Injury $ _____

Each Occurrence (Bodily Injury and Property Damage) $ _____

3. Automobile Liability under Paragraph 6.03.D. of the General Conditions:

Bodily Injury:

Each person $ _____

Each accident $ _____

Property Damage:

Each accident $ _____

[or]

Combined Single Limit of $ _____

4. Excess or Umbrella Liability:

Per Occurrence $ _____

General Aggregate $ _____

5. Contractor's Pollution Liability:

Each Occurrence $ _____

General Aggregate $ _____

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

6. **Additional Insureds: In addition to Owner and Engineer, include as additional insureds the following:** *[Here list by name (not category, role, or classification) other persons or entities to be included on the commercial general liability, automobile liability, umbrella or excess, and pollution liability policies as additional insureds.]*

7. **Contractor's Professional Liability:**

Each Claim $ _____

Annual Aggregate $ _____

SC-6.05 Property Insurance

SC-6.05. Add the following to the list of requirements in Paragraph 6.05.A, as a numbered item:

14. be subject to a deductible amount of no more than [$_____] for direct physical loss in any one occurrence.

SC-6.05.A. Add the following to the list of items in Paragraph 6.05.A, as numbered items:

15. include for the benefit of Owner loss of profits and soft cost coverage including, without limitation, fixed expenses and debt service for a minimum of 12 months with a maximum deductible of 30 days, plus attorneys fees and engineering or other consultants' fees, if not otherwise covered;

16. include, in addition to the Contract Price amount, the value of the following equipment and materials to be installed by the Contractor but furnished by the Owner or third parties:

a. *[here list specific items of equipment and purchase value]*

b. *[here list items of material and purchase value]*

17. include by express endorsement coverage of damage to Contractor's equipment.

ARTICLE 7 – CONTRACTOR'S RESPONSIBILITIES

SC-7.01 Supervision and Superintendence

SC-7.01.B. Amend Paragraph 7.01.B to add the following sentences: "The Contractor shall identify their representative at the Site that shall have authority to act on behalf of Contractor. All communications given to or received from this representative shall be binding on Contractor."

SC-7.01.C. Add the following new paragraph immediately after Paragraph 7.01.B:

Any superintendent or other personnel, who repeatedly fails to follow the Engineer's written or oral orders, directions, instructions, or determinations, shall be subject to removal from the project. Upon the written request of the Engineer, the Contractor shall immediately remove such superintendent or other personnel and name a replacement in writing. Noncompliance with the Engineer's request to remove and replace personnel at any level shall be grounds for terminating the Contract.

SC-7.02 Labor; Working Hours

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

B. In the absence of any Laws or Regulations to the contrary, Contractor may perform the Work on holidays, during any or all hours of the day, and on any or all days of the week, at Contractor's sole discretion.

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

Owner shall be responsible for the cost of any overtime pay or other expense incurred by the Owner for Engineer's services (including those of the Resident Project Representative, if any), Owner's representative, and construction observation services, occasioned by the performance of Work on Saturday, Sunday, any legal holiday, or as overtime on any regular work day. If Contractor is responsible but does not pay, or if the parties are unable to agree as to the amount owed, then Owner may impose a reasonable set-off against payments due under Article 15.

SC-7.03 Services, Materials, and Equipment

SC-7.03.B. Add the following new subparagraphs immediately after Paragraph 7.03.B:

1. Where the Work requires equipment be furnished, due to the lack of standardization of equipment as produced by the various manufacturers, it may become necessary to make minor modifications in the structures, buildings, piping, mechanical work, electrical work, accessories, controls, or other work, to accommodate the particular equipment offered. Contractor's bid price for any equipment offered shall include the cost of making any necessary changes subject to the approval of Engineer.

SC-7.18 Indemnification

SC 7.18.A Amend the second sentence of Paragraph 7.18.A by striking out "negligent".

ARTICLE 10 – ENGINEER'S STATUS DURING CONSTRUCTION

SC-10.03 Project Representative

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

B. On this Project, by agreement with the Owner, Engineer will not furnish a Resident Project Representative to represent Engineer at the Site or assist Engineer in observing the progress and quality of the Work.

SC-10.06 Determinations for Unit Price Work

10.06.A Modify Paragraph GC-10.06.A by adding the following sentence at the end of the first sentence: "Contractor shall, at his own expense, provide help and other assistance as may be required for making measurements of Unit Price Work.

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

SC-13.03 Unit Price Work

SC-13.03.B. Amend Paragraph 13.03.B to add the following sentences: "Progress estimates serve only as basis for partial payments. The Engineer may revise progress estimates and/or quantities any time before final acceptance. If the Engineer deems it proper to do so, changes may be made in progress estimates and in the final estimate."

SC-13.03.C. Amend Paragraph 13.03.C to add the following sentences: "Work described in the Contract Documents, or reasonably inferred as required for a functionally complete installation, but not identified in the listing of unit price items, shall be considered incidental to unit price work listed and the cost of incidental work included as a part of the unit price."

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

SC-15.07 Waiver of Claims

SC-15.07.B. Amend Paragraph 15.07.B to state "The acceptance of final payment by Contractor will constitute a waiver by Contractor of all claims and rights against Owner and/or Engineer other than those pending matters that have been duly submitted or appealed under the provisions of Article 17."

ARTICLE 17 – FINAL RESOLUTION OF DISPUTES

SC-17.02 Arbitration

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

SC-17.02 Arbitration

A. All matters subject to final resolution under this Article will be decided by arbitration in accordance with the rules of the appropriate State of Texas agency, subject to the conditions and limitations of this paragraph. This agreement to arbitrate and any other agreement or consent to arbitrate entered into will be specifically enforceable under the prevailing law of any court having jurisdiction.

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

by the applicable statute of limitations. The demand for arbitration should include specific reference to Paragraph SC-17.02.D below.

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

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

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

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

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

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

SC-17.03 Attorneys' Fees

SC-17.03 Attorneys' Fees: For any matter subject to final resolution under this Article, the prevailing party shall be entitled to an award of its attorneys' fees incurred in the final resolution proceedings, in an equitable amount to be determined in the discretion of the court, arbitrator, arbitration panel, or other arbiter of the matter subject to final resolution, taking into account the parties' initial demand or defense positions in comparison with the final result.

SECTION 00830

PREVAILING WAGE RATES

Prevailing wage rates for Williamson County are attached

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General Decision Number: TX160016 01/08/2016 TX16

Superseded General Decision Number: TX20150016

State: Texas

Construction Types: Heavy and Highway

Counties: Atascosa, Bandera, Bastrop, Bell, Bexar, Brazos, Burleson, Caldwell, Comal, Coryell, Guadalupe, Hays, Kendall, Lampasas, McLennan, Medina, Robertson, Travis, Williamson and Wilson Counties in Texas.

HEAVY (excluding tunnels and dams, not to be used for work on Sewage or Water Treatment Plants or Lift / Pump Stations in Bell, Coryell, McClennon and Williamson Counties) and HIGHWAY Construction Projects

Note: Under Executive Order (EO) 13658, an hourly minimum wage of $10.15 for calendar year 2016 applies to all contracts subject to the Davis-Bacon Act for which the solicitation was issued on or after January 1, 2015. If this contract is covered by the EO, the contractor must pay all workers in any classification listed on this wage determination at least $10.15 (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in calendar year 2016. The EO minimum wage rate will be adjusted annually. Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Modification Number	Publication Date
0	01/08/2016

* SUTX2011-006 08/03/2011

	Rates	Fringes
CEMENT MASON/CONCRETE FINISHER (Paving and Structures)	$ 12.56	
ELECTRICIAN	$ 26.35	
FORM BUILDER/FORM SETTER		
Paving & Curb	$ 12.94	
Structures	$ 12.87	
LABORER		
Asphalt Raker	$ 12.12	
Flagger	$ 9.45	
Laborer, Common	$ 10.50	
Laborer, Utility	$ 12.27	
Pipelayer	$ 12.79	
Work Zone Barricade Servicer	$ 11.85	

PAINTER (Structures).....$ 18.34

POWER EQUIPMENT OPERATOR:
- Agricultural Tractor.....$ 12.69
- Asphalt Distributor.....$ 15.55
- Asphalt Paving Machine.....$ 14.36
- Boom Truck.....$ 18.36
- Broom or Sweeper.....$ 11.04
- Concrete Pavement Finishing Machine.....$ 15.48
- Crane, Hydraulic 80 tons or less.....$ 18.36
- Crane, Lattice Boom 80 tons or less.....$ 15.87
- Crane, Lattice Boom over 80 tons.....$ 19.38
- Crawler Tractor.....$ 15.67
- Directional Drilling Locator.....$ 11.67
- Directional Drilling Operator.....$ 17.24
- Excavator 50,000 lbs or Less.....$ 12.88
- Excavator over 50,000 lbs...$ 17.71
- Foundation Drill, Truck Mounted.....$ 16.93
- Front End Loader, 3 CY or Less.....$ 13.04
- Front End Loader, Over 3 CY.$ 13.21
- Loader/Backhoe.....$ 14.12
- Mechanic.....$ 17.10
- Milling Machine.....$ 14.18
- Motor Grader, Fine Grade....$ 18.51
- Motor Grader, Rough.....$ 14.63
- Pavement Marking Machine....$ 19.17
- Reclaimer/Pulverizer.....$ 12.88
- Roller, Asphalt.....$ 12.78
- Roller, Other.....$ 10.50
- Scraper.....$ 12.27
- Spreader Box.....$ 14.04
- Trenching Machine, Heavy....$ 18.48

Servicer.....$ 14.51

Steel Worker
- Reinforcing.....$ 14.00
- Structural.....$ 19.29

TRAFFIC SIGNAL INSTALLER
- Traffic Signal/Light Pole Worker.....$ 16.00

TRUCK DRIVER
- Lowboy-Float.....$ 15.66
- Off Road Hauler.....$ 11.88
- Single Axle.....$ 11.79
- Single or Tandem Axle Dump Truck.....$ 11.68
- Tandem Axle Tractor w/Semi Trailer.....$ 12.81

WELDER.....$ 15.97

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

==========

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of "identifiers" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than "SU" or "UAVG" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under the "SU" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which

these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

* an existing published wage determination
* a survey underlying a wage determination
* a Wage and Hour Division letter setting forth a position on a wage determination matter
* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request

review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

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END OF GENERAL DECISION

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SECTION 01060
SPECIAL CONDITIONS

PART 1 - GENERAL

1.1 PRECONSTRUCTION CONFERENCE

A. A preconstruction conference shall be held at the Owner's offices after award of Contract. Engineer will notify the Contractor as to the date and time of the conference two (2) weeks in advance of the proposed date. Contractor's Project Superintendent and Project Driller shall attend.

1.2 DRAWINGS AND CONTRACT DOCUMENTS FOR CONTRACTOR USE

A. Refer to General Conditions.

B. Additional documents after "no-charge" documents will be furnished to Contractor at cost.

1.3 SCHEDULE OF VALUES

A. Schedule of Values Application for Payment shall be based on Bid Items in the Bid Form document.

1.4 PROJECT MEETINGS

A. Regular progress meetings will not be conducted. Engineer will schedule periodic site visits and will notify the Contractor in advance. Contractor's project manager or superintendent shall accompany Engineer during such visits.

1.5 SPECIAL CONSIDERATIONS RELATED TO ADJACENT PROPERTIES AND FACILITIES

A. Contractor shall be responsible for negotiations of any waivers or alternate arrangements required to enable transportation of materials to the site.

B. Maintain conditions of access roads to site such that roadway conditions are not deteriorated as the result of construction related activities.

C. Access, Traffic Control, and Parking:
   1. Maintain conditions of access road to site such that access is not hindered as the result of construction related deterioration.
   2. Do not permit driving across or transporting materials or equipment across areas outside the construction limits shown on the Drawings.
   3. Provide access routes for emergency vehicles at all times.
   4. Provide daily sweeping of hard-surface roadways to remove soils tracked onto roadway.
   5. Provide on site parking for all staff to limit interference with adjacent properties and businesses.

1.6 UTILITIES FOR CONSTRUCTION

A. Arrange and pay for all temporary telephone and electric utility service required for execution of the contract.

B. Owner will provide water service to the Contractor for a fee from an on-site non-potable hydrant. Contractor is to coordinate with the Owner when water can be provided from hydrant.

C. Wastewater service is not available. Furnish portable toilets for the use of Contractor's personnel.

PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SECTION)

PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SECTION)

END OF SECTION

SECTION 01061

BID ITEMS: SCOPE OF WORK

PART 1 - GENERAL

A. Section Includes:
   1. A description of the work included with each Bid Item.
   2. Basis of measurement for each Bid Item.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 02221 – Trenching, Backfilling and Compacting for Utilities.

1.2 DEFINITIONS

A. "Base Bid Items" refers to those bid items that will be included in the contract without exception.

B. "Alternate Bid Items" refers to those Bid Items that will be included in the contract at the Owner's discretion during period of the contract, except as noted herein.

C. Except in the case of allowances, "Cost" refers to the total cost to the OWNER for the work described, including all of direct and indirect costs borne by the Contractor in conjunction with the work described, plus Contractor's overhead and profit associated with the work described. In the case of allowances identified on the bid form, "Cost" refers to the direct cost to the Contractor of the materials or services described and shall be equal to the stated allowance; "Cost" shall exclude indirect costs borne by the Contractor and the Contractor's overhead and profit.

1.3 BID ITEMS FOR WELL #6:

A. Bid Item 1: Mobilization and Drilling Rig Setup
   1. Work Included: Provision of acceptable contract documents, bonds, and insurance; placement in field and transportation of 90% of Contractor's equipment to and from Site.
   2. Measurement: Lump sum not to exceed 5% of total bid.

B. Bid Item 2: Drill Pilot Test Hole and Log.
   1. Work Included: Drilling of test hole at the Well to 180 feet and performing sampling, geophysical logging, plumbness and alignment testing, and caliper logging of the test hole. All other services and supplies for completion of this Bid Item are included.
   2. Measurement: Vertical Foot.

C. Bid Item 3: Ream Pilot Test Hole and Set Casing
   1. Work Included: Drilling of 20 inch diameter surface bore hole to specified depth (60 feet). Installing and grouting 16 inch diameter casing at the Well. All other services and supplies for completion of this Bid Item are included.
   2. Measurement: Vertical Foot.

D. Bid Item 4: Ream Pilot Test Hole to Total Depth.
   1. Work Included: Reaming test hole at the Well to a total depth of 150 feet and 16 inch diameter. All services and supplies required by Bid Item are included.
   2. Measurement: Vertical Foot.

E. Bid Item 5: Well Development, Performance Testing, and Disinfection.

1. Work Included: Developing the well to meet the turbidity and allowable sand content specifications. Develop well for at least 4 HRS. Install and operate temporary test pump for 6 HR step drawdown test. Performing well performance testing and measurements. Disinfection of the Well. Includes all equipment, materials, labor, testing services, and all other items needed to complete these services.
2. Measurement: Lump Sum.

F. Bid Item 6: Install Submersible Pump and Motor, Discharge Column, PVC Water Level Monitoring Tube, Electrical Cables, Concrete Pad, Well Head, Connection to Pipeline at First Bend Below Ground, Conduct Pumping Test and Collect Water Samples.
1. Work Included: Providing and installing the submersible turbine well pump and motor, drop pipe, discharge and check valves, flow meter, concrete pad and pipe support, gauges connection to the well collection line (first bend below grade), conducting 36-HR pumping test at design capacity, collecting water samples, and performing water quality analysis. All other services and supplies for completion of this Bid Item are included
2. Measurement: Lump Sum.

G. Bid Item 7: Install Pipeline and Make Connection to Existing Collection Pipeline.
1. Work Included: Providing and installing well collection line from the first bend below grade to the existing transmission line and repairing asphalt where required. All other services and supplies for completion of this Bid Item are included.
2. Measurement: Linear Foot

H. Bid Item 8: Electrical.
1. Work Included: Providing and installing all electrical and instrumentation equipment, installing the needed conduits and wiring, installing the meter provided by the electric utility and the meter loop. All other services and supplies for completion of this Bid Item are included.
2. Measurement: Lump Sum.

I. Bid Item 9: Chain Link Fence, Barbed Wire Fence and Gate.
1. Work Included: Furnishing labor, material, and equipment to construct the Chain Link Security Fencing and Barbed Wire Fencing and Gates at the Well site as shown on the drawings. All other services and supplies for completion of this Bid Item are included.
2. Measurement: Lump Sum.

J. Bid Item 10: All-Weather Access Road.
1. Work Included: Furnishing labor, material, and equipment to construct the All-Weather Access Road as shown on the drawings. All other services and supplies for completion of this Bid Item are included.
2. Measurement: Lump Sum

K. Bid Item 11: Final Clean-up, Grading and Restoration.
1. Work Included: Furnishing labor, material, and equipment to topsoil, grade, and revegetate all disturbed areas or as specified in the Contract Documents. All other services and supplies for completion of this Bid Item are included.
2. Measurement: Lump Sum.

L. Bid Item 12: Silt Fence.
1. Work Included: Furnishing labor, material, and equipment to install, maintain, and remove Silt Fencing as directed by the Owner or Engineer. All other services and supplies for completion of this Bid Item are included.
2. Measurement: Linear Foot.

M. Bid Item 13: Contract Administration, Drillers Report, and Reporting.
1. Work Included: Includes preparing and submitting drillers report, and preparing and submitting well data and pumping test data to Engineer.
2. Measurement: Lump Sum.

1.4 ALTERNATE BID ITEMS

A. Bid Item A.1: Mobilization and Drilling Rig Setup
   1. Work Included: Provision of acceptable contract documents, bonds, and insurance; placement in field and transportation of 90% of Contractor's equipment to and from Site.
   2. Measurement: Lump sum.

B. Bid Item A.2: Drill Pilot Test Hole and Log.
   1. Work Included: Drilling of test hole at the Well to 180 feet and performing sampling, geophysical logging, plumbness and alignment testing, and caliper logging of the test hole. All other services and supplies for completion of this Bid Item are included.
   2. Measurement: Vertical Foot.

C. Bid Item A.3: Plug Test Hole with Grout with Gravel Pack thru Edwards Section.
   1. Work Included: plugging test hole at the Well to Land Surface. All other services and supplies for completion of this Bid Item are included.
   2. Measurement: Vertical Foot

D. Bid Item A.4: Final Clean-up, Grading and Restoration.
   1. Work Included: Furnishing labor, material, and equipment to topsoil, grade, and revegetate all disturbed areas or as specified in the Contract Documents. All other services and supplies for completion of this Bid Item are included.
   2. Measurement: Lump Sum

E. Bid Item A-5: Contract Administration, Drillers Report, and Reporting.
   1. Work Included: Includes preparing and submitting drillers report, and preparing and submitting well data to Engineer.
   2. Measurement: Lump Sum.

END OF SECTION

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SECTION 01340
SUBMITTALS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Mechanics and administration of the submittal process for:
      a. Shop Drawings.
      b. Samples.
      c. Miscellaneous submittals.
      d. Operation and Maintenance Manuals.
   2. General content requirements for Shop Drawings.
   3. Content requirements for Operation and Maintenance Manuals.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Sections in Division 02 through Division 16 identifying required submittals.

1.2 DEFINITIONS

A. Shop Drawings:
   1. See General Conditions.
   2. Product data and samples are Shop Drawing information.

B. Operation and Maintenance Manuals:
   1. Contain the information required for proper installation and maintenance of building materials and finishes.
   2. Contain the technical information required for proper installation, operation and maintenance of process, electrical and mechanical equipment and systems.

C. Miscellaneous Submittals:
   1. Submittals other than Shop Drawings and Operation and Maintenance Manuals.
   2. Representative types of miscellaneous submittal items include but are not limited to:
      a. Construction schedule.
      b. Concrete, soil compaction, and pressure test reports.
      c. Installed equipment and systems performance test reports.
      d. Manufacturer's installation certification letters.
      e. Instrumentation and control commissioning reports.
      f. Warranties.
      g. Service agreements.
      h. Construction photographs.
      i. Survey data.
      j. Cost breakdown (Schedule of Values).

1.3 SUBMITTAL SCHEDULE

A. Schedule of Shop Drawings:
   1. Submitted and approved within 20 days of receipt of Notice to Proceed.
   2. Account for multiple transmittals under any specification section where partial submittals will be transmitted.

B. Shop Drawings: Submittal and approval prior to 50 percent completion.

C. Operation and Maintenance Manuals and Completed Equipment Record Sheets: Initial submittal within 60 days after date Shop Drawings are approved.

1.4 PREPARATION OF SUBMITTALS

A. General:
1. All submittals and all pages of all copies of a submittal shall be completely legible.
2. Submittals which, in the Engineer's sole opinion, are illegible will be returned without review.

B. Shop Drawings:
1. Scope of any submittal and letter of transmittal:
   a. Limited to one (1) Specification Section.
   b. Do not submit under any Specification Section entitled (in part) "Basic Requirements" unless the product or material submitted is specified, in total, in a "Basic Requirements" Section.
2. Numbering letter of transmittal:
   a. Include as prefix the Specification Section number followed by a series number, "-xx", beginning with "01" and increasing sequentially with each additional transmittal.
   b. If more than one (1) submittal under any Specification Section, assign consecutive series numbers to subsequent transmittal letters.
3. Describing transmittal contents:
   a. Provide listing of each component or item in submittal capable of receiving an independent review action.
   b. Identify for each item:
      1) Manufacturer and Manufacturer's Drawing or data number.
      2) Contract Document tag number(s).
      3) Unique page numbers for each page of each separate item.
   c. When submitting "or-equal" items that are not the products of named manufacturers, include the words "or-equal" in the item description.
4. Contractor stamping:
   a. General:
      1) Contractor's review and approval stamp shall be applied either to the letter of transmittal or a separate sheet preceding each independent item in the submittal.
         a) Contractor's signature and date shall be wet ink signature.
         b) Shop Drawing submittal stamp shall read "(Contractor's Name) has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review and approval as stipulated under General Conditions Paragraph 6.17C."
         c) Letters of transmittal may be stamped only when the scope of the submittal is one (1) item.
      2) Submittals containing multiple independent items shall be prepared with an index sheet for each item listing the discrete page numbers for each page of that item, which shall be stamped with the Contractor's review and approval stamp.
         a) Individual pages or sheets of independent items shall be numbered in a manner that permits Contractor's review and approval stamp to be associated with the entire contents of a particular item.
   b. Electronic stamps:
      1) Contractor may electronically embed Contractor's review and approval stamp to either the letter of transmittal or a separate index sheet preceding each independent item in the submittal.
      2) Contractor's signature and date on electronically applied stamps shall be wet ink signature.
5. Resubmittals:
   a. Number with original root number and a suffix letter starting with "A" on a (new) duplicate transmittal form.
   b. Do not increase the scope of any prior transmittal.

c. Account for all components of prior transmittal.
    1) If items in prior transmittal received "A" or "B" Action code, list them and indicate "A" or "B" as appropriate.
        a) Do not include submittal information for items listed with prior "A" or "B" Action in resubmittal.
    2) Indicate "Outstanding-To Be Resubmitted At a Later Date" for any prior "C" or "D" Action item not included in resubmittal.
        a) Obtain Engineer's approval to exclude items.

6. For 8-1/2 x 11 IN, 8-1/2 x 14 IN, and 11 x 17 IN size sheets, provide three (3) copies of each page for Engineer plus the number required by the Contractor.
    a. The number of copies required by the Contractor will be defined at the Preconstruction Conference, but shall not exceed three (3).
    b. All other size sheets:
        1) Submit one (1) reproducible transparency or high resolution print and one (1) additional print of each Drawing until approval is obtained.
        2) Utilize mailing tube; do not fold.
        3) The Engineer will mark and return the reproducible to the Contractor for his reproduction and distribution.
7. Provide clear space (3 IN SQ) for Engineer stamping of each component defined in PREPARATION OF SUBMITTALS – Contractor Stamping.
8. Contractor shall not use red color for marks on transmittals.
    a. Duplicate all marks on all copies transmitted, and ensure marks are photocopy reproducible.
    b. Outline Contractor marks on reproducible transparencies with a rectangular box.
9. Transmittal contents:
    a. Coordinate and identify Shop Drawing contents so that all items can be easily verified by the Engineer.
    b. Identify equipment or material use, tag number, Drawing detail reference, weight, and other Project specific information.
    c. Provide sufficient information together with technical cuts and technical data to allow an evaluation to be made to determine that the item submitted is in compliance with the Contract Documents.
    d. Submit items such as equipment brochures, cuts of fixtures, product data sheets or catalog sheets on 8-1/2 x 11 IN pages.
        1) Indicate exact item or model and all options proposed.
    e. When a Shop Drawing submittal is called for in any Specification Section, include as appropriate, scaled details, sizes, dimensions, performance characteristics, capacities, test data, anchoring details, installation instructions, storage and handling instructions, color charts, layout Drawings, rough-in diagrams, wiring diagrams, controls, weights and other pertinent data in addition to information specifically stipulated in the Specification Section.
        1) Arrange data and performance information in format similar to that provided in Contract Documents.
        2) Provide, at minimum, the detail specified in the Contract Documents.
    f. If proposed equipment or materials deviate from the Contract Drawings or Specifications in any way, clearly note the deviation and justify the said deviation in detail in a separate letter immediately following transmittal sheet.
10. Samples:
    a. Identification:
        1) Identify sample as to transmittal number, manufacturer, item, use, type, project designation, tag number, standard Specification Section or Drawing detail reference, color, range, texture, finish and other pertinent data.
        2) If identifying information cannot be marked directly on sample without defacing or adversely altering samples, provide a durable tag with identifying information securely attached to the sample.
    b. Include application specific brochures, and installation instructions.

c. Provide Contractor's stamp of approval on samples or transmittal form as indication of Contractor's checking and verification of dimensions and coordination with interrelated work.
d. Resubmit samples of rejected items.

C. Miscellaneous Submittals:
1. Prepare in the format and detail specified in Specification requiring the miscellaneous submittal.

D. Operation and Maintenance Manuals:
1. Owner's use of manufacturer's Operation and Maintenance materials:
a. Materials are provided for Owner's use, reproduction and distribution as training and reference materials within Owner's organization.
1) Applicable to hard copy or electronic media.
2) Applicable to materials containing copyright notice as well as those with no copyright notice.
b. Notify manufacturer of this intended use of materials provided under the Contract.
2. Number each Operation and Maintenance Manual transmittal with the original root number of the associated Shop Drawing.
a. Identify resubmittals with the original number plus a suffix letter starting with "A."
3. Submittal format:
a. Interim submittals: Submit two (2) paper copies until manual is approved.
b. Final submittals:
1) Within 30 days of receipt of approval, submit one (1) additional paper copy and two (2) electronic copies on Compact Disc (CD-ROM) in Portable Document Format (PDF).
a) Compact discs to be secured in jewel cases.
2) Electronic copies will be reviewed for conformance with the approved paper copy and the electronic copy (PDF) requirements of this Specification.
3) Non-conforming CDs will be returned with comments.
a) Provide final CDs within 30 days of receipt of comments.
4. Paper copy submittals:
a. Submit Operation and Maintenance Manuals printed on 8-1/2 x 11 IN size heavy first quality paper with standard three-hole punching and bound in appropriately sized three-ring (or post) vinyl view binders with clear overlays front, spine and back.
1) Provide binders with titles inserted under clear overlay on front and on spine of each binder.
a) As space allows, binder titles shall include, but not necessarily be limited to, Project Name, related Specification Number, Equipment Name(s) and Project Equipment Tag Numbers.
2) Provide a Cover Page for each manual with the following information:
a) Manufacturer(s).
b) Date.
c) Project Owner and Project Name.
d) Specification Section.
e) Project Equipment Tag Numbers.
f) Model Numbers.
g) Engineer.
h) Contractor.
3) Provide a Table of Contents or Index for each manual.
4) Use plastic-coated dividers to tab each section of each manual per the manual's Table of Contents/Index for easy reference.
5) Provide plastic sheet lifters prior to first page and following last page.
b. Reduce Drawings or diagrams bound in manuals to an 8-1/2 x 11 IN or 11 x 17 IN size.
1) Where reduction is not practical to ensure readability, fold larger Drawings separately and place in vinyl envelopes which are bound into the binder.
2) Identify vinyl envelopes with Drawing numbers.

c. Mark each sheet to clearly identify specific products and component parts and data applicable to the installation for the Project.
    1) Delete or cross out information that does not specifically apply to the Project.

5. Electronic copy submittals:
    a. Electronic copies of the approved paper copy Operation and Maintenance Manuals are to be produced in Adobe Acrobat's Portable Document Format (PDF) Version 5.0 or higher.
    b. Do not password protect and/or lock the PDF document.
    c. Create one (1) PDF document (PDF file) for each equipment Operation and Maintenance Manual.
    d. Drawings or other graphics must be converted to PDF format and made part of the one (1) PDF document.
        1) Scanning to be used only where actual file conversion is not possible.
    e. Rotate pages that must be viewed in landscape to the appropriate position for easy reading.
    f. Images only shall be scanned at a resolution of 300 dpi or greater.
        1) Perform Optical Character Recognition (OCR) capture on all images.
        2) Achieve OCR with the "original image with hidden text" option.
        3) Word searches of the PDF document must operate successfully to demonstrate OCR compliance.
    g. Create bookmarks in the navigation frame, for each entry in the Table of Contents/Index.
        1) Normally three (3) levels deep (i.e., "Chapter," "Section," "Sub-section").
    h. Thumbnails must be generated for each PDF file.
    i. Set the opening view for PDF files as follows:
        1) Initial view: Bookmarks and Page.
        2) Magnification: Fit in Window.
        3) Page layout: Single page.
        4) Set the file to open to the cover page of the manual with bookmarks to the left, and the first bookmark linked to the cover page.
    j. All PDF documents shall be set with the option "Fast Web View" to open the first pages of the document for the viewer while the rest of the document continues to load.
    k. File naming conventions:
        1) File names shall use a "ten dot three" convention (XXXXX-YY-Z.PDF) where XXXXX is the Specification Section number, YY is the Shop Drawing Root number and Z is an ID number used to designate the associated volume.
            a) Example 1:
                (1) Two (2) pumps submitted as separate Shop Drawings under the same Specification Section:
                    (a) Pump 1 = 11061-01-1.pdf.
                    (b) Pump 2 = 11061-02-1.pdf.
            b) Example 2:
                (1) Control system submitted as one (1) Shop Drawing but separated into two (2) Operation and Maintenance volumes:
                    (a) Volume 1 = 13440-01-1.pdf.
                    (b) Volume 2 = 13440-01-2.pdf.
    l. Labeling:
        1) As a minimum, include the following labeling on all CD-ROM discs and jewel cases:
            a) Project Name.
            b) Equipment Name and Project Tag Number.
            c) Project Specification Section.
            d) Manufacturer Name.
            e) Vendor Name.
    m. Binding:
        1) Include labeled CD(s) in labeled jewel case(s).

a) Bind jewel cases in standard three-ring binder Jewel Case Page(s), inserted at the front of the Final paper copy submittal.
b) Jewel Case Page(s) to have means for securing Jewel Case(s) to prevent loss (e.g., flap and strap).

6. Operation and Maintenance Manuals for Materials and Finishes:
   a. Building Products, Applied Materials and Finishes:
      1) Include product data, with catalog number, size, composition and color and texture designations.
      2) Provide information for re-ordering custom manufactured products.
   b. Instructions for Care and Maintenance:
      1) Include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods and recommended schedule for cleaning and maintenance.
   c. Moisture Protection and Weather Exposed Products:
      1) Include product data listing, applicable reference standards, chemical composition, and details of installation.
      2) Provide recommendations for inspections, maintenance and repair.
   d. Additional requirements as specified in individual product specifications.
7. Operation and Maintenance Manuals for Equipment and Systems:
   a. Submission of Operation and Maintenance Manuals for equipment and systems is applicable but not necessarily limited to:
      1) Major equipment.
      2) Equipment powered by electrical, pneumatic or hydraulic systems.
      3) Specialized equipment and systems including instrumentation and control systems and system components for HVAC process system control.
      4) Valves and water control gates.
   b. Equipment and Systems Operation and Maintenance Manuals shall include, but not necessarily be limited to, the following completed forms and detailed information, as applicable:
      1) Fully completed type-written copies of the associated Equipment Record(s), Exhibits C1, C2 and C3, shall be included under the first tab following the Table of Contents of each Operation and Maintenance Manual.
         a) Each section of the Equipment Record must be completed in detail.
            (1) Simply referencing the related manual for nameplate, maintenance, spare parts or lubricant information is not acceptable.
         b) For equipment items involving components or subunits, a fully completed Equipment Record Form is required for each operating component or subunit.
         c) Submittals that do not include the associated Equipment Record(s) will be rejected without further content review.
         d) Electronic copies of the Exhibits may be obtained by contacting the Project Manager.
      2) Equipment function, normal operating characteristics, limiting operations.
      3) Assembly, disassembly, installation, alignment, adjustment, and checking instructions.
      4) Operating instructions for start-up, normal operation, control, shutdown, and emergency conditions.
      5) Lubrication and maintenance instructions.
      6) Troubleshooting guide.
      7) Parts lists:
         a) Comprehensive parts and parts price lists.
         b) A list of recommended spare parts.
         c) List of spare parts provided as specified in the associated Specification Section.
      8) Outline, cross-section, and assembly Drawings; engineering data; and electrical diagrams, including elementary diagrams, wiring diagrams, connection diagrams, word description of wiring diagrams and interconnection diagrams.

9) Test data and performance curves.
10) As-constructed fabrication or layout Drawings and wiring diagrams.
11) Instrumentation or tag numbers assigned to the equipment by the Contract Documents are to be used to identify equipment and system components.
12) Additional information as specified in the associated equipment or system Specification Section.

1.5 TRANSMITTAL OF SUBMITTALS

A. Shop Drawings, Samples and Operation and Maintenance Manuals:
1. Transmit all submittals to:
HDR Engineering, Inc.
4401 West Gate Blvd
Austin, TX 78745
Attn: Peter Newell, P.E., peter.newell@hdrinc.com

2. Utilize two (2) copies of attached Exhibit "A" to transmit all Shop Drawings and samples.
3. Utilize two (2) copies of attached Exhibit "B" to transmit all Operation and Maintenance Manuals.
4. All submittals must be from Contractor.
a. Submittals will not be received from or returned to subcontractors.
b. Operation and Maintenance Manual submittal stamp may be Contractor's standard approval stamp.
5. Provide submittal information defining specific equipment or materials utilized on the Project.
a. Generalized product information, not clearly defining specific equipment or materials to be provided, will be rejected.

B. Miscellaneous Submittals:
1. Transmit under Contractor's standard letter of transmittal or letterhead.
2. Submit in triplicate or as specified in individual Specification Section.
3. Transmit to:
HDR Engineering, Inc.
4401 West Gate Blvd
Austin, TX 78745
Attn: Peter Newell, P.E., peter.newell@hdrinc.com
4. Provide copy of letter of transmittal without attachments to Owner's Representative.
a. Exception for concrete, soils compaction and pressure test reports.
1) Transmit one (1) copy of test reports to Resident Project Engineer.
2) Transmit one (1) copy of test reports to location and individual indicated above for other miscellaneous submittals.

C. Expedited Return Delivery:
1. Include prepaid express envelope or airbill in submittal transmittal package for any submittals Contractor expects or requires express return mail.
2. Inclusion of prepaid express envelope or airbill does not obligate Engineer to conduct expedited review of submittal.

D. Electronic submittals will not be accepted except for approved Operation and Maintenance Manuals as required by this Specification.

E. Fax Transmittals:
1. Permitted on a case-by-case basis to expedite review when approved by Engineer.
2. Requires hard copy transmittal to immediately follow.
a. Engineer will proceed with review of fax transmittal.
b. Engineer's approval or rejection comments will be recorded and returned on hard copy transmittal.
3. Provisions apply to both:

a. Initial transmittal contents.
b. Supplemental information required to make initial transmittal contents complete.

1.6 ENGINEER'S REVIEW ACTION

A. Shop Drawings and Samples:
1. Items within transmittals will be reviewed for overall design intent and will receive one of the following actions:
a. A - FURNISH AS SUBMITTED.
b. B - FURNISH AS NOTED (BY ENGINEER).
c. C - REVISE AND RESUBMIT.
d. D - REJECTED.
e. E - ENGINEER'S REVIEW NOT REQUIRED.
2. Submittals received will be initially reviewed to ascertain inclusion of Contractor's approval stamp.
a. Submittals not stamped by the Contractor or stamped with a stamp containing language other than that specified herein will not be reviewed for technical content and will be returned without any action.
3. In relying on the representation on the Contractor’s review and approval stamp, Owner and Engineer reserve the right to review and process poorly organized and poorly described submittals as follows:
a. Submittals transmitted with a description identifying a single item and found to contain multiple independent items:
1) Review and approval will be limited to the single item described on the transmittal letter.
2) Other items identified in the submittal will:
a) Not be logged as received by the Engineer.
b) Be removed from the submittal package and returned without review and comment to the Contractor for coordination, description and stamping.
c) Be submitted by the Contractor as a new series number, not as a re-submittal number.
b. Engineer, at Engineer’s discretion, may revise the transmittal letter item list and descriptions, and conduct review.
1) Unless Contractor notifies Engineer in writing that the Engineer’s revision of the transmittal letter item list and descriptions was in error, Contractor’s review and approval stamp will be deemed to have applied to the entire contents of the submittal package.
4. Submittals returned with Action "A" or "B" are considered ready for fabrication and installation.
a. If for any reason a submittal that has an "A" or "B" Action is resubmitted, it must be accompanied by a letter defining the changes that have been made and the reason for the resubmittal.
b. Destroy or conspicuously mark "SUPERSEDED" all documents having previously received "A" or "B" Action that are superseded by a resubmittal.
5. Submittals with Action "A" or "B" combined with Action "C" (Revise and Resubmit) or "D" (Rejected) will be individually analyzed giving consideration as follows:
a. The portion of the submittal given "C" or "D" will not be distributed (unless previously agreed to otherwise at the Preconstruction Conference).
1) One (1) copy or the one (1) transparency of the "C" or "D" Drawings will be marked up and returned to the Contractor.
a) Correct and resubmit items so marked.
b. Items marked "A" or "B" will be fully distributed.
c. If a portion of the items or system proposed are acceptable, however, the major part of the individual Drawings or documents are incomplete or require revision, the entire submittal may be given "C" or "D" Action.
1) This is at the sole discretion of the Engineer.

2) In this case, some Drawings may contain relatively few or no comments or the statement, "Resubmit to maintain a complete package."
3) Distribution to the Owner and field will not be made (unless previously agreed to otherwise).

6. Failure to include any specific information specified under the submittal paragraphs of the Specifications will result in the submittal being returned to the Contractor with "C" or "D" Action.
7. Calculations required in individual Specification Sections will be received for information purposes only, as evidence calculations have been performed by individuals meeting specified qualifications, and will be returned stamped "E. Engineer's Review Not Required" to acknowledge receipt.
8. Transmittals of submittals which the Engineer considers as "Not Required" submittal information, which is supplemental to but not essential to prior submitted information, or items of information in a transmittal which have been reviewed and received "A" or "B" Action in a prior submittal, will be returned with Action "E. Engineer's Review Not Required."
9. Samples may be retained for comparison purposes.
   a. Remove samples when directed.
   b. Include in bid all costs of furnishing and removing samples.
10. Approved samples submitted or constructed, constitute criteria for judging completed work.
    a. Finished work or items not equal to samples will be rejected.

B. Operation and Maintenance Manuals:
1. Engineer will review and indicate one of the following review actions:
   a. A - ACCEPTABLE.
   b. B - FURNISH AS NOTED.
   c. C - REVISE AND RESUBMIT.
   d. D - REJECTED.
2. Acceptable paper copy submittals will be retained with the transmittal form returned with a request for one (1) additional paper copy and two (2) electronic copies on CD-ROM.
3. Deficient submittals (paper copy and/or electronic copy) will be returned along with the transmittal form which will be marked to indicate deficient areas.

PART 2 - PRODUCTS – (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

PART 3 - EXECUTION – (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

END OF SECTION

EXHIBIT A

Shop Drawing Transmittal No. _____-_____

(Spec Section) (Series)

Project Name:		Date Received:	
Project Owner:		Checked By:	
Contractor:	HDR Engineering, Inc.	Log Page:	
Address:	Address:	HDR No.:	
		Spec Section:	
		Drawing/Detail No.:	
Attn:	Attn:	1st. Sub	ReSub.
Date Transmitted:	Previous Transmittal Date:		

Item No.	No. Copies	Description	Manufacturer	Mfr/Vendor Dwg or Data No.	Action Taken*

Remarks:

* The Action designated above is in accordance with the following legend:

A - Furnish as Submitted

B - Furnish as Noted

C - Revise and Submit
1. Not enough information for review.
2. No reproducibles submitted.
3. Copies illegible.
4. Not enough copies submitted.
5. Wrong sequence number.
6. Wrong resubmittal number.
7. Wrong spec. section.
8. Wrong form used.
9. See comments.

D - Rejected

E - Engineer's review not required
1. Submittal not required.
2. Supplemental Information. Submittal retained for informational purposes only.
3. Information reviewed and approved on prior submittal.
4. See comments.

Comments:

By Date

Distribution: Contractor | File | Field | Owner | Other

(Jun 1990; Revised Jun 1997; Revised Oct 2001, Revised Nov 2007)

SECTION 01560

ENVIRONMENTAL PROTECTION AND SPECIAL CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Addresses:
   1. Minimizing the pollution of air, water, or land; control of noise, the disposal of solid waste materials, and protection of deposits of historical or archaeological interest.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.

1.2 SUMBITTALS

A. Shop Drawings:
   1. See Section 01340.
   2. Prior to the start of any construction activities submit:
      a. A detailed proposal of all methods of control and preventive measures to be utilized for environmental protection.
      b. A drawing of the work area, haul routes, storage areas, access routes and current land conditions including trees and vegetation.
      c. Storm Water Pollution Prevention Plan (SWPPP) as required by the Texas Pollutant Discharge Elimination System (TPDES) General Permit.
      d. Notice of Intent (NOI) as required by the TPDES General Permit.

PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SECTION)

PART 3 - EXECUTION

3.1 INSTALLATION

A. Employ and utilize environmental protection methods, obtain all necessary permits, and fully observe all local, state, and federal regulations.

B. Land Protection:
   1. Except for any work or storage area and access routes specifically assigned for the use of the Contractor, the land areas outside the limits of construction shall be preserved in their present condition. Contractor shall confine his construction activities to areas defined for work within the Contract Documents.
   2. Manage and control all work or storage areas to prevent sediment from entering nearby water or land adjacent to the work site.
   3. Restore all disturbed areas and establish permanent type of locally adaptable vegetative cover.
   4. Unless earthwork is immediately paved or surfaced, protect all side slopes and backslopes immediately upon completion of final grading.
   5. Plan and execute earthwork in a manner to minimize duration of exposure of unprotected soils.

6. Except for areas designated by the Contract Documents to be cleared and grubbed, the Contractor shall not deface, injure or destroy trees and vegetation, nor remove, cut, or disturb them without approval of the Engineer. Any damage caused by the Contractor's equipment or operations shall be restored as nearly as possible to its original condition at the Contractor's expense.

C. Surface Water Protection:
   1. Comply with Texas Commission on Environmental Quality (TCEQ) rules relating to Construction Storm Water Permits, the Texas Pollutant Discharge Elimination System (TPDES) stormwater program, and TPDES Construction General Permit No. TXR150000. (information and guidance on the TCEQ stormwater program is available online at https://www.tceq.texas.gov/permitting/stormwater/TXR15_AIR.html).
      a. Submit copy (copies) of a Stormwater Pollution Prevention Plan (SWPPP), Notice of Intent (NOI), and any supporting materials required by TCEQ.
      b. SWPPP may include copies of the contract drawings and specifications showing the proposed locations, notes, details, and specifications describing the temporary erosion/sedimentation control devices and revegetation requirements of the Contract.
      c. Prepare and submit all supporting materials required by TCEQ.
      d. The Engineer shall approve any deviations from or amendments to the proposed locations, notes, and details describing temporary erosion/sedimentation control devices and revegetation requirements of the Contract.
      e. Submit copies to Engineer of all correspondence to and from TCEQ.
   2. Utilize, as necessary, erosion control methods to protect side and backslopes, minimize and the discharge of sediment to the surface water leaving the construction site as soon as rough grading is complete. These controls shall be maintained until the site is ready for final grading and landscaping or until they are no longer warranted and concurrence is received from the Engineer. Physically retard the rate and volume of runon and runoff by:
      a. Implementing structural practices such as silt fences, rocked outlet protection, and sediment traps.
      b. Implementing vegetative practices such as permanent seeding, mulching, erosion control blankets, or a combination of these methods.
      c. Providing Construction sites with graveled or rocked access entrance and exit drives and parking areas to reduce the tracking of sediment onto public or private roads.
   3. Discharges from the construction site shall not contain pollutants at concentrations that produce objectionable films, colors, turbidity, deposits or noxious odors in the receiving stream or waterway.

D. Solid Waste Disposal:
   1. Collect solid waste on a daily basis.
   2. Provide disposal of degradable solid waste to an approved solid waste disposal site.
   3. Provide disposal of nondegradable solid waste to an approved solid waste disposal site or in an alternate manner approved by Engineer and regulatory agencies.
   4. No building materials wastes or unused building materials shall be buried, dumped, or disposed of on the site.

E. Fuel and Chemical Handling:
   1. Store and dispose of chemical wastes in a manner approved by regulatory agencies.
   2. Take special measures to prevent chemicals, fuels, oils, greases, herbicides, and insecticides from entering drainage ways.
   3. Do not allow water used in onsite material processing, concrete curing, cleanup, and other waste waters to enter a drainage way(s) or stream.
   4. The Contractor shall provide containment around fueling and chemical storage areas to ensure that spills in these areas do not reach waters of the state.

F. Control of Dust:

1. The control of dust shall mean that no construction activity shall take place without applying all such reasonable measures as may be required to prevent particulate matter from becoming airborne so that it remains visible beyond the limits of construction. Reasonable measures may include frequent road cleaning, application of water or application of chemical dust suppressants. The use of chemical agents such as calcium chloride must be approved by the Texas Department of Transportation (TxDOT).
2. Utilize methods and practices of construction to eliminate dust.

G. Burning:
1. Do not burn material on the site. If the Contractor elects to dispose of waste materials by burning, make arrangements for an off-site burning area and conform to all agency regulations.

H. Control of Noise:
1. Control noise by fitting equipment with appropriate mufflers.

I. Completion of Work:
1. Upon completion of work, leave area in a clean, natural looking condition.
2. Ensure all signs of temporary construction and activities incidental to construction of required permanent work are removed.

J. Historical Protection:
1. Refer to Section 01060.

END OF SECTION

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SECTION 01600
PRODUCT DELIVERY, STORAGE, AND HANDLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Scheduling of product delivery.
   2. Packaging of products for delivery.
   3. Protection of products against damage from:
      a. Handling.
      b. Exposure to elements or harsh environments.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.

C. Payment:
   1. No payment will be made to Contractor for equipment or materials not properly stored and insured or without approved shop drawings.
      a. Previous payments for items will be deducted from subsequent progress estimate(s) if proper storage procedures are not observed.

1.2 DELIVERY

A. Scheduling:
   1. Schedule delivery of products or equipment as required to allow timely installation and to avoid prolonged storage.

B. Packaging:
   1. Deliver products or equipment in manufacturer's original unbroken cartons or other containers designed and constructed to protect the contents from physical or environmental damage.

C. Identification:
   1. Clearly and fully mark and identify as to manufacturer, item, and installation location.

D. Protection and Handling:
   1. Provide manufacturer's instructions for storage and handling.

PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SECTION)

PART 3 - EXECUTION

3.1 PROTECTION, STORAGE AND HANDLING

A. Manufacturer's Instruction:
   1. Protect all products or equipment in accordance with manufacturer's written directions.
      a. Store products or equipment in location to avoid physical damage to items while in storage.
      b. Handle products or equipment in accordance with manufacturer's recommendations and instructions.
   2. Protect equipment from exposure to elements and keep thoroughly dry.
   3. When space heaters are provided in equipment, connect and operate heaters during storage until equipment is placed in service.

3.2 STORAGE FACILITIES

A. Temporary Storage Structure:
   1. Provide a weatherproof temporary on-site storage specifically for the purpose of providing for protection of products and equipment. Size structure to accommodate anticipated storage items.
   2. Equip structure with lockable doors, and provide electrical service for equipment space heaters and heating or ventilation.
   3. Provide methods of storage of products and equipment off the ground.
   4. Provide this structure within 30 days after Notice to Proceed. Locate structure on-site where shown on the Drawings or in location approved by Engineer. Remove structure from site prior to startup and demonstration period.

3.3 FIELD QUALITY CONTROL

A. Inspect Deliveries:
   1. Inspect all products or equipment delivered to the site prior to unloading. Reject all products or equipment that are damaged, used, or in any other way unsatisfactory for use on Project.

B. Monitor Storage Area:
   1. Monitor storage area to ensure suitable temperature and moisture conditions are maintained.

END OF SECTION

SECTION 01640
PRODUCT SUBSTITUTIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. The procedure for requesting substitution approval for a product which is specified by descriptive or performance criteria or defined by reference to one or more of the following:
      a. Name of manufacturer.
      b. Name of vendor.
      c. Trade name.
      d. Catalog number.
   2. Substitutions are not "or-equals."
   3. This Specification Section does not address substitutions for major equipment.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.

C. Requests for Substitution - General:
   1. Base all bids on materials, equipment, and procedures specified.
   2. Certain types of equipment and kinds of material are described in specifications by means of references to names of manufacturers and vendors, trade names, or catalog numbers. When this method of specifying is used, it is not intended to exclude from consideration other products bearing other manufacturer's or vendor's names, trade names, or catalog numbers, provided said products are capable of accomplishing the same tasks as the products specifically indicated.
   3. Other types of equipment and kinds of material may be acceptable substitutions under the following conditions:
      a. Or-equals are unavailable due to strike, discontinued production of products meeting specified requirements, or other factors beyond control of Contractor; or,
      b. Contractor proposes a cost and/or time reduction incentive to the Owner.

1.2 QUALITY ASSURANCE

A. In making request for substitution or in using an approved product, Contractor represents:
   1. He has investigated proposed product, and has determined that it is adequate or superior in all respects to that specified, and that it will perform function for which it is intended.
   2. He will provide same guarantee for substitute item as for product specified.
   3. He will coordinate installation of accepted substitution into work, to include building modifications if necessary, making such changes as may be required for work to be complete in all respects.
   4. He waives all claims for additional costs related to substitution which subsequently arise.

1.3 DEFINITIONS

A. Product: Manufactured material or equipment.

1.4 PROCEDURE FOR REQUESTING SUBSTITUTION

A. Considered after award of Contract.

B. Written requests through Contractor only.

C. Transmittal Mechanics:

1. Follow the transmittal mechanics prescribed for shop drawings in Section 01340. Product substitution will be treated in a manner similar to "deviations," as described in paragraph 1.04-A.19.f of Section 01340. List the letter describing the deviation and justifications on the transmittal form in the space provided under the column with the heading "DESCRIPTION." Include in the transmittal letter, either directly or as a clearly marked attachment, the items listed in paragraph D below.

D. Transmittal Contents:
   1. Product identification:
      a. Manufacturer's name.
      b. Telephone number and representative contact name.
      c. Specification section or drawing reference of originally specified product, including discrete name or tag number assigned to original product in the Contract Documents.
   2. Manufacturer's literature clearly marked to show compliance of proposed product with Contract Documents.
   3. Itemized comparison of original and proposed product addressing product characteristics including but not necessarily limited to:
      a. Size.
      b. Composition or materials of construction.
      c. Weight.
      d. Electrical or mechanical requirements.
   4. Product experience:
      a. Location of past projects utilizing product.
      b. Name and telephone number of persons associated with referenced projects knowledgeable concerning proposed product.
      c. Available field data and reports associated with proposed product.
   5. Data relating to changes in construction schedule.
   6. Data relating to changes in cost.
   7. Samples:
      a. At request of Engineer.
      b. Full size if requested by Engineer.
      c. Held until substantial completion.
      d. Engineer not responsible for loss or damage to samples.

1.5 APPROVAL OR REJECTION

A. Written approval or rejection of substitution given by the Engineer.

B. Engineer reserves the right to require proposed product to comply with color and pattern of specified product if necessary to secure design intent.

C. In event substitution results in a change of Contract price or time, provisions in General Conditions will be applied for adjustment.

D. Substitutions will be rejected if:
   1. Submittal is not through the Contractor with his stamp of approval.
   2. Requests are not made in accordance with this Section.
   3. In the Engineer's opinion, acceptance will require substantial revision of the original design.
   4. In the Engineer's opinion, substitution is not equal to original product specified or will not perform adequately the function for which it was intended.

E. Contractor shall reimburse Owner for the cost of Engineer's evaluation whether or not substitution is approved

END OF SECTION

SECTION 01650
FACILITY STARTUP

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Procedures and actions, required of the Contractor, which are necessary to achieve and demonstrate Substantial Completion.
   2. Requirements for Substantial Completion Submittals.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 02580 – Gravel Pack Wells.
   4. Section 11005 - Equipment: Basic Requirements.

1.2 DEFINITIONS

A. Pre-Demonstration Period: The period of time, of unspecified duration after initial construction and installation activities during which Contractor, with assistance from manufacturer's representatives, performs in the following sequence:
   1. Finishing type construction work to ensure the Project has reached a state of Substantial Completion.
   2. Equipment startup.
   3. Personnel training.

B. Demonstration Period: A period of time, of specified duration, following the Pre-Demonstration Period, during which the Contractor initiates product through the facility and starts up and operates the facility, without exceeding specified downtime limitations, to prove the functional integrity of the mechanical and electrical equipment and components and the control interfaces of the respective equipment and components comprising the facility as evidence of Substantial Completion.

C. Substantial Completion: See Division 0, General Conditions.

1.3 SUBMITTALS

A. Submit in the chronological order listed below prior to the completion of the Pre-Demonstration Period.
   1. Startup schedule:
      a. Submit 30 days (minimum) prior to startup.
      b. Schedule to include:
         1) Target date and time for Owner witnessing of system initial startup.
         2) Target date for initiation of Demonstration Period.
         3) Target date and time for operation and maintenance training for each system, both field and classroom.
      c. Submit for review and approval by Owner.
      d. Include holidays observed by Owner.
   2. Substantial Completion Submittal:
      a. File Contractor's Notice of Substantial Completion and Request for Inspection.
      b. Approved Operation and Maintenance manuals received by Engineer minimum 1 week prior to scheduled startup.

c. Written request for Owner to witness each system pre-demonstration startup. Request to be received by Owner minimum 1 week before scheduled training of Owner's personnel on that system.
d. Equipment installation and pre-demonstration startup certifications.
e. Letter verifying completion of all pre-demonstration startup activities including receipt of all specified items from manufacturers or suppliers as final item prior to initiation of Demonstration Period.

1.4 SEQUENCING AND SCHEDULING

A. Phased Construction:

B. Schedule of Events:

1.5 COST OF STARTUP

A. Contractor to pay all costs associated with Facility startup.

PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SECTION)

PART 3 - EXECUTION

3.1 GENERAL

A. Facility Startup Divided into Two Periods:
1. Pre-Demonstration Period including:
a. Completion of construction work to bring Project to a state of Substantial Completion.
b. Startup of Equipment.
c. Training of Personnel.
d. Completion of the filing of all required submittals.
e. Filing of Contractor's Notice of Substantial Completion and Request for Inspection.
2. Demonstration Period including:
a. Demonstration of functional integrity of facility.

3.2 PRE-DEMONSTRATION PERIOD

A. Completion of Construction Work:
1. Complete the work to bring the Project to a state of substantial completion.

B. Equipment Startup:
1. Requirements for individual items of equipment are included in Divisions 2 through 16 of these Specifications.
2. Prepare the equipment so it will operate properly and safely and be ready to demonstrate functional integrity during the Demonstration Period.
3. Perform Equipment Startup to extent possible without introducing product flow.
4. Introduce product flow to complete Equipment Startup for the following equipment:
a. Well and appurtenances..
5. Procedures include but are not necessarily limited to the following:
a. Test or check and correct deficiencies of:
1) Cleanliness of connecting piping systems.
2) Alignment of connected machinery.
3) Vacuum and pressure of all closed systems.
4) Lubrication.
5) Valve orientation and position status for manual operating mode.
6) All equipment: Proper connections, alignment, calibration and adjustment.
b. Manually rotate or move moving parts to assure freedom of movement.

c. Perform other tests, checks, and activities required to make the equipment ready for Demonstration Period.
d. Documentation:
1) Prepare a log showing each equipment item subject to this paragraph and listing what is to be accomplished during Equipment Startup. Provide a place for the Contractor to record date and person accomplishing required work. Submit completed document before requesting inspection for Substantial Completion certification.

6. Obtain certifications, without restrictions or qualifications, and deliver to Engineer:
a. Manufacturer's equipment installation check letters.
b. Instrumentation Supplier's Instrumentation Installation Certificate.

C. Personnel Training:
1. See schedule below:

SPECIFICATION SECTION	EQUIPMENT	HOURS OF TRAINING
11072	Vertical Turbine Well (Submersible)	2

2. Conduct all personnel training after completion of Equipment Start-up for the equipment for which training is being conducted.
a. Personnel training on individual equipment or systems will not be considered completed unless:
1) All pretraining deliverables are received and approved before commencement of training on the individual equipment or system.
2) No system malfunctions occur during training.
3) All provisions of field and classroom training specifications are met.
b. Training not in compliance with the above will be performed again in its entirety by the manufacturer at no additional cost to Owner.
3. Field training requirements:
a. Notify each manufacturer specified for on-site training that the Owner reserves the right to video record any or all training sessions. Organize each training session in a format compatible with video recording.
b. Training instructor: Factory trained and familiar with giving both classroom and "hands-on" instructions.
c. Training instructors: Be at classes on time. Session beginning and ending times to be coordinated with the Owner and indicated on the master schedule. Normal time lengths for class periods can vary, but brief rest breaks should be scheduled and taken.
d. Organize training sessions into maintenance verses operation topics and identify on schedule.
e. Plan for minimum class attendance of 6 people at each session and provide sufficient classroom materials, samples, and handouts for those in attendance.
f. Instructors to have a typed agenda and well prepared instructional material. The use of visual aids, e.g., films, pictures, and slides is recommended for use during the classroom training programs. Deliver agendas to the Engineer a minimum of 7 days prior to the classroom training. Provide equipment required for presentation of films, slides, and other visual aids.
g. In the on-site training sessions, cover the information required in the Operation and Maintenance manuals submitted according to Section 01340 and the following areas as applicable to PCS's.
1) Operation of equipment.
2) Lubrication of equipment.
3) Maintenance and repair of equipment.
4) Troubleshooting of equipment.
5) Preventive maintenance procedures.
6) Adjustments to equipment.
7) Inventory of spare parts.
8) Optimizing equipment performance.

9) Capabilities.
10) Operational safety.
11) Emergency situation response.
12) Takedown procedures (disassembly and assembly).

h. Address above Paragraphs 1), 2), 8), 9), 10), and 11) in the operation sessions. Address above Paragraphs 3), 4), 5), 6), 7), and 12) in the maintenance sessions.

i. Maintain a log of classroom training provided including: Instructors, topics, dates, time, and attendance.

D. Complete the filing of all required submittals:
1. Shop drawings.
2. Operation and Maintenance Manuals.

E. Filing of Contractor's Notice of Substantial Completion and Request for Inspection of Project:
1. File the notice when the following have been completed:
a. Construction work (brought to state of Substantial Completion).
b. Equipment Startup.
c. Personnel Training.
d. Submittal of required documents.
2. Engineer will review required submittals for completeness within 7 calendar days of Contractor's notice. If complete, Engineer will complete inspection of the Work, within 14 calendar days of Contractor's notice.
3. Engineer will inform Contractor in writing of the status of the Work reviewed, within 21 calendar days of Contractor's notice.
a. Work determined not meeting state of Substantial Completion:
1) Contractor: Correct deficiencies noted or submit plan of action for correction within 7 days of Engineer's determination.
2) Engineer: Reinspect work within 7 days of Contractor's notice of correction of deficiencies.
3) Reinspection costs incurred by Engineer will be billed to Owner who will deduct them from final payment due Contractor.
b. Work determined to be in state of tentative Substantial Completion: Engineer to prepare tentative "Engineer's Certificate of Substantial Completion."
c. Engineer's Certificate of Substantial Completion:
1) Certificate tentatively issued subject to successful Demonstration of functional integrity.
2) Issued for Project as a whole.
3) Issued subject to completion or correction of items cited in the certificate (punch list).
4) Issued with responsibilities of Owner and Contractor cited.
5) Executed by Engineer.
6) Accepted by Owner.
7) Accepted by Contractor.
d. Upon successful completion of Demonstration Period, Engineer will endorse certificate attesting to the successful demonstration, and citing the hour and date of ending the successful Demonstration Period of functional integrity as the effective date of Substantial Completion.

3.3 DEMONSTRATION PERIOD

A. General:
1. Demonstrate the functional integrity of the components comprising the facility as evidence of Substantial Completion.
2. Duration of Demonstration Period: See Section 02580.

3. If, during the Demonstration Period, the aggregate amount of time used for repair, alteration, or unscheduled adjustments to any equipment or systems that renders the affected equipment or system inoperative exceed 10 percent of the Demonstration Period, the demonstration of functional integrity will be deemed to have failed. In the event of failure, a new Demonstration Period will recommence after correction of the cause of failure. The new Demonstration Period shall have the same requirements and duration as the Demonstration Period previously conducted.
4. Conduct the demonstration of functional integrity under full operational conditions.
5. Owner will provide operational personnel to provide process decisions affecting system performance. Owner's assistance will be available only for system decisions. Contractor will perform all other functions including but not limited to equipment operation and maintenance until successful completion of the Demonstration Period.
6. Owner reserves the right to simulate operational variables, equipment failures, routine maintenance scenarios, etc., to verify the functional integrity of automatic and manual backup systems and alternate operating modes.
7. Time of beginning and ending any Demonstration Period shall be agreed upon by Contractor, Owner, and Engineer in advance of initiating Demonstration Period.
8. Throughout the Demonstration Period, provide knowledgeable personnel to answer Owner's questions, provide final field instruction on select systems and to respond to any system problems or failures which may occur.
9. Provide all labor, supervision, utilities, chemicals, maintenance, equipment, vehicles or any other item necessary to operate and demonstrate all systems being demonstrated.

END OF SECTION

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SECTION 01710
CLEANING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Intermediate and final cleaning of Work not including special cleaning of closed systems specified elsewhere.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.

1.2 STORAGE AND HANDLING

A. Store cleaning products and cleaning wastes in containers specifically designed for those materials.

1.3 SCHEDULING

A. Schedule cleaning operations so that dust and other contaminants disturbed by cleaning process will not fall on newly painted surfaces.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents:
   1. Compatible with surface being cleaned.
   2. New and uncontaminated.
   3. For Manufactured Surfaces: Material recommended by manufacturer.

PART 3 - EXECUTION

3.1 CLEANING - GENERAL

A. Prevent accumulation of wastes that create hazardous conditions.

B. Conduct cleaning and disposal operations to comply with laws and safety orders of governing authorities.

C. Do not dispose of volatile wastes such as mineral spirits, oil, or paint thinner in storm or sanitary drains or sewers.

D. Dispose of degradable debris at an approved solid waste disposal site.

E. Dispose of non-degradable debris at an approved solid waste disposal site or in an alternate manner approved by Engineer and regulatory agencies.

F. Handle materials in a controlled manner with as few handlings as possible.

G. Do not drop or throw materials from heights greater than 4 FT or less than 4 FT if conditions warrant greater care.

H. On completion of work, leave area in a clean, natural looking condition. Remove all signs of temporary construction and activities incidental to construction of required permanent Work.

I. Do not burn on-site.

3.2 EXTERIOR (SITE) CLEANING

A. Cleaning During Construction:
   1. Construction debris:
      a. Confine in strategically located container(s):
         1) Cover to prevent blowing by wind.
         2) Haul from site minimum once a week.
      b. Remove from work area to container daily.
   2. Vegetation:
      a. Keep weeds and other vegetation trimmed to 3 IN maximum height.
   3. Soils, sand, and gravel deposited on paved areas and walks:
      a. Remove as required to prevent muddy or dusty conditions.
      b. Do not flush into storm sewer system.

B. Final Cleaning:
   1. Remove trash and debris containers from site:
   2. Clean paved roadways.

3.3 FIELD QUALITY CONTROL

A. Immediately prior to Demonstration Period, conduct an inspection with Engineer to verify condition of all work areas.

END OF SECTION

SECTION 02110
SITE CLEARING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Site clearing, tree protection, stripping topsoil and demolition.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 02200 - Earthwork.
   4. Section 02260 - Topsoiling and Finished Grading.

PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SECTION)

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect existing trees and other vegetation to remain against damage.
   1. Do not smother trees by stockpiling construction materials or excavated materials within drip line.
   2. Avoid foot or vehicular traffic or parking of vehicles within drip line.
   3. Provide temporary protection as required.

B. Repair or replace trees and vegetation damaged by construction operations.
   1. Repair to be performed by a qualified tree surgeon.
   2. Remove trees which cannot be repaired and restore to full-growth status.
   3. Replace with new trees of minimum 4 IN caliper.

3.2 SITE CLEARING

A. Topsoil Removal:
   1. Strip topsoil to depths encountered.
      a. Remove heavy growths of grass before stripping.
      b. Stop topsoil stripping sufficient distance from such trees to prevent damage to main root system.
      c. Separate from underlying subsoil or objectionable material.
   2. Stockpile topsoil on site.
      a. Construct storage piles to freely drain surface water.
      b. Seed or cover storage piles to prevent erosion.
   3. Do not strip topsoil in wooded areas where no change in grade occurs.

B. Clearing and Grubbing:
   1. Clear from within limits of construction all trees not marked to remain.
      a. Include shrubs, brush, downed timber, rotten wood, heavy growth of grass and weeds, vines, rubbish, structures and debris.
   2. Grub (remove) from within limits of construction all stumps, roots, root mats, logs and debris encountered.
      a. Grubbing under areas to be paved:
         1) Totally grub.
      b. Grubbing in lawn areas:

1) In cut areas, totally grub.
2) In fill areas, where fill is less than 3 FT totally grub ground.
3) Where fill is 3 FT or more in depth, stumps may be left no higher than 6 IN above existing ground surface.

C. Disposal of Waste Materials:
1. Do not burn combustible materials on site.
2. Remove all waste materials from site.
3. Do not bury organic matter on site.

3.3 ACCEPTANCE

A. Upon completion of the site clearing, obtain Engineer's acceptance of the extent of clearing, depth of stripping and rough grade.

END OF SECTION

SECTION 02200
EARTHWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Earthwork.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 02221 – Trenching, Backfilling and Compacting for Utilities

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Society for Testing and Materials (ASTM):
      a. C33, Standard Specification for Concrete Aggregates.
      b. D698, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft3).
      c. D1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/f(2,700 kN-m/m)).
      d. D2487, Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System.
      e. D3786, Standard Test Method for Bursting Strength of Textile Fabrics--Diaphragm Bursting Strength Tester Method.
      f. D4253, Standard Test Methods for Maximum Index Density of Soils Using a Vibratory Table.
      g. D4254, Test Methods for Minimum Index Density of Soils and Calculation of Relative Density.
      h. D4632, Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Section 01340.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
   3. Certifications.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Fill and Backfill: Selected material approved by Engineer from site excavation or from off site borrow.

B. Granular Fill Under Slabs-On-Grade: Clean, crushed, nonporous rock, crushed or uncrushed gravel complying with ASTM C33 gradation size No.67, 3/4 IN to No.4.

C. Geotextile Filter Fabric:
   1. Nonwoven type.
   2. Equivalent opening size: 50-100 (U.S. Standard Sieve).
   3. Permeability coefficient (cm/second): 0.07 minimum, 0.30 maximum.

4. Grab strength: 90 LBS minimum in either direction in accordance with ASTM D4632 requirements.
5. Mullen burst strength: 125 psi minimum in accordance with ASTM D3786 requirements.

PART 3 - EXECUTION

3.1 PROTECTION

A. Protect existing surface and subsurface features on-site and adjacent to site as follows:
   1. Provide barricades, coverings, or other types of protection necessary to prevent damage to existing items indicated to remain in place.
   2. Protect and maintain bench marks, monuments or other established reference points and property corners. If disturbed or destroyed, replace at own expense to full satisfaction of Owner and controlling agency.
   3. Verify location of utilities in accordance with applicable laws and regulations. Omission or inclusion of utility items does not constitute non-existence or definite location. Secure and examine local utility records for location data.
      a. Take necessary precautions to protect existing utilities from damage due to any construction activity.
      b. Repair damages to utility items at own expense.
      c. In case of damage, notify Engineer at once so required protective measures may be taken.
   4. Maintain free of damage, existing sidewalks, structures, and pavement, not indicated to be removed. Any item known or unknown or not properly located that is inadvertently damaged shall be repaired to original condition. All repairs to be made and paid for by Contractor.
   5. Provide full access to public and private premises, fire hydrants, street crossings, sidewalks and other points as designated by Owner to prevent serious interruption of travel.
   6. Maintain stockpiles and excavations in such a manner to prevent inconvenience or damage to structures on-site or on adjoining property.
   7. Avoid surcharge or excavation procedures which can result in heaving, caving, or slides.

B. Dispose of waste materials, legally, off site. Burning, as a means of waste disposal, is not permitted.

3.2 SITE EXCAVATION AND GRADING

A. The work includes all operations in connection with excavation, borrow, construction of fills and embankments, rough grading, and disposal of excess materials in connection with the preparation of the site(s) for construction of the proposed facilities.

B. Excavation and Grading: Perform as required by the Contract Drawings.
   1. Contract Drawings may indicate both existing grade and finished grade required for construction of Project. Stake all units, structures, piping, roads, parking areas and walks and establish their elevations. Perform other layout work required. Replace property corner markers to original location if disturbed or destroyed.
   2. Preparation of ground surface for embankments or fills: Before fill is started, scarify to a minimum depth of 6 IN in all proposed embankment and fill areas. Where ground surface is steeper than one vertical to four horizontal, plow surface in a manner to bench and break up surface so that fill material will bind with existing surface.
   3. Protection of finish grade: During construction, shape and drain embankment and excavations. Maintain ditches and drains to provide drainage at all times. Protect graded areas against action of elements prior to acceptance of work. Reestablish grade where settlement or erosion occurs.

C. Borrow: Provide necessary amount of approved fill compacted to density equal to that indicated in this Specification. Include cost of all borrow material in original proposal. Fill material to be approved by Engineer prior to placement.

D. Construct embankments and fills as required by the Contract Drawings:
   1. Construct embankments and fills at locations and to lines of grade indicated. Completed fill shall correspond to shape of typical cross section or contour indicated regardless of method used to show shape, size, and extent of line and grade of completed work.
   2. Provide approved fill material which is free from roots, organic matter, trash, frozen material, and stones having maximum dimension greater than 6 IN. Ensure that stones larger than 4 IN are not placed in upper 6 IN of fill or embankment. Do not place material in layers greater than 8 IN loose thickness. Place layers horizontally and compact each layer prior to placing additional fill.
   3. Compact by sheepsfoot, pneumatic rollers, vibrators, or by other equipment as required to obtain specified density. Control moisture for each layer necessary to meet requirements of compaction.

3.3 USE OF EXPLOSIVES

A. Blasting with any type of explosive is prohibited.

3.4 FIELD QUALITY CONTROL

A. Moisture density relations, to be established by the Engineer required for all materials to be compacted.

B. Extent of compaction testing will be as necessary to assure compliance with Specifications.

C. Give minimum of 24 HR advance notice to Engineer when ready for compaction or subgrade testing and inspection.

D. Should any compaction density test or subgrade inspection fail to meet Specification requirements, perform corrective work as necessary.

E. Pay for all costs associated with corrective work and retesting resulting from failing compaction density tests.

3.5 COMPACTION DENSITY REQUIREMENTS

A. Obtain approval from Engineer with regard to suitability of soils and acceptable subgrade prior to subsequent operations.

B. Provide dewatering system necessary to successfully complete compaction and construction requirements.

C. Remove frozen, loose, wet, or soft material and replace with approved material as directed by Engineer.

D. Stabilize subgrade with well graded granular materials as directed by Engineer.

E. Assure by results of testing that compaction densities comply with the following requirements:
   1. Sitework:

LOCATION	COMPACTION DENSITY
UNDER PAVED AREAS, SIDEWALKS AND PIPING:	
Cohesive Soils	100 percent, ASTM D698
Cohesionless Soils	75 percent relative density per ASTM D4253 and D4254

UNPAVED AREAS	
Cohesive Soils	85 percent, ASTM D698
Cohesionless Soils	60 percent relative density per ASTM D4253 and D4254

2. Structures:

LOCATION	COMPACTION DENSITY
Inside of structures under foundations, under equipment support pads, under slabs-on-grade and scarified existing subgrade under fill material	95 percent, ASTM D1557
Outside structures next to walls, piers, columns and any other structure exterior member	90 percent, ASTM D1557

3. Specific areas:

LOCATION	COMPACTION DENSITY
Outside structures under equipment support foundations	95 percent, ASTM D1557
Under void forms	85 percent, ASTM D1557
Granular fill under building floor slabs-on-grade	60 percent relative density per ASTM D4253 and D4254

3.6 EXCAVATION, FILLING, AND BACKFILLING FOR STRUCTURES

A. General:
   1. In general, work includes, but is not necessarily limited to, excavation for structures and retaining walls, removal of underground obstructions and undesirable material, backfilling, filling, and fill, backfill, and subgrade compaction.
   2. Obtain fill and backfill material necessary to produce grades required. Materials and source to be approved by Engineer. Excavated material approved by Engineer may also be used for fill and backfill.
   3. In this Section of the Specifications, the word "foundations" includes footings, base slabs, foundation walls, mat foundations, grade beams, piers and any other support placed directly on soil.
   4. In the paragraphs of this Section of the Specifications, the word "soil" also includes any type of rock subgrade that may be present at or below existing subgrade levels.

B. Excavation Requirements for Structures:
   1. General. Do not commence excavation for foundations for structures until:
      a. Engineer approves:
         1) The removal of topsoil and other unsuitable and undesirable material from existing subgrade.
         2) Density and moisture content of site area compacted fill material meets requirements of specifications.
         3) Site surcharge or mass fill material can be removed from entire construction site or portion thereof.
         4) Surcharge or mass fill material has been removed from construction area or portions thereof.

b. Engineer grants approval to begin excavations.

2. Dimensions:
   a. Excavate to elevations and dimensions indicated or specified.
   b. Allow additional space as required for construction operations and inspection of foundations.
3. Removal of obstructions and undesirable materials in excavation includes, but is not necessarily limited to, removal of old foundations, existing construction, unsuitable subgrade soils, expansive type soils, and any other materials which may be concealed beneath present grade, as required to execute work indicated on Contract Drawings. If undesirable material and obstructions are encountered during excavation, remove material and replace as directed by Engineer.
4. Level off bottoms of excavations to receive foundations, floor slabs, equipment support pads, or compacted fill. Remove loose materials and bring excavations into approved condition to receive concrete or fill material. Where compacted fill material must be placed to bring subgrade elevation up to underside of construction, scarify existing subgrade upon which fill material is to be placed to a depth of 6 IN and then compact to density stated in this Section of Specifications before fill material can be placed thereon. Do not carry excavations lower than shown for foundations except as directed by Engineer or Engineer. If any part of excavations is carried below required depth without authorization, maintain excavation and start foundation from excavated level with concrete of same strength as required for superimposed foundation, and no extra compensation will be made to Contractor therefor.
5. Make excavations large enough for working space, forms, dampproofing, waterproofing, and inspection.
6. Notify Engineer as soon as excavation is completed in order that subgrades may be inspected. Do not commence further construction until subgrade under compacted fill material, under foundations, under floor slabs-on-grade, under equipment support pads, and under retaining wall footings has been inspected and approved by the Engineer as being free of undesirable material, being of compaction density required by this specification, and being capable of supporting the allowable foundation design bearing pressures and superimposed foundation, fill, and building loads to be placed thereon. Engineer shall be given the opportunity to inspect subgrade below fill material both prior to and after subgrade compaction.
   a. Place fill material, foundations, retaining wall footings, floor slabs-on-grade, and equipment support pads as soon as weather conditions permit after excavation is completed, inspected, and approved and after forms and reinforcing are inspected and approved. Before concrete or fill material is placed, protect approved subgrade from becoming loose, wet, frozen, or soft due to weather, construction operations, or other reasons.
7. Dewatering: Where groundwater is encountered during excavation, install a dewatering system to prevent softening and disturbance of subgrade below foundations and fill material, to allow foundations and fill material to be placed in the dry, and to maintain a stable excavation side slope. Groundwater shall be maintained at least 3 FT below the bottom of any excavation. Employ dewatering specialist for selecting and operating dewatering system. Keep dewatering system in operation until dead load of structure exceeds possible buoyant uplift force on structure. Dispose of groundwater to an area which will not interfere with construction operations or damage existing construction. Install groundwater monitoring wells as necessary. Shut off dewatering system at such a rate to prevent a quick upsurge of water that might weaken the subgrade.

8. Subgrade stabilization: If subgrade under foundations, fill material, floor slabs-on-grade, or equipment support pads is in a frozen, loose, wet, or soft condition before construction is placed thereon, remove frozen, loose, wet, or soft material and replace with approved compacted material as directed by Engineer. Provide compaction density of replacement material as stated in this specification section. Loose, wet, or soft materials, when approved by Engineer, may be stabilized by a compacted working mat of well graded crushed stone. Compact stone mat thoroughly into subgrade to avoid future migration of fines into the stone voids. Remove and replace frozen materials as directed by Engineer. Method of stabilization shall be performed as directed by Engineer. Do not place further construction on the repaired subgrades, until the subgrades have been approved by the Engineer.
9. Do not place floor slabs-on-grade including equipment support pads until subgrade below has been approved, piping has been tested and approved, reinforcement placement has been approved, and Contractor receives approval to commence slab construction. Do not place building floor slabs-on-grade including equipment support pads when temperature of air surrounding the slab and pads is or is expected to be below 40 DegF before structure is completed and heated to a temperature of at least 50 DegF.
10. Protection of structures: Prevent new and existing structures from becoming damaged due to construction operations or other reasons. Prevent subgrade under new and existing foundations from becoming wet and undermined during construction due to presence of surface or subsurface water or due to construction operations.
11. Shoring: Shore, sheet pile, slope, or brace excavations as required to prevent them from collapsing. Remove shoring as backfilling progresses but only when banks are stable and safe from caving or collapse.
12. Drainage: Control grading around structures so that ground is pitched to prevent water from running into excavated areas or damaging structures. Maintain excavations where foundations, floor slabs, equipment support pads or fill material are to be placed free of water. Provide pumping required to keep excavated spaces clear of water during construction. Should any water be encountered in the excavation, notify Engineer. Provide free discharge of water by trenches, pumps, wells, well points, or other means as necessary and drain to point of disposal that will not damage existing or new construction or interfere with construction operations.
13. Frost protection: Do not place foundations, slabs-on-grade, equipment support pads, or fill material on frozen ground. When freezing temperatures may be expected, do not excavate to full depth indicated, unless foundations, floor slabs, equipment support pads, or fill material can be placed immediately after excavation has been completed and approved. Protect excavation from frost if placing of concrete or fill is delayed.
    a. Where a concrete slab is a base slab-on-grade located under and within a structure that will not be heated, protect subgrade under the slab from becoming frozen until final acceptance of the Project by the Owner.
    b. Protect subgrade under foundations of a structure from becoming frozen until structure is completed and heated to a temperature of at least 50 DegF.

C. Fill and Backfill Inside of Structure and Below Foundations, Base Slabs, Floor Slabs, Equipment Support Pads and Piping:
1. General: Subgrade to receive fill or backfill shall be free of undesirable material as determined by Engineer and scarified to a depth of 6 IN and compacted to density specified herein. Surface may be stepped by at not more than 12 IN per step or may be sloped at not more than 2 percent. Do not place any fill or backfill material until subgrade under fill or backfill has been inspected and approved by Engineer as being free of undesirable material and compacted to specified density.
2. Obtain approval of fill and backfill material and source from Engineer prior to placing the material.
3. Granular fill under slabs-on-grade: Place all floor slabs-on-grade on a minimum of 6 IN of granular fill unless otherwise indicated.

4. Fill and backfill placement: Prior to placing fill and backfill material, optimum moisture and maximum density properties for proposed material shall be obtained from Engineer. Place fill and backfill material in thin lifts as necessary to obtain required compaction density. Compact material by means of equipment of sufficient size and proper type to obtain specified density. Use hand operated equipment for filling and backfilling next to walls. Do not place fill and backfill when the temperature is less than 40 DegF and when subgrade to receive fill and backfill material is frozen, wet, loose, or soft. Use vibratory equipment to compact granular material; do not use water.
5. Where fill material is required below foundations, place fill material, conforming to the required density and moisture content, outside the exterior limits of foundations located around perimeter of structure the following horizontal distance whichever is greater:
    a. As required to provide fill material to indicated finished grade.
    b. 5 FT.
    c. Distance equal to depth of compacted fill below bottom of foundations.
    d. As directed by Engineer.

D. Filling and Backfilling Outside of Structures. This paragraph of these specifications apply to fill and backfill placed outside of structures above bottom level of both foundations and piping but not under paving. Provide material as approved by Engineer for filling and backfilling outside of structures.
1. Fill and backfill placement: Prior to placing fill and backfill material, obtain optimum moisture and maximum density properties for proposed material from Engineer. Place fill and backfill material in thin lifts as necessary to obtain required compaction density. Compact material with equipment of proper type and size to obtain density specified. Use only hand operated equipment for filling and backfilling next to walls and retaining walls. Do not place fill or backfill material when temperature is less than 40 DegF and when subgrade to receive material is frozen, wet, loose, or soft. Use vibratory equipment for compacting granular material; do not use water.
2. Backfilling against walls:
    a. Do not backfill around any part of structures until each part has reached specified 28-day compressive strength and backfill material has been approved. Do not start backfilling until concrete forms have been removed, trash removed from excavations, pointing of masonry work, concrete finishing, dampproofing and waterproofing have been completed.
    b. Do not place fills against walls until floor slabs at top, bottom, and at intermediate levels of walls are in place and have reached 28-day required compressive strength to prevent wall movement.
    c. Bring backfill and fill up uniformly around the structures and individual walls, piers, or columns.

E. Backfilling Outside of Structures Under Piping or Paving: When backfilling outside of structures requires placing backfill material under piping or paving, the material shall be placed from bottom of excavation to underside of piping or paving at the density required for fill under piping or paving as indicated in this Section. This compacted material shall extend transversely to the centerline of piping or paving a horizontal distance each side of the exterior edges of piping or paving equal to the depth of backfill measured from bottom of excavation to underside of piping or paving. Provide special compacted bedding or compacted subgrade material under piping or paving as required by other sections of these Specifications.

END OF SECTION

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SECTION 02221

TRENCHING, BACKFILLING, AND COMPACTING FOR UTILITIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Excavation, trenching, backfilling and compacting for all underground utilities.
   2. Water piping.
   3. Electrical duct banks, conduits, and direct burial cables.
   4. All related utility appurtenances.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 02200 - Earthwork.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Association of State Highway & Transportation Officials (AASHTO):
      a. T99, The Moisture-Density Relations of Soils Using a 5.5 LB Rammer and a 12 IN Drop.
      b. T180, Moisture-Density Relations of Soils Using a 10 LB Rammer and an 18 IN Drop.
   2. American Society for Testing and Materials (ASTM):
      a. C33, Standard Specification for Concrete Aggregates.
      b. D698, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft3).
      c. D1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/f(2,700 kN-m/m)).
      d. D2487, Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System.
      e. D4253, Standard Test Methods for Maximum Index Density of Soils Using a Vibratory Table.
      f. D4254, Minimum Index Density of Soils and Calculation of Relative Density.

1.3 DEFINITIONS

A. Excavation:
   1. All excavation will be defined as unclassified.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Section 01340 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
   3. Trench shield (trench box) certification if employed:
      a. Specific to Project conditions.
      b. Re-certified if members become distressed.
      c. Certification by registered professional structural engineer, registered in the state where the Project is located.
      d. Engineer is not responsible to, and will not, review and approve.

4. Submit respective pipe or conduit manufacturer's data regarding bedding methods of installation and general recommendations.
5. Submit sieve analysis reports on all granular materials.

1.5 PROJECT CONDITIONS

A. Avoid overloading or surcharge a sufficient distance back from edge of excavation to prevent slides or caving. Maintain and trim excavated materials in such manner to be as little inconvenience as possible to public and adjoining property owners.

B. Provide full access to public and private premises and fire hydrants, at road crossings, sidewalks and other points as designated by Owner to prevent serious interruption of travel.

C. Protect and maintain bench marks, monuments or other established points and reference points and if disturbed or destroyed, replace items to full satisfaction of Owner and controlling agency.

D. Verify location of existing underground utilities prior to beginning excavation as required by applicable state laws and regulations.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Backfill Material:
1. As approved by Engineer.
    a. Free of rock cobbles, roots, sod or other organic matter, and frozen material.
    b. Moisture content at time of placement: 3 percent plus/minus of optimum moisture content as specified in accordance with ASTM D698.

B. Subgrade Stabilization Materials: Provide subgrade stabilization material consisting of coarse aggregate, ASTM C33, No. 67.

C. Bedding Materials:
1. ASTM C33, gradation 8.
2. Or other uniformly graded granular material approved by the Engineer and Owner.

PART 3 - EXECUTION

3.1 GENERAL

A. Remove and dispose of unsuitable materials to site provided by Contractor.

3.2 EXCAVATION

A. Unclassified Excavation:
1. Remove rock excavation, clay, silt, gravel, hard pan, loose shale, and loose stone as directed by Geotechnical Engineer.

B. Excavation for Appurtenances:
1. 12 IN (minimum) clear distance between outer surface and embankment.
2. See Section 02200 for applicable requirements.

C. Trench Excavation:
1. Excavate trenches by open cut method to depth shown on Drawings and necessary to accommodate work.
    a. Support existing utility lines and yard piping where proposed work crosses at a lower elevation.
        1) Stabilize excavation to prevent undermining of existing utility and yard piping.
2. Open trench outside buildings, units, and structures:

a. No more than the distance between two manholes, structures, units, or 300 LF, whichever is less.
b. Field adjust limitations as weather conditions dictate.

3. Maximum length of open trench:
   a. No more than 100 LF at any one time.
4. Any trench or portion of trench, which is opened and remains idle for 7 calendar days, or longer, as determined by the Owner, may be directed to be immediately refilled, without completion of work, at no additional cost to Owner. Said trench may not be reopened until Owner is satisfied that work associated with trench will be prosecuted with dispatch.
5. Observe following trenching criteria:
   a. Trench size.
      1) Excavate width to accommodate free working space.
      2) Maximum trench width at top of pipe or conduit may not exceed outside diameter of utility service by more than the following dimensions:

OVERALL DIAMETER OF UTILITY SERVICE	EXCESS DIMENSION
33 IN and less	18 IN
more than 33 IN	24 IN

      3) Cut trench walls vertically from bottom of trench to 1 FT above top of pipe, conduit, or utility service.
      4) Keep trenches free of water.
         a) Include cost in Bid.
         b) No separate payment for surface water runoff pumping will be made.

D. Trenching for Electrical Installations:
1. Observe paragraph 3.2 C "Trench Excavation"
2. Modify for electrical installations as follows:
   a. Open no more than 600 LF of trench in exterior locations for trenches more than 12 IN but not more than 30 IN wide.
   b. Any length of trench may be opened in exterior locations for trenches which are 12 IN wide or less.
   c. Do not over excavate trench.
   d. Cut trenches for electrical runs with minimum 30 IN cover, unless otherwise specified.
   e. See Division 16 for additional requirements.

E. Flowable Fill:
1. Flowable fill shall be:
   a. Discharged from a mixer by any means acceptable to the Engineer into the area to be filled.
   b. Placed in 4 FT maximum lifts to the elevations indicated.
      1) Allow 12 HR set-up time before placing next lift or as approved by the Engineer.
      2) Contractor shall place flowable fill lifts in such a manner as to prevent flotation of the pipe.
2. Flowable fill shall not be placed on frozen ground.
3. Subgrade on which flowable fill is placed shall be free of disturbed or softened material and water.
4. Conform to appropriate requirements of Specification Section 02200.
5. Flowable fill batching, mixing, and placing may be started if weather conditions are favorable, and the air temperature is 34 DegF and rising.
6. At the time of placement, flowable fill must have a temperature of at least 40 DegF.
7. Mixing and placing shall stop when the air temperature is 38 DegF or less and falling.
8. Each filling stage shall be as continuous an operation as is practicable.
9. Contractor shall prevent traffic contact with flowable fill for at least 24 HRS after placement or until flowable fill is hard enough to prevent rutting by construction equipment.

3.3 PREPARATION OF FOUNDATION FOR PIPE LAYING

A. Over-Excavation:
   1. Backfill and compact to 90 percent of maximum dry density per ASTM D698.
   2. Backfill with granular bedding material as option.

B. Rock Excavation:
   1. Excavate minimum of 6 IN below bottom exterior surface of the pipe or conduit.
   2. Backfill to grade with suitable earth or granular material.
   3. Form bell holes in trench bottom.

C. Subgrade Stabilization:
   1. Stabilize the subgrade when directed by the Owner.
   2. Observe the following requirements when unstable trench bottom materials are encountered.
      a. Notify Owner when unstable materials are encountered.
         1) Define by drawing station locations and limits.
      b. Remove unstable trench bottom caused by Contractor failure to dewater, rainfall, or Contractor operations.
         1) Replace with subgrade stabilization with no additional compensation.

3.4 BACKFILLING METHODS

A. Do not backfill until tests to be performed on system show system is in full compliance to specified requirements.

B. Carefully Compacted Backfill:
   1. Furnish if indicated on drawings, specified for trench embedment conditions and for compacted backfill conditions up to 12 IN above top of pipe or conduit.
   2. Comply with the following:
      a. Place backfill in lifts not exceeding 8 IN (loose thickness).
      b. Hand place, shovel slice, and pneumatically tamp all carefully compacted backfill.
      c. Observe specific manufacturer's recommendations regarding backfilling and compaction.
      d. Compact each lift to specified requirements.

C. Common Trench Backfill:
   1. Perform in accordance with the following:
      a. Place backfill in lift thicknesses capable of being compacted to densities specified.
      b. Observe specific manufacturer's recommendations regarding backfilling and compaction.
      c. Avoid displacing joints and appurtenances or causing any horizontal or vertical misalignment, separation, or distortion.

D. Water flushing for consolidation is not permitted.

E. Backfilling for Electrical Installations:
   1. Observe paragraph 3.4 C or D "Backfilling Methods."
   2. Modify for electrical installation as follows:
      a. Observe notes and details on electrical drawings for fill in immediate vicinity of direct burial cables.

3.5 COMPACTION

A. General:
   1. Place and assure bedding, backfill, and fill materials achieve an equal or "higher" degree of compaction than undisturbed materials adjacent to the work.
   2. In no case shall degree of compaction below "Minimum Compaction" specified be accepted.

B. Compaction Requirements: Unless noted otherwise on Drawings or more stringently by other sections of these Specifications, comply with following trench compaction criteria:

MINIMUM COMPACTIONS

LOCATION	SOIL TYPE	DENSITY
1. Bedding Material:		
All Locations	Cohesionless Soils	75 percent of max relative density by ASTM D4253 and D4254
2. Carefully compacted backfill:		
All applicable areas	Cohesive soils	95 percent of max dry density by ASTM D698
	Cohesionless soils	75 percent relative density by ASTM D4253 and D4254
3. Common trench backfill:		
Under pavements roadways surfaces, within highway right-of-ways	Cohesive soils	90 percent of max dry density by ASTM D698
	Cohesionless soils	60 percent of relative density by ASTM D4253 and D4254
Under turfed, sodded, plant seeded, non-traffic areas	Cohesive soils	85 percent of max dry density by ASTM D698
	Cohesionless soils	40 percent of relative density by ASTM D4253 and D4254

3.6 FIELD QUALITY CONTROL

A. Testing:
   1. Perform in-place moisture-density tests as directed by the Owner.
   2. Perform tests through recognized testing laboratory approved by Owner.
   3. Costs of "Passing" tests paid by Owner.
   4. Perform additional tests as directed until compaction meets or exceeds requirements.
   5. Cost associated with "Failing" tests shall be paid by Contractor.
   6. Reference to Engineer in this Specification Section will imply Geotechnical Engineer when employed by Owner and directed by Engineer to undertake necessary inspections as approvals as necessary.
   7. Assure Owner has immediate access for testing of all soils related work.
   8. Ensure excavations are safe for testing personnel.

END OF SECTION

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SECTION 02260
TOPSOILING AND FINISHED GRADING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Topsoiling and finished grading.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 02110 - Site Clearing.
   4. Section 02200 - Earthwork.
   5. Section 02930 - Seeding.

C. Location of Work: All areas within limits of grading and all areas outside limits of grading which are disturbed in the course of the work.

1.2 SUBMITTALS

A. Shop Drawings:
   1. See Section 01340.
   2. Project Data: Test reports for furnished topsoil.

1.3 SITE CONDITIONS

A. Verify amount of topsoil stockpiled and determine amount of additional topsoil, if necessary to complete work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Topsoil:
   1. Original surface soil typical of the area.
   2. Existing topsoil stockpiled under Section 02110.
   3. Capable of supporting native plant growth.

2.2 TOLERANCES

A. Finish Grading Tolerance: 0.1 FT plus/minus from required elevations.

PART 3 - EXECUTION

3.1 PREPARATION

A. Correct, adjust and/or repair rough graded areas.
   1. Cut off mounds and ridges.
   2. Fill gullies and depressions.
   3. Perform other necessary repairs.
   4. Bring all sub-grades to specified contours, even and properly compacted.

B. Loosen surface to depth of 2 IN, minimum.

C. Remove all stones and debris over 2 IN in any dimension.

3.2 ROUGH GRADE REVIEW

A. Reviewed by Engineer in Section 02110, Site Clearing.

3.3 PLACING TOPSOIL

A. Do not place when subgrade is wet or frozen enough to cause clodding.

B. Spread to compacted depth of 4 IN for all disturbed earth areas.

C. If topsoil stockpiled is less than amount required for work, furnish additional topsoil at no cost to Owner.

D. Provide finished surface free of stones, sticks, or other material 1 IN or more in any dimension.

E. Provide finished surface smooth and true to required grades.

F. Restore stockpile area to condition of rest of finished work.

3.4 ACCEPTANCE

A. Upon completion of topsoiling, obtain Engineer's acceptance of grade and surface.

B. Make test holes where directed to verify proper placement and thickness of topsoil.

END OF SECTION

SECTION 02444
CHAIN LINK FENCE AND GATES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Chain link gates.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 02200 - Earthwork.
   4. Section 03002 - Concrete.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Society for Testing and Materials (ASTM):
      a. A153, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
      b. A392, Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric.
      c. A824, Standard Specification for Metallic-Coated Steel Marcelled Tension Wire for use with Chain-Link Fence.
      d. F552, Terminology Relating to Chain-Link Fencing.
      e. F567, Standard Practice for Installation of Chain Link Fence.
      f. F626, Standard Specification for Fence Fittings.
      g. F900, Standard Specification for Industrial and Commercial Swing Gates.
      h. F1043, Standard Specification for Strength and Protective Coatings on Steel Industrial Fence Framework.
      i. F1083, Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures.
   2. Chain Link Manufacturer's Institute for "Galvanized Steel Chain Link Fence Fabric and Accessories."

B. Qualifications:
   1. Installer shall have a minimum 2 years experience installing similar fencing.

1.3 DEFINITIONS

A. See ASTM F552.

B. NPS: Nominal pipe size, in inches.

C. Installer or Applicator: Installer or applicator is the person actually installing or applying the product in the field at the Project site.
   1. Installer or applicator are synonymous.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Section 01340.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
   3. Scaled plan layout showing spacing of components, accessories, fittings, and post anchorage.
   4. Mill certificates.

5. Source quality control test results.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Fence manufacturers:
      a. Cyclone.
      b. Page-Wilson Corporation (Page Fence Division).
      c. Anchor Fence, Inc.
      d. Or approved equal.

B. Submit requests for substitution in accordance with Specification Section 01640.

2.2 COMPONENTS

A. Chain Link Fabric:
   1. Fabric type:
      a. ASTM A392 zinc-coated steel:
         1) Coated before weaving, 2.0 OZ/SF.
   2. Wire gage: 9.
   3. Mesh size: 2 IN.
   4. Selvage treatment:
      a. Top: Knuckled.
      b. Bottom: Twisted and barbed.

B. Concrete: See Section 03002.

C. Tension Wire:
   1. Bottom of fabric:
      a. ASTM A824, galvanized steel, Class 3.

D. Swing Gate:
   1. ASTM F900.
   2. Materials as specified for fence framework and fabric.
   3. Hardware:
      a. Galvanized per ASTM A153.
      b. Hinges to permit 180-degree outward gate opening.

E. Line Post:
   1. ASTM F1083 pipe:
      a. Schedule 40, NPS 2.

F. Corner or Terminals Posts:
   1. ASTM F1083 pipe:
      a. Schedule 40, NPS 2-1/2.

G. Brace and Rails:
   1. ASTM F1083 pipe:
      a. Schedule 40, NPS 1-1/4.

H. Fence Fittings (Post and Line Caps, Rail and Brace Ends, Sleeves-Top Rail, Tie Wires and Clips, Tension and Brace Bands, Tension Bars, Truss Rods):
   1. ASTM F626.

I. Barber Wire:
   1. Three strands.
   2. Galvanized steel:
      a. ASTM A121.
      b. Class 3 zinc coating.
      c. Four-point barbs.

2.3 SOURCE QUALITY CONTROL

A. Test related fence construction materials to meet the following standards:
   1. Posts and rails:
      a. ASTM F1043, Heavy Industrial.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with:
   1. Manufacturer's instructions.
   2. As per Drawings.
   3. In accordance with ASTM F567.

B. Do not start fence installation before final grading is complete and finish elevations are established.

C. Drill holes in firm, undisturbed or compacted soil.

D. Place fence with bottom edge of fabric at maximum clearance above grade, as shown on Drawings.
   1. Correct minor irregularities in earth to maintain maximum clearance.

E. Space line posts at equal intervals not exceeding 10 FT OC.

F. Provide post braces for each gate, corner, pull and terminal post and first adjacent line post.

G. Install tension bars full height of fabric.

H. Rails:
   1. Fit rails with expansion couplings of outside sleeve type.
   2. Rails continuous for outside sleeve type for full length of fence.

I. Provide expansion couplings in top rails at not more than 20 FT intervals.

J. Anchor top rails to main posts with appropriate wrought or malleable fittings.

K. Install bracing assemblies at all end and gate posts, as well as side, corner, and pull posts.
   1. Locate compression members at mid-height of fabric.
   2. Extend diagonal tension members from compression members to bases of posts.
   3. Install so that posts are plumb when under correct tension.

L. Pull fabric taut and secure to posts and rails.
   1. Secure so that fabric remains in tension after pulling force is released.
   2. Secure to posts at not over 15 IN OC, and to rails at not over 24 IN OC, and to tension wire at not over 24 IN OC.
   3. Use U-shaped wire conforming to diameter of pipe to which attached, clasping pipe and fabric firmly with ends twisted at least two (2) full turns.
   4. Bend ends of wire to minimize hazards to persons or clothing.

M. Install post top at each post.

N. Gates:
   1. Construct with fittings or by welding.
   2. Provide rigid, weatherproof joints.
   3. Assure right, non-sagging, non-twisting gate.
   4. Coat welds with rust preventive paint, color to match pipe.
   5. Install tension bars full height of fabric.

END OF SECTION

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SECTION 02580
PRODUCTION WELL

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the specifications for the construction of a production well.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. ASTM International (ASTM):
      a. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
      b. C150, Standard Specification for Portland Cement.
      c. C494, Standard Specification for Chemical Admixtures for Concrete.
   2. American Welding Society (AWS):
      a. Code for Arc and Gas Welding.
   3. American Water Works Association (AWWA):
      a. A100, Standard for Water Wells.

B. Qualifications:
   1. Licensed by the Texas Department of Licensing and Regulation for Water Well Drillers and Water Well Pump Installers.

C. Comply with all State of Texas rules and regulations concerning water well construction.

1.3 SUBMITTALS

A. Submit one (1) copy of the following Well Data at conclusion of drilling the pilot hole and running of geophysical logs to the Engineer as soon as possible. Copy may be in paper or digital format. This data is time sensitive in that it will be used by Engineer to select pump size or to plug the pilot hole. The data include:
   1. Description of driller’s log, including time schedule and description of formations encountered with emphasis on major fractures and cavities, drilling fluid used, and drilling fluids and cuttings returns and losses.
   2. Copy of geophysical logs.

B. Submit two (2) copies of the following Well Data at conclusion of substantially complete construction. Copies may be in paper or digital format.
   1. Daily driller's report:
      a. Maintain a daily, detailed driller's report during the drilling of the well.
      b. Furnish a complete description of all formations encountered, number of feet drilled, number of hours on the job, shutdown due to breakdowns or weather, feet of casing set, and such other pertinent data as may be requested by the Engineer.
   2. Driller's log:
      a. During the drilling of the well, prepare and keep and complete log setting forth the following:
         1) The reference point for all depth measurements.
         2) The depth at which each change of formation occurs.
         3) The depth at which the first water was encountered.
         4) The identification of the material of which each stratum is composed, such as:
            a) Clay.

b) Sand or silt.
c) Limestone, including fractures and voids.
d) Hard rock.
5) Samples of drill cuttings of formations encountered (one (1) set total).
6) The depth interval from which each formation sample was taken.
7) The depth to the static water level (SWL).
8) Total depth of completed well.
9) Any and all other pertinent information for a complete and accurate log.
10) Depth or location of any lost drilling fluid, drilling materials or tools.
11) The depth of the surface seal.
12) Well development description, including methods, time duration, and results.

3. Geophysical log:
   a. Following completion of test drilling, run the following geophysical logs:
      1) Electric (SP and Resistivity),
      2) Gamma,
      3) Caliper, and
      4) Video of zone below water table.
4. Well performance test results:
   a. Keep accurate records of the pumping test data, including: date of the test, the clock time, depth to water below the measuring point, the pumping rate, and any pertinent comments on conditions that may affect the accuracy of the data.
      1) Measure depth to water with an electric water level meter or data logger and pressure transducer.
      2) Measure discharge with a flow meter or inline orifice weir.
   b. Provide copies of the results of the well performance tests as described in these specifications.
5. Completed State of Texas Well Registration Form.
   a. Submit two (2) copies to Engineer.
6. Completed laboratory analysis of water sample.
   a. Submit two (2) copies to Engineer.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Well Casing:
   1. Provide steel well casing material conforming to ASTM A53 (Grade B).
   2. Furnish well casing diameter and length as shown on Drawings.

2.2 MIXES

A. Well Grout:
   1. Well annulus grout to be a mixture of one (1) bag of Portland cement (94 LBS, ASTM C150) to not more than 6 GAL of clean water.

PART 3 - EXECUTION

3.1 GENERAL

A. Sequence:
   1. Drill a pilot test hole to depth as indicated on Drawings. Collect formation samples as drilling progresses.
   2. Perform geophysical logging
   3. Provide data and information to Engineer for either selection of discharges for test pumping. or plugging the pilot test hole and abandoning well construction

4. If the decision is to plug the pilot test hole, the contractor is to:
    a. Plug the test hole according to the Specifications.
5. If the decision is to construct a producing well, the sequence is as follows:
    a. Conduct a plumbness/alignment test.
    b. Ream the pilot test hole to the depth of the casing.
    c. Install and grout the casing.
    d. Ream the pilot test hole to completion depth, as determined by the Engineer and at a diameter as shown in the Drawings. The well will be open hole completion.
    e. Develop the well.
    f. Conduct preliminary Step-Drawdown test.
    g. Using data from Step-Drawdown test, Engineer will make recommendation on well pump and motor sizing. Owner and Engineer will provide direction to Contractor in writing.
    h. Disinfect the well.
    i. Install permanent pumping equipment.
    j. Conduct 36-HR constant rate pumping test at design capacity.
    k. Collect water samples and submit to laboratory.
    l. Install well head and piping, valves, power, and meters, as shown on the Drawings.
    m. Conduct start-up operations.

3.2 WELL CONSTRUCTION

A. Well Drilling:
1. Install or construct containment facilities for drilling fluids, drill cuttings and returns. Pits are permitted. However, shallow bedrock may inhibit their construction. If pits are dug, they must be completely emptied and filled and compacted with native soil.
2. Drill well utilizing air rotary method.
3. Drilling fluid:
    a. Selection of drilling fluids and additives is made by Contractor, but they must be approved for use in the construction of potable water wells.
    b. Take all necessary measures to protect water-bearing formations from contamination and ensure that the drilling method used will not permanently plug the water-bearing formations with drilling fluid and cuttings.
4. Drill one nominal 7 IN pilot hole to a depth of approximately 180 FT.
5. Contain drilling fluids, waste, returns and cuttings to Site.
6. Obtain samples of formations encountered during drilling.
7. Purge test hole of drilling fluids and cuttings.
8. Run geological logs.
9. Provide data and information to Engineer for recommendation on step-drawdown test pumping.
10. Ream test hole to bottom of casing, as shown on the Drawings or determined by Engineer, to nominal 20 IN diameter.
11. Install nominal 16 IN diameter steel casing to bottom of reamed test hole. Utilize up to three (3) centralizers to center casing in borehole.
12. Grout casing.
13. Well Grout:
    a. Grout annular space between well casing and drill hole to seal well against infiltration of contaminated surface water.
    b. Ensure that annular space is free from obstructions before placing grout.
    c. Emplace grout using the positive displacement-exterior method (AWWA standard A100-06, Appendix C, Section C.2).
        1) Ensure that no voids are formed in grout seal.
        2) Place grout casing to land surface with continuous pour, starting at bottom of casing.
14. Ream test hole down to total depth to nominal 15 IN diameter, as shown on the Drawings or determined by Engineer.

15. Well Development:
    a. Furnish necessary pumps, compressors, plungers, bailing or other needed equipment and develop well by such approved methods.
    b. Development will continue for at least 4 HRS.
16. Step-Drawdown Test Pumping:
    a. Install a temporary test pump that is capable of producing up to 300, 600 or 1,000 GPM, as directed by Engineer.
    b. Install a discharge pipe with the outlet at least 150 FT down gradient from the well.
    c. Install a sediment trap to collect sand or debris at end of discharge pipe.
    d. Operate test pump up to 2 HRS to further develop the well and get preliminary information on well yield and drawdown.
    e. After the well has been idle for 1 HR or more, conduct a 6 HR step drawdown test. Pumping rates are to be last about 2 HRS and at about 0.75, 1.00 ,1.20 times the constant rate discharge of about 300, 600 or 1,000 GPM, as directed by Engineer. This rate may be adjusted down by the Engineer on the basis well performance during development.
        1) Measure groundwater levels before test pumping begins and, at least, at 5 MIN intervals for first hour of the each of the pumping rates and 15 MIN for the next hour. Actual times are to be recorded to the nearest minute. If an automated water level recorder is used instead of manual measurements, the time interval is to be set a 1 MIN.
        2) Measure well discharge at half- hour intervals or less.
17. Sanitary protection of well:
    a. At all times during the Work, use reasonable precautions to prevent either tampering with the test hole or test well or the entrance of foreign material into it.
    b. Extend watertight well casing to not less than 24 IN above final ground level elevation.
    c. Upon completion of well, install a temporary suitable threaded, flanged, or welded cap so as to prevent any pollutants from entering the well.
    d. Keep well drilling equipment and tools clean.

B. Well Disinfection:
1. After well is completed, disinfect well and pump with chlorine solution. Thoroughly clean well of all foreign substances, oil, grease, joint dope, and scum, including tools, timbers, rope, debris, cement, prior to disinfection. Utilize chemical cleaners if necessary.
2. Disinfect well in accordance with AWWA A100 and 30 TAC §290. Disinfectant to remain in well for at least 6 HRS per TAC §290.41(c)(3)(F).

C. Pumping Equipment:
1. Using data from Step-Drawdown test, Engineer will make recommendation on well pump and motor sizing. Owner and Engineer will provide decision on well pump and motor sizing to Contractor in writing.
2. Install permanent pumping equipment (See Section 11072)

D. Test Pumping:
    a. Install a discharge pipe with the outlet at least 150 FT down gradient from the well.
    b. Install a sediment trap to collect sand or debris at end of discharge pipe.
    c. Conduct a 36 HR pumping test at a constant rate of about 300, 600 or 1,000 GPM, as previously directed by Engineer.
        1) Measure groundwater levels before test pumping begins and, at least, at 5 MIN intervals for first hour of the pumping test, 15 MIN for the next three hours, and 30 MIN for the remainder of the pumping cycle. During recovery, measure water levels at 10 MIN intervals. Intervals are guidelines. Actual times are to be recorded to the nearest minute. If an automated water level recorder is used instead of manual measurements, the time interval is to be set a 1 MIN.
        2) Measure well discharge at half- hour intervals or less.

E. Water Sample:

1. Near the end of the 36 HR constant rate pumping test, collect a water sample in containers provided by laboratory approved by TCEQ.
2. Laboratory analyses required by TCEQ for a public water supply well in Williamson County.

F. Protection of Quality of Water:
1. Take necessary precautions to prevent contamination of the well and the aquifer from which the well is to draw its supply.
2. In the event the well becomes contaminated due to the neglect of the Contractor, the Contractor, at his own expense, will perform such work as may be necessary to eliminate the contamination.

3.3 FIELD QUALITY CONTROL:

A. Plumbness and Alignment Tests:
1. Conduct tests for plumbness and alignment following construction of the pilot test hole, and before test pump equipment is installed, in accordance with AWWA A100 and Appendix D of AWWA A100, or other method approved by the Engineer.
2. Maximum misalignment and out-of-plumb shall be as specified in AWWA A 100 and Appendix D of AWWA A100.
3. Correct the plumbness and alignment of the well or redrill at Contractor's expense.
4. Make records of deflection readings and all other pertinent information a part of the permanent well log and record.

END OF SECTION

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SECTION 02930
SEEDING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Seeding of all disturbed areas resulting from construction activities.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 02260 - Topsoiling and Finished Grading.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Nursery and Landscape Association/American National Standards Institute (ANLA/ANSI):
   2. Z60.1, American Standard for Nursery Stock American Society for Testing and Materials (ASTM):
      a. D2028, Standard Specification for Cutback Asphalt.
      b. D5276, Standard Test Method for Drop Test of Loaded Containers by Free Fall.
   3. Standard Methods of the Association of Official Agricultural Chemists.
   4. United States Department of Agriculture, (USDA):
      a. Federal Seed Act.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Section 01340.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
      c. Signed copies of vendor's statement for seed mixture required, stating botanical and common name, place of origin, strain, percentage of purity, percentage of germination, and amount of Pure Live Seed (PLS) per bag.
   3. Certification:
      a. Certify each container of seed delivered will be labeled in accordance with Federal and State Seed Laws and equals or exceeds Specification requirements.
   4. Other documents:
      a. Copies of invoices for fertilizer used on Project showing grade furnished, along with certification of quality and warranty. If Engineer determines fertilizer requires sampling and testing to verify quality, testing will be done at Contractor's expense, in accordance with current methods of Association of Official Agricultural Chemists. Upon completion of Project, a final check of total quantities of fertilizer used will be made against total area seeded. If minimum rates of application have not been met, Contractor will be required to distribute additional quantities to make up minimum application specified.
      b. Perform and submit a soils analysis and fertilizer recommendations prepared by an independent, qualified entity.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Topsoil: See Section 02260.

B. Fertilizer: Complete, soluble fertilizer, uniform in composition, dry and free-flowing, part of the elements of which are derived from organic sources. It shall contain the following percentages by weight:

Nitrogen (N) 16 Phosphorus (P) 20 Potassium (K)

Deliver fertilizers mixed as specified, in standard size, unopened containers, showing weight, analysis and name of manufacturer. Store in a weatherproof storage place and in such a manner that the fertilizer will be kept dry and its effectiveness not impaired. If and when bulk delivery and spreading of fertilizer is authorized, provided with a notarized, written affidavit certifying weight and analysis of the fertilizer. Cyanic compounds on hydrated lime are not permitted in fertilizer mix.

C. Grass Seed: to be provided in the quantities, and at the application rates and specified times for District 15, Mixture for Use in clay to Tight soils, per TxDOT Standard Specifications for Construction of highways, Streets, and Bridges, Item # 164, table 2. Utilize seeding for native grasses for pipelines.

D. Mulch: Cellulose Fiber Mulch produced from grinding clean, whole wood chips with a labeled ash content not to exceed 7%: designed for use in conventional hydraulic mulching of grass seed with fertilizers and other additives and shall be such that when applied, will form a strong, moisture-retaining mat without the need of an asphalt binder.

E. Water: provide water for the execution of this work and maintenance until Project Acceptance, capable of initiating and supporting plant growth, and free of harmful or deleterious substances.

F. Erosion Control Blanket: 100% straw with lightweight photodegradable netting on both sides. Netting sewn on 3 IN center or less. Minimum roll width 7.5 Ft. Approved products include:
   1. Straw Mat by Erosion Control Systems, Tuscaloosa, AL.
   2. S2 Straw blanket bu Bon terra America, Moscow, ID.
   3. Or approved equal

PART 3 - EXECUTION

3.1 SOIL PREPARATION

A. General:
   1. Limit preparation to areas which will be planted soon after.
   2. Provide facilities to protect and safeguard all persons on or about premises.
   3. Protect existing trees designated to remain.
   4. Verify location and existence of all underground utilities. Take necessary precaution to protect existing utilities from damage due to construction activity. Repair all damages to utility items at sole expense.
   5. Provide facilities such as protective fences and/or watchmen to protect work from vandalism. Contractor to be responsible for vandalism until acceptance of work in whole or in part.

B. Preparation of Soil for Seeding.
   1. Loosen surface to minimum depth of 4 IN. Remove stones over 1 IN in any dimension and sticks, roots, rubbish, and other extraneous matter.
   2. Prior to applying fertilizer, loosen areas to be seeded with a double disc or other suitable device if the soil has become hard or compacted. Correct any surface irregularities in order to prevent pocket or low areas which will allow water to stand.

3. Distribute fertilizer uniformly over areas to be seeded:
   a. For lawn-type seeding: 30 LBS per 1000 SF.
   b. For pasture seeding: 200 LBS per acre.
4. Incorporate fertilizer into soil to a depth of at least 2 IN by disking, harrowing, or other approved methods.
5. Grade lawn areas to a smooth, even surface with a loose, uniformly fine texture. Roll and rake, remove ridges and fill depressions, as required to meet finish grades. Limit fine grading to areas which can be planted soon after preparation.
6. Restore lawn areas to specified condition if eroded or otherwise disturbed after fine grading and before planting.

3.2 HYDROSEEDING AND MULCHING

A. Seed within seven days of completion of topsoiling and finished grading prior to soil retention blanket installation to minimize potential for erosion.

B. Optimum seeding dates are February 1st to May 15th for warm season grasses. Seeding shall be done whenever weather and soil conditions are favorable. If Contractor completes earthwork and erosion control mat installation prior to February 1st, Contractor shall seed with a mixture of oats (2 lbs. Per acre) and, winter wheat grass (8 lbs. Per acre) for temporary erosion control until seeding in accordance with this section is performed.

C. Do not use seed which is wet, moldy, or otherwise damaged.

D. Application Rates:
   1. Seed: See paragraph 2.1C. Adjust actual application rates as necessary depending on PLS of seed delivered to the project to achieve the application rates specified.
   2. Fertilizer: 20LBS/1000SF (Dry weight in hydroseed application), or as recommended in soil analysis.
   3. Cellulose Fiber Mulch: 70LBS/1000SF (Dry weight).

E. Uniformly distribute the seed mixture over all areas to receive hydroseeding. All varieties of seed, fertilizer, and cellulose fiber may be distributed at the same time at the specified rate after being mixed and agitated in the hydoseeding machine for at least ten (10) minutes, in order to provide a homogeneous mixture. Apply, mixture as water slurry and achieve an even, solid cover. Mixture shall be dyed green to allow visual metering of its application.

F. Protect all areas not to receive hydroseding mixture adjacent to the work from direct or overspray.

G. Seed mixture shall be prepared immediately prior to application, and shall be promptly applied once mixed. Seed mixture which, in the opinion of the Engineer is old, shall be wasted at the Contractor expense.

3.3 INSTALLATION OF SOIL RETENTION BLANKET

A. Install soil retention blanket on all disturbed areas which exceed a slope of 10% and as directed by the Engineer and in accordance with manufacture's recommendations for critical area installations.

B. Minimize side overlaps by using widest widths available from manufacturer.

3.4 MAINTENANCE AND REPLACEMENT

A. General:
   1. Begin maintenance of seeded areas immediately after each portion is seeded and continue until final acceptance or for a specific time period as stated below, whichever is the longer.
   2. Provide and maintain temporary piping, hoses, and watering equipment as required to convey water from water sources and to keep planted areas uniformly moist as required for proper growth.

B. Seeded Areas:
   1. Maintain by watering, fertilizing, weeding, mowing, trimming, and other operations such as rolling, regrading, and reseeding as required to establish a smooth, uniform area, free of weeds and eroded or bare areas.
   2. Repair damage to soil retention blanket using same materials and methods.
   3. Protect all seeded areas from erosion, rutting, or other damage. Correct all damage which occurs by applying fresh topsoil and reseeding using same materials and methods specified.
   4. Lay out temporary lawn watering system and arrange watering schedule to avoid walking over muddy and newly seeded areas. Use equipment and water to prevent puddling and water erosion and displacement of seed or mulch.
   5. Coordinate maintenance activities with Owner.
   6. Maintain seeded areas until final completion
   7. Any seeded area not showing sufficient growth within thew twelve-month project warranty period shall be prepared and reseeded. “Sufficient growth” is defined as 85% cover with no bare areas exceeding 15 SF in area.

END OF SECTION

SECTION 03002
CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Cast-in-place concrete and grout.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Concrete Institute (ACI):
      a. CT-13, Cement and Concrete Terminology.
      b. 211.1, Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete.
      c. 212.3R, Chemical Admixtures for Concrete.
      d. 304R, Guide for Measuring, Mixing, Transporting, and Placing Concrete.
      e. 304.2R, Placing Concrete by Pumping Methods.
      f. 305.1, Hot Weather Concreting.
      g. 306.1, Cold Weather Concreting.
      h. 318, Building Code Requirements for Structural Concrete.
      i. 347, Guide to Formwork for Concrete.
   2. American Society for Testing and Materials (ASTM):
      a. A82, Standard Specification Steel Wire, Plain, for Concrete Reinforcement.
      b. A185, Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
      c. A615, Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement (Including Supplementary Requirements S1).
      d. A775, Standard Specification for Epoxy-Coated Reinforcing Steel Bars.
      e. C31, Standard Practice for Making and Curing Concrete Test Specimens in the Field.
      f. C33, Standard Specification for Concrete Aggregates.
      g. C39, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
      h. C94/C94M, Standard Specification for Ready-Mixed Concrete.
      i. C138, Standard Method of Test for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete.
      j. C143, Standard Test Method for Slump of Hydraulic Cement Concrete.
      k. C150, Standard Specification for Portland Cement.
      l. C157, Standard Test Method for Length Change of Hardened Hydraulic Cement Mortar and Concrete.
      m. C171, Standard Specification for Sheet Materials for Curing Concrete.
      n. C172, Standard Practice for Sampling Freshly Mixed Concrete.
      o. C173, Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
      p. C231, Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
      q. C260, Standard Specification for Air Entraining Admixtures for Concrete.
      r. C289, Standard Test Method for Potential Alkali-Silica Reactivity of Aggregates (Chemical Method).

s. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
t. C494, Standard Specification for Chemical Admixtures for Concrete.
u. C595, Standard Specification for Blended Hydraulic Cements.
v. C618, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete.
w. D994, Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
x. D1056, Standard Specification for Flexible Cellular Materials Sponge or Expanded Rubber.
y. D1751, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
z. E329, Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction.

3. Federal Specification (FS):
   a. CEGS 03300, Vegetable Fiber.
4. Corps of Engineers: Specification CRD-C572 Polyvinyl Waterstops.

B. Quality Control:
1. Concrete testing agency.
   a. Contractor to employ and pay for services of a testing laboratory to:
      1) Perform materials evaluation.
      2) Design concrete mixes.
   b. Concrete testing agency to meet requirements of ASTM E329.
2. Do not begin concrete production until proposed concrete mix design has been approved by Engineer.
   a. Approval of concrete mix design by Engineer does not relieve Contractor of his responsibility to provide concrete that meets the requirements of this Specification.
3. Adjust concrete mix designs when material characteristics, job conditions, weather, strength test results or other circumstances warrant.
   a. Do not use revised concrete mixes until submitted to and approved by Engineer.
4. Perform structural calculations as required to prove that all portions of the structure in combination with remaining forming and shoring system has sufficient strength to safely support its own weight plus the loads placed thereon.

C. Qualifications:
1. Ready mixed concrete batch plant certified by National Ready Mixed Concrete Association (NRMCA).

1.3 DEFINITIONS

A. Per ACI CT-13 except as modified herein:
1. Concrete fill: Non-structural concrete.
2. Concrete Testing Agency: Testing agency employed to perform materials evaluation, design of concrete mixes or testing of concrete placed during construction.
3. Exposed concrete: Exposed to view after construction is complete.
4. Indicated: Indicated by Contract Documents.
5. Lean concrete: Concrete with low cement content.
6. Nonexposed concrete: Not exposed to view after construction is complete.
7. Required: Required by Contract Documents.
8. Specified strength: Specified compressive strength at 28 days.
9. Submitted: Submitted to Engineer.

1.4 SUBMITTALS

A. Shop Drawings:
1. See Section 01340.

2. Concrete mix designs proposed for use. Concrete mix design submittal to include the following information:
    a. Sieve analysis and source of fine and coarse aggregates.
    b. Test for aggregate organic impurities.
    c. Test for deleterious aggregate per ASTM C289.
    d. Proportioning of all materials.
    e. Type of cement with mill certificate for cement.
    f. Type of fly ash with certificate of conformance to specification requirements.
    g. Slump.
    h. Air content.
    i. Brand, type, ASTM designation, and quantity of each admixture proposed for use.
    j. 28-day cylinder compressive test results of trial mixes per ACI 318 and as indicated herein.
3. Manufacturer and type of joint filler, joint sealant, curing agent and chemical floor hardener.
4. Manufacturer and type of bonding and patching mortar and bonding adhesive used at construction joints.
5. Manufacturer and type of nonshrink grout and the cure/seal compound required for the nonshrink grout.
6. Reinforcing steel: Show grade, sizes, number, configuration, spacing, location and all fabrication and placement details.
    a. In sufficient detail to permit installation of reinforcing without having to make reference to Contract Drawings.
    b. Obtain approval of shop drawings by Engineer before fabrication.
    c. Mill certificates.

B. Collect and submit batching tickets to Engineer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Storage of Material:
1. Cement and pozzolan:
    a. Store in moistureproof, weathertight enclosures.
    b. Do not use if caked or lumpy.
2. Aggregate:
    a. Store to prevent segregation and contamination with other sizes or foreign materials.
    b. Obtain samples for testing from aggregates at point of batching.
    c. Do not use frozen or partially frozen aggregates.
    d. Do not use bottom 6 IN of stockpiles in contact with ground.
    e. Allow sand to drain until moisture content is uniform prior to use.
3. Admixtures:
    a. Protect from contamination, evaporation, freezing, or damage.
    b. Maintain within temperature range recommended by manufacturer.
    c. Completely mix solutions and suspensions prior to use.
4. Reinforcing steel:
    a. Support and store all rebars above ground.

B. Delivery:
1. Concrete:
    a. Prepare a batching (delivery) ticket for each load for ready-mixed concrete.
    b. Batching tickets shall indicate:
        1) Mix identification mark.
        2) Quantity delivered.
        3) Amount of each material in batch.
        4) Outdoor temp in the shade.
        5) Time at which cement was added.
        6) Numerical sequence of the delivery.
        7) Amount of water added.

2. Reinforcing steel: Ship to jobsite with attached plastic or metal tags with permanent mark numbers.
    a. Mark numbers to match shop drawing mark number.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
    1. Nonshrink, nonmetallic grout:
        a. Sika "SikaGrout 212."
        b. Euclid Chemical "NSGrout."
        c. Master Builders "Masterflow 713."
    2. Epoxy grout:
        a. BASF Admixtures, Inc. “Brutem MPG”
        b. Euclid Chemical Company, "E3-G."
        c. Fosroc, "Conbextra EPHF".
    3. Expansion joint fillers:
        a. Permaglaze Co.
        b. Rubatex Corp.
        c. Williams Products, Inc.
    4. Form coating:
        a. Richmond "Rich Cote."
        b. Industrial Lubricants "Nox-Crete Form Coating."
        c. Euclid Chemical “Kurez DR VOX”
    5. Chemical Floor Hardeners.
        a. L & M Construction Chemicals, Inc.
        b. Euclid Chemicals Inc.
        c. Dayton Superior.

2.2 MATERIALS

A. Portland Cement: Conform to ASTM C150 Type I.

B. Fly Ash:
    1. ASTM C618, Class F or Class C.
    2. Nonstaining.
        a. Hardened concrete containing fly ash to be uniform light gray color.
    3. Maximum loss on ignition: 4 percent.
    4. Compatible with other concrete ingredients.
    5. Obtain proposed fly ash from a source approved by the Texas Department of Transportation for use in structural concrete.

C. Admixtures:
    1. Air entraining admixtures: ASTM C260.
    2. Water reducing, retarding, and accelerating admixtures:
        a. ASTM C494 Type A through E.
        b. Conform to provisions of ACI 212.3R.
        c. Do not use retarding or accelerating admixtures unless specifically approved in writing by Engineer and at no cost to Owner.
        d. Follow manufacturer's instructions.
        e. Use chloride free admixtures only.
    3. Maximum total water soluble chloride ion content contributed from all ingredients of concrete including water, aggregates, cementitious materials and admixtures by weight percent of cement: 0.10.
    4. Do not use calcium chloride.

5. Pozzolanic admixtures: ASTM C618.
6. Provide admixtures of same type, manufacturer and quantity as used in establishing required concrete proportions in the mix design.

D. Water: Potable, clean, free of oils, acids and organic matter.

E. Aggregates:
   1. Normal weight concrete: ASTM C33, except as modified below.
   2. Fine aggregate: Clean natural sand.
      a. No manufactured or artificial sand.
   3. Coarse aggregate: Crushed rock, natural gravel, or other inert granular material.
      a. Maximum amount of clay or shale particles: 1 percent.
   4. Gradation of coarse aggregate:
      a. Lean concrete and concrete topping: Size #7.
      b. All other concrete: Size #57 or #67.

F. Concrete Grout:
   1. Nonshrink nonmetallic grout:
      a. Nonmetallic, noncorrosive, nonstaining, premixed with only water to be added.
      b. Grout to produce a positive but controlled expansion.
      c. Mass expansion not to be created by gas liberation.
      d. Minimum compressive strength of nonshrink grout at 28 days: 6500 psi.
   2. Epoxy grout:
      a. 3-component epoxy resin system.
         1) Two liquid epoxy components.
         2) One inert aggregate filler component.
      b. Each component packaged separately for mixing at jobsite.

G. Reinforcing Steel:
   1. Reinforcing bars: ASTM A615, Grade 60.
   2. Welded wire fabric: ASTM A185.
      a. Minimum yield strength: 60,000 psi.

H. Forms:
   1. Prefabricated or job built
   2. Wood forms:
      a. New 5/8 or 3/4 IN 5-ply structural plywood of concrete form grade.
      b. Built-in-place or prefabricated type panel.
   3. Metal forms:
      a. Metal forms excluding aluminum may be used.
      b. Forms to be tight to prevent leakage, free of rust and straight without dents to provide members of uniform thickness.
   4. Chamfer strips: Clear white pine, surface against concrete planed.
   5. Form ties: Removable end, permanently embedded body type with cones on outer ends not requiring auxiliary spreaders.
      a. Cone diameter: 3/4 IN minimum to 1 IN maximum.
      b. Embedded portion 1 IN minimum back from concrete face.
      c. If not provided with threaded ends, constructed for breaking off ends without damage to concrete.
   6. Form release: Nonstaining and shall not prevent bonding of future finishes to concrete surface.

I. Chairs, Runners, Bolsters, Spacers, and Hangers:
   1. Stainless steel, epoxy coated, or plastic coated metal.
      a. Plastic coated: Rebar support tips in contact with the forms only.

J. Chemical Floor Hardener:
   1. Colorless, no VOC,odorless chemical solution containing alkaline siliconates.
   2. Will not support bacteria growth.

3. 10 year manufacturers warranty
4. L&M Construction Chemicals Inc. “Seal Hard”

K. Membrane Curing Compound: ASTM C309, Type II-B.
1. Resin based, dissipates upon exposure to UV light.
2. Curing compound shall not prevent bonding of any future coverings, coatings or finishes.
3. Curing compounds used in water treatment plant construction to be nontoxic and taste and odor free.

L. Expansion Joint Filler:
1. Exterior driveways, curbs and sidewalks:
a. Asphalt expansion joint filler.
b. ASTM D994.
2. Other use:
a. Fiber expansion joint filler.
b. ASTM D1751.

2.3 CONCRETE MIXES

A. General:
1. All concrete to be ready mixed concrete conforming to ASTM C94/C94M.
2. Provide concrete of specified quality capable of being placed without segregation and, when cured, of developing all properties required.
3. All concrete to be normal weight concrete.
4. Provide pozzolan content for all cast-in-place construction.

B. Strength:
1. Provide specified strength and type of concrete for each use in structure(s) as follows:

TYPE	WEIGHT	SPECIFIED STRENGTH*
Concrete Fill	Normal weight	3000 psi
All other general use Concrete	Normal weight	4000 psi

*Minimum 28-day compressive strength.

C. Air Entrainment: Provide air entrainment in all concrete resulting in a total air content percent by volume as follows:

MAX AGGREGATE SIZE	TOTAL AIR CONTENT PERCENT
1 IN or 3/4 IN	6 ±1-1/2
<3/4 IN	6-1/2 ±1-1/2

1. Air content to be measured in accordance with ASTM C231, ASTM C173, or ASTM C138.

D. Slump: 4 IN maximum, 1 IN minimum.
1. Measured at point of discharge of the concrete into the concrete construction member.
2. 8 IN maximum after addition of superplasticizer (if used).
3. Concrete of lower than minimum slump may be used provided it can be properly placed and consolidated.
4. Pumped concrete:
a. Provide additional water at batch plant to allow for slump loss due to pumping.
b. Provide only enough additional water so that slump of concrete at discharge end of pump hose does not exceed maximum slump specified above.
5. Determine slump per ASTM C143.

E. Selection of Proportions:
1. General - Proportion ingredients to:
a. Produce proper workability, durability, strength, and other required properties.
b. Prevent segregation and collection of excessive free water on surface.

2. Minimum cement contents and maximum water cement ratios for concrete to be as follows:

SPECIFIED STRENGTH	MINIMUM CEMENT, LB/CY MAXIMUM AGGREGATE SIZE, IN 1/2	3/4	1	MAXIMUM WATER CEMENT RATIO BY WEIGHT
3000	---	517	517	0.45
4000	611	611	611	0.45

3. Substitution of fly ash:
   a. Maximum of 25 percent by weight of cement at rate of 1 LB fly ash for 1 LB of cement.
4. Sand cement grout:
   a. Three parts sand.
   b. One part Portland cement.
   c. Entrained air: Six percent plus or minus one percent.
   d. Sufficient water for required workability.
   e. Minimum 28-day compressive strength: 3,000 psi.
5. Submit mix design data as required by this specification section.
6. Normal weight concrete: Proportion mixture to provide desired characteristics using one of methods described below:
   a. Method 1 (Trial Mix): Per ACI 318, Chapter 5, except as modified herein.
      1) Air content within range specified above.
      2) Record and report temperature of trial mixes.
      3) Proportion trial mixes per ACI 211.1.
   b. Method 2 (Field Experience): Per ACI 318, Chapter 5, except as modified herein:
      1) Field test records must be acceptable to Engineer to use this method.
      2) Test records shall represent materials, proportions and conditions similar to those specified.
7. Required average strength to exceed the specified 28-day compressive strength by the amount determined or calculated in accordance with the requirements of Chapter 5 of ACI 318 using the standard deviation of the proposed concrete production facility.

PART 3 - EXECUTION

3.1 FORMING AND PLACING CONCRETE

A. General:
   1. Contractor is responsible for design and erection of formwork.
   2. Construct formwork so that concrete members and structures are of correct size, shape, alignment, elevation and position.
      a. Allowable tolerances: As recommended in ACI 347.
   3. Provide slabs and beams of minimum indicated depth when sloping foundation base slabs.
      a. For slabs on grade, slope top of subgrade to provide floor slabs of minimum uniform indicated depth.
      b. Do not place floor drains through beams.

B. Openings: Provide openings in formwork to accommodate work of other trades.
   1. Accurately place and securely support items built into forms.

C. Chamfer Strips: Place 3/4 IN chamfer strips in forms to produce 3/4 IN wide beveled edges on permanently exposed corners of members.

D. Construction, Expansion, and Contraction Joints:
   1. Provide at locations indicated.
   2. Locate construction joints in floor slabs and foundation base slabs so that concrete placements are approximately square and do not exceed 2500 SF.

3. At least 48 HRS shall elapse between placing of adjoining concrete construction.
4. Thoroughly clean and remove all laitance and loose and foreign particles from construction joints.
5. Before new concrete is placed, coat all construction joints with an approved bonding adhesive used and applied in accordance with manufacturer's instructions.

E. Embedments:
1. Set and build in anchorage devices and other embedded items required for other work that is attached to, or supported by concrete.
2. Use setting diagrams, templates and instructions for locating and setting.

F. Preparation:
1. Clean and adjust forms prior to concrete placement.
2. Tighten forms to prevent mortar leakage.
3. Coat form surfaces with form release agents prior to placing reinforcing bars in forms.

G. Placing Concrete:
1. Place concrete in compliance with ACI 304R and 304.2R.
2. Place in a continuous operation within planned joints or sections.
3. Begin placement when work of other trades affecting concrete is completed.
4. Place concrete by methods which prevent aggregate segregation.
5. Do not allow concrete to free fall more than 4 FT.
6. Where free fall of concrete will exceed 4 FT, place concrete by means of tremie pipe or chute.

H. Consolidation:
1. Consolidate all concrete using mechanical vibrators supplemented with hand rodding and tamping, so that concrete is worked around reinforcement and embedded items into all parts of forms.

I. Protection:
1. Protect concrete from physical damage or reduced strength due to weather extremes.
2. In cold weather comply with ACI 306.1 except as modified herein.
   a. Do not place concrete on frozen ground or in contact with forms or reinforcing bars coated with frost, ice or snow.
   b. Minimum concrete temperature at the time of mixing:

OUTDOOR TEMPERATURE AT PLACEMENT (IN SHADE)	CONCRETE TEMPERATURE AT MIXING
Below 30 DegF	70 DegF
Between 30-45 DegF	60 DegF
Above 45 DegF	50 DegF

   c. Do not place heated concrete that is warmer than 80 DegF.
   d. If freezing temperatures are expected during curing, maintain the concrete temperature at or above 50 DegF for 7 days or 70 DegF for 3 days.
   e. Do not allow concrete to cool suddenly.
3. In hot weather comply with ACI 305.1 except as modified herein.
   a. At air temperature of 90 DegF and above, keep concrete as cool as possible during placement and curing.
   b. Do not allow concrete temperature to exceed 90 DegF at placement.
   c. Prevent plastic shrinkage cracking due to rapid evaporation of moisture.
   d. Do not place concrete when the actual or anticipated evaporation rate equals or exceeds 0.2 LBS/SF/HR as determined from ACI 305.1, Figure 2.1.5.

J. Curing:
1. Begin curing concrete as soon as free water has disappeared from exposed surfaces.
2. Cure concrete by use of moisture retaining cover, burlap kept continuously wet or by membrane curing compound.

3. Provide protection as required to prevent damage to concrete and to prevent moisture loss from concrete during curing period.
4. Provide curing for minimum of 7 days.
5. Form materials left in place may be considered as curing materials for surfaces in contact with the form materials except in periods of hot weather.
6. In hot weather follow curing procedures outlined in ACI 305.1.
7. In cold weather follow curing procedures outlined in ACI 306.1.
8. If forms are removed before 7 days have elapsed, finish curing of formed surfaces by one of above methods for the remainder of the curing period.
9. Curing vertical surfaces with a curing compound:
    a. Cover vertical surfaces with a minimum of two coats of the curing compound.
    b. Allow the preceding coat to completely dry prior to applying the next coat.
    c. Apply the first coat of curing compound immediately after form removal.
    d. Vertical surface at the time of receiving the first coat shall be damp with no free water on the surface.
    e. A vertical surface is defined as any surface steeper than 1 vertical to 4 horizontal.

K. Form Removal:
1. Remove forms after concrete has hardened sufficiently to resist damage from removal operations or lack of support.

3.2 CONCRETE FINISHES

A. Tolerances:
1. Class A: 1/8 IN in 10 FT.
2. Class B: 1/4 IN in 10 FT.

B. Surfaces Exposed to View:
1. Provide a smooth finish for exposed concrete surfaces and surfaces that are:
    a. To be covered with a coating or covering material applied directly to concrete.
    b. Scheduled for grout cleaned finish.
2. Remove fins and projections, and patch voids, air pockets, and honeycomb areas with cement grout.
3. Fill tie holes with nonshrink nonmetallic grout.

C. Surfaces Not Exposed to View:
1. Patch voids, air pockets and honeycomb areas with cement grout.
2. Fill tie holes with nonshrink nonmetallic grout.

D. Slab Float Finish:
1. After concrete has been placed, consolidated, struck off, and leveled, do no further work until ready for floating.
2. Do not use water to aid in finishing.
3. Begin floating when water sheen has disappeared and surface has stiffened sufficiently to permit operation.
4. During or after first floating, check planeness of entire surface with a 10 FT straightedge applied at not less than two different angles.
5. Cut down all high spots and fill all low spots during this procedure to produce a surface within Class B tolerance throughout.
6. Refloat slab immediately to a uniform sandy texture.

E. Troweled Finish:
1. Float finish surface.
2. Next power trowel, and finally hand trowel.
3. Do not use water to aid in finishing.
4. Produce a smooth surface which is relatively free of defects with first hand troweling.
5. Perform additional trowelings by hand after surface has hardened sufficiently.
6. Final trowel when a ringing sound is produced as trowel is moved over surface.
7. Thoroughly consolidate surface by hand troweling.

8. Leave finished surface essentially free of trowel marks, uniform in texture and appearance and plane to a Class A tolerance.
9. On surfaces intended to support floor coverings remove any defects of sufficient magnitude that would show through floor covering by grinding.

F. Broom Finish: Immediately after concrete has received a float finish as specified, give it a transverse scored texture by drawing a broom across surface.

3.3 GROUT

A. Preparation:
1. Nonshrinking nonmetallic grout:
a. Clean concrete surface to receive grout.
b. Saturate concrete with water for 24 HRS prior to grouting.
2. Epoxy grout: Apply only to clean, dry, sound surface.

B. Application:
1. Non-shrinking nonmetallic grout:
a. Mix in a mechanical mixer.
b. Use no more water than necessary to produce flowable grout.
c. Place in accordance with manufacturer's instructions.
d. Completely fill all spaces and cavities below the bottom of baseplates.
e. Provide forms where baseplates and bedplates do not confine grout.
f. Where exposed to view, finish grout edges smooth.
g. Except where a slope is indicated on Drawings, finish edges flush at the baseplate, bedplate, member, or piece of equipment.
h. Protect against rapid moisture loss by covering with wet rags or polyethylene sheets.
i. Wet cure grout for 7 days, minimum.
2. Epoxy grout:
a. Mix and place in accordance with manufacturer's instructions.
b. Completely fill all cavities and spaces around dowels and anchors without voids.
c. Obtain manufacturer's field technical assistance as required to ensure proper placement.

3.4 FIELD QUALITY CONTROL

A. Owner will employ and pay for services of a concrete testing laboratory to perform testing of concrete placed during construction.
1. Contractor to cooperate with Owner in obtaining and testing samples.

B. Tests During Construction:
1. Strength test - procedure:
a. Three cylinders, 6 IN DIA x 12 IN high, will be taken from each sample per ASTM C172 and C31.
b. Cylinders will be tested per ASTM C39:
1) One at 7 days.
2) Two at 28 days.
2. Strength test - frequency:
a. Not less than one test each day concrete placed.
b. Not less than one test for each 50 CY or major fraction thereof placed in one day.
c. Not less than one test for each type of concrete poured.
d. Not less than one test for each concrete structure exceeding 2 CY volume.
3. Slump test: Per ASTM C143.
a. Determined for each strength test sample.
b. Additional slump tests may be taken.
4. Air content: Per ASTM C231, C173, and C138.
a. Determined for each strength test sample.
5. Temperature: Determined for each strength test sample.

C. Evaluation of Tests:

1. Strength test results: Average of 28-day strength of two cylinders from each sample.
    a. If one cylinder manifests evidence of improper sampling, molding, handling, curing or testings, strength of remaining cylinder will be test result.
    b. If both cylinders show any of above defects, test will be discarded.

D. Acceptance of Concrete:
1. Strength level of each type of concrete shall be considered satisfactory if both of the following requirements are met:
    a. Average of all sets of three consecutive strength tests equals or exceeds the required specified 28-day compressive strength.
    b. No individual strength test falls below the required specified 28-day compressive strength by more than 500 psi.
2. If tests fail to indicate satisfactory strength level, perform additional tests and/or corrective measures as directed by Engineer.
    a. Perform additional tests and/or corrective measures at no additional cost to Owner.

3.5 SCHEDULES

A. Form Types:
1. Surfaces exposed to view:
    a. Job-built wood forms.
    b. Laid out in a regular and uniform pattern with long dimensions vertical and joints aligned.
    c. Produce finished surfaces free from offsets, ridges, waves, and concave or convex areas.
    d. Construct forms sufficiently tight to prevent leakage of mortar.
2. Surfaces normally submerged or not normally exposed to view:
    a. Wood or steel forms sufficiently tight to prevent leakage of mortar.
3. Other types of forms may be used:
    a. For surfaces not restricted to plywood or lined forms.
    b. As backing for form lining.

B. Grout:
1. Nonshrinking nonmetallic grout: General use.
2. Epoxy grout:
    a. Grouting of dowels and anchor bolts into existing concrete.
    b. Other uses indicated on Drawings.
3. Sand cement grout: Keyways of precast members.

C. Concrete:
1. Lean concrete: Where indicated on Drawings.
2. Concrete fill: Thrust blocking for piping and where indicated on Drawings.
3. Normal weight concrete: All other locations.

D. Concrete Finishes:
1. Grout cleaned finish: Formed surfaces permanently exposed to view.
2. Slab finishes:
    a. Use following finishes as applicable, unless otherwise indicated:
        1) Floated finish: Surfaces intended to receive roofing, concrete topping, lean concrete, concrete fill and waterproofing.
        2) Troweled finish: Interior floor slabs, exposed roof slabs and base slabs of structures, equipment bases, and column bases.
        3) Broom finish: Sidewalks, docks, concrete stairs, and ramps.

END OF SECTION

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SECTION 09905
PAINTING AND PROTECTIVE COATINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Painting and protective coatings.
   2. Minimum surface preparation requirements.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 03002 - Concrete.
   4. Section 11005 - Equipment: Basic Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American National Standards Institute (ANSI):
      a. A224.1, Test Procedures and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
      b. Z535.1, Safety Color Code.
   2. American Society for Testing and Materials (ASTM):
      a. A780, Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
      b. D4258, Practice for Surface Cleaning Concrete for Coating.
      c. D4259, Practice for Abrading Concrete.
      d. D4261, Practice for Surface Cleaning Concrete Unit Masonry for Coating.
      e. D4262, Test Method for pH of Chemically Cleaned or Etched Concrete Surfaces.
      f. D4263, Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.
      g. E84, Test Method for Surface Burning Characteristics of Building Materials.
   3. National Bureau of Standards (NBS):
      a. Certified Coating Thickness Calibration Standards.
   4. National Fire Protection Association (NFPA):
      a. 101, Life Safety Code.
   5. Steel Structures Painting Council (SSPC):
      a. PA-2, Measurement of Dry Paint Thickness with Magnetic Gages.
      b. SP-1, Solvent Cleaning.
      c. SP-2, Hand Tool Cleaning.
      d. SP-3, Power Tool Cleaning.
      e. SP-5, White Metal Blast Cleaning.
      f. SP-6, Commercial Blast Cleaning.
      g. SP-7, Brush-off Blast Cleaning.
      h. SP-10, Near-White Blast Cleaning.

B. Qualifications:
   1. Coating manufacturer's authorized representative shall provide written statement attesting that Applicator has been instructed on proper preparation, mixing and application procedures for coatings specified.
   2. Applicator shall have minimum of 10 years experience in application of similar products on similar project. Provide references for minimum of three different projects completed in last 5 years with similar scope of work. Include name and address of project, size of project in value (painting) and contact person.

C. Miscellaneous:
   1. Furnish paint through one manufacturer unless noted otherwise.
   2. Coating used in all corridors and stairways shall meet requirements of NFPA 101 and ASTM E84.

D. Deviation from specified mil thickness or product type is not allowed without written authorization of Engineer.

E. Material may not be thinned unless approved, in writing, by paint manufacturer's authorized representative.

1.3 DEFINITIONS

A. Installer or Applicator: Installer or applicator is the person actually installing or applying the product in the field at the Project site.
   1. Installer or applicator are synonymous.

B. Approved Factory Finish: Finish on a product in compliance with the finish specified in the section where the product is specified or in Section 11005.

C. Holiday: A void, crack, thin spot, foreign inclusion, or contamination in the coating film that significantly lowers the dielectric strength of the coating. May also be identified as a holiday or pinhole.

D. Exposed Exterior Surface: Surface which is exposed to weather but not necessarily exposed to view as well as surface exposed to view.

E. Paint includes fillers, primers, sealers, emulsions, oils, alkyds, latex, enamels, thinners, stains, epoxies, vinyls, chlorinated rubbers, urethanes, shellacs, varnishes, and any other applied coating specified within this Section.

F. Surface Hidden from View: Surfaces such as those within pipe chases, and between top side of ceilings (including drop-in tile ceilings) and underside of floor or roof structure above.

G. VOC: Volatile Organic Compounds.

1.4 SUBMITTALS

A. Manufacturer's statement regarding Applicator instruction on product use.

B. Applicator experience qualifications.

C. Manufacturer's recommendation for universal barrier coat.

D. Shop Drawings:
   1. See Section 01340.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's application instructions.
      c. Manufacturer's surface preparation instructions.
      d. If products being used are manufactured by Company other than listed in Article 2.2, provide complete individual data sheet comparison of proposed products with specified products including application procedure, coverage rates and verification that product is designed for intended use.
      e. Contractor's written plan of action for containing airborne particles created by blasting operation and location of disposal of spent contaminated blasting media.
      f. Coating manufacturer's recommendation on abrasive blasting.

E. Results of discontinuity testing indicating any corrective action taken.

F. Samples:
   1. Manufacturer's full line of colors for Engineer's color selection.
   2. After initial color selection by Engineer provide two 3 x 5 IN samples of each color selected.

G. Miscellaneous Submittals:
1. See Section 01340.
2. Approval of application equipment.
3. Applicator's daily record when requested by Engineer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver in original containers, labeled as follows:
1. Name or type number of material.
2. Manufacturer's name and item stock number.
3. Contents, by volume, of major constituents.
4. Warning labels.
5. VOC content.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, only the following manufacturers are acceptable:
1. Tnemec.
2. Ameron Protective Coatings Div.
3. ICI Devoe.
4. Valspar Corp.
5. Carboline Protective Coatings.
6. Sherwin Williams.
7. Dampney Company, Inc.

B. Submit requests for substitution in accordance with Specification Section 01640.

2.2 MATERIALS

A. All materials used must contain not more than 3.5 LBS/GAL VOC as applied (in thinned state) unless noted otherwise.

B. For unspecified materials such as thinner, provide manufacturer's recommended products.

C. Paint Systems - General:
1. P=prime coat. F1, F2 . . . Fn = first finish coat, second finish coat . . … . nth finish coat, color as selected by Engineer.
2. If two finish coats of same material are required, Contractor may, at his option and by written approval from paint manufacturer, apply one coat equal to mil thickness of two coats specified.

D. Products specified are manufactured by Tnemec.

E. Paint Systems:
1. System #1 – NOT USED.
2. System #2 - NOT USED.

3. System #3 - Polyamide Epoxy Primer with Polyamide Epoxy or Aliphatic Acrylic Polyurethane Enamel Top Coats.

P1-Series 66 Hi=Build Epoxoline (Polyamide Epoxy) 1 coat, 2 mils	VOOC=3.42
*F1=Series 66 Hi-Build Epoxoline (Polyamide Epoxy) 1 coat, 2 mils	
*F1E=Series 74 Endura-Shield (Aliphatic Acrylic	VOC=2.80

Polyurethane Enamel
01 coat, 2.5 mils
*Replace F1 with F1E for exterior environment

4. System #4 - Zinc-rich Urethane Primer with Polyamide Epoxy or Aliphatic Acrylic Polyurethane Enamel Top Coats.

P1=90-97 Tneme-Zinc (Zinc-Rich Urethane) VOC=3.10
1 coat, 2.5 mils
*F1=Series 66 Hi-Build Epoxoline (Polyamide Epoxy) VOC=3.42
1 coat, 3 mils
*F1E=Series 74 Endura-Shield (Aliphatic Acrylic Polyurethane Enamel) VOC=2.80
1 coat, 2.5 mils
*Replace F1 with F1E for exterior environment

5. System #5 through #10- NOT USED.

6. System #11 – Zinc –Rich Aromatic Urethane Primer.

P1=90-97 Tneme-Zinc (Zinc-Rich Aromatic Urethane) VOC=3.10
1 coat, 3.5 mils

7. Systems #12 through #18 - NOT USED.

8. System #19 - Polyamide Epoxy Coating.

P1=Series 66 Hi-Build Epoxoline (Polyamide Epoxy) VOC=3.42
1 coat, 5 mils

9. System #20 - NOT USED.
10. System #21 – NOT USED.

11. System #22 - Polyamidoamine Epoxy Primer with Modified Polyurethane Top Coat(s).
    a. Prime coat:
        1) P1=1 coat, 5 mils, Series N140 Pota-Pox Plus (Polyamidoamine Epoxy), VOC=2.37
    b. Finish coat(s):
        1) Interior:
            a) F1=1 coat, 25 mils, Series 264 NSF Certified Elasto-Shield (Modified Polyurethane), VOC=0.77
            b) F2=1 coat, 25 mils, Series 264 Elasto-Shield (Modified Polyurethane), VOC=0.77

12. System #23 - Zinc-Rich Aromatic Urethane Potable Water Approved Primer with Polyamide Epoxy Potable Water Approved Top Coats.

P1=Series 92 H_20 Hydro-Zinc (zinc-Rich Aromatic Urethane) VOC=2.67
1 coat, 3 mils
F1=Series 20-1255 Pota-Pox (Polyamide Epoxy Potable Water System) VOC=3.42
1 coat, 5 mils
F2=Series 20-WH02 Pota-Pox (Polyamide Epoxy Potable Water System VOC=3.42
1 coat, 5 mils

13. Systems #24 through #27 - NOT USED.

PART 3 - EXECUTION

3.1 ITEMS TO BE PAINTED

A. Exposed Exterior Surfaces including:
   1. All piping, valves, fittings, and hydrants except when covered by pipe jacketing.
   2. Exterior and interior surfaces of ferrous metal tankage except surfaces receiving an Approved Factory Finish.
   3. Miscellaneous ferrous metal surfaces.
   4. Pipe bollards.
   5. Steel lintels (plain).
      a. Concealed surface of steel lintels shall be completely painted (with both prime and finish coats) prior to installing in the wall.
   6. Exposed wood.
   7. Structural steel.

B. New Equipment:
   1. Paint new equipment, except:
      a. Where noted in Article 3.2.
      b. Where specified elsewhere in the Contract Documents.

3.2 ITEMS NOT TO BE PAINTED

A. General: Do not paint items listed in Article 3.2 unless specifically noted in the Contract Documents to be painted.

B. Items with Approved Factory Finish.

C. Electrical Equipment:
   1. Do not field paint certain items of electrical equipment as listed in Section 11005; except where painting is specifically stated elsewhere in these Contract Documents, or where the equipment is subject to a corrosive environment. The list of equipment includes specific types of equipment with Approved Factory Finishes.

D. Surfaces Hidden from View.

E. Other Items:
   1. Stainless steel surfaces.
   2. Galvanized steel surfaces except piping.
   3. Aluminum surfaces except:
      a. Where imbedded in concrete.
      b. Where in contact with dissimilar metals.
   4. Fiberglass surfaces.
   5. Interior of pipe, ductwork, and conduits.
   6. Moving parts of mechanical and electrical units where painting would interfere with the operation of the unit.
   7. Code labels and equipment identification and rating plates.
   8. Exterior CMU surfaces.
   9. Contact surfaces of friction-type connections.
   10. Split face CMU.

3.3 SCHEDULE OF ITEMS TO BE PAINTED AND PAINTING

PAINTING SYSTEM
NUMBER

A. Pipe, Valves, and Fittings:

1. Steel, cast-iron, and uncoated ductile iron. 23

B. Galvanized Metals:
1. Field cut edge where top coat is required. 4
a. Prime paint only the cut edge.
2. Field touch-up of galvanized surfaces not requiring a finish top coat. 11
a. Paint only damaged areas.

C. Steel equipment with existing paint coating or factory-applied prime or finish coating including: 23
1. Equipment specifically indicated in the Contract Documents to be painted. Factory-applied coats to remain and be compatible with post coating system.

D. Non-ferrous metals (except galvanized): Including copper, brass, aluminum and aluminum flashing specifically indicated on the Drawings to be painted. 3

E. Aluminum buried in concrete and between dissimilar metals which are not below liquid level. 19

3.4 PREPARATION

A. General:
1. Prepare surfaces to be painted in accordance with coating manufacturer's instructions and this Section.
2. Remove all dust, grease, oil, compounds, dirt and other foreign matter which would prevent bonding of coating to surface.

B. Protection:
1. Protect surrounding surfaces not to be coated.
2. Remove and protect hardware, accessories, plates, fixtures, finished work, and similar items; or provide ample in-place protection.

C. Prepare and Paint Before Assembly: Where component is subject to corrosive or highly corrosive environment, prepare and paint, before assembly, all surfaces which may be subject to environment which are inaccessible after assembly.

D. Ferrous Metal:
1. Complete fabrication, welding or burning before beginning surface preparation.
a. Chip or grind off flux, spatter, slag or other laminations left from welding.
b. Remove mill scale.
c. Grind smooth rough welds and other sharp projections.
2. Solvent clean in accordance with SSPC SP-1 all surfaces scheduled to receive additional SSPC surface preparation.
3. Surfaces subject to corrosive or highly corrosive environment and all surfaces subject to immersion service:
a. Near-white blast clean in accordance with SSPC SP-10.
4. Interior and exterior surfaces not subject to corrosive or highly corrosive environment (including structural steel surfaces):
a. Commercial blast clean in accordance with SSPC SP-6.
5. Surfaces subject to high temperatures.
a. Heat in excess of 600 DegF: SSPC-SP10.
b. Heat in excess of 200 DegF but less than 600 DegF: SSPC-SP6.
6. Steel surfaces scheduled to receive paint system No. 24:
a. White metal blast in accordance with SSPC SP-5.
7. Restore surface of field welds and adjacent areas to original surface preparation.
8. All surfaces of steel lintels used in wall construction shall be completely painted with both prime and finish coats prior to placing in wall.

E. Hollow Metal:
   1. Solvent clean in accordance with SSPC SP-1.

F. Galvanized Metal:
   1. Solvent clean in accordance with SSPC SP-1 followed by abrasive brush blast in accordance with SSPC SP-7 to provide 1 mil profile.

G. Concrete:
   1. Cure for minimum of 28 days.
   2. Verify that concrete surfaces have been cleaned and that voids have been patch in accordance with Section 03002.
      a. Concrete surfaces shall be cleaned in accordance with ASTM D4258.
   3. Mechanically abrade concrete surfaces in accordance ASTM D4259 as recommended by coating manufacturer.
   4. Brush-off blast concrete surfaces in accordance with SSPC-SP-7 to provide profile recommended by coatings manufacturer.
   5. Test pH of surface to be painted in accordance with ASTM D4262.
      a. If surface pH is not within coating manufacturer's required acceptable range, flush with clean water as required to bring pH within acceptable range.
      b. Retest pH until acceptable results are obtained.
   6. Verify that moisture content of surface to be painted is within coating manufacturer's recommended acceptable limits.
      a. Test moisture content of surface to be coated in accordance with ASTM D4263.
      b. After remedial measures have been taken to lower or raise moisture content, retest surface until acceptable results are obtained.

H. Preparation by Abrasive Blasting:
   1. All abrasive-blasted ferrous metal surfaces shall be inspected immediately prior to application of paint coatings.
      a. Inspection shall be performed to determine cleanliness and profile depth of blasted surfaces and to certify that surface has been prepared in accordance with these Specifications.
   2. Schedule the abrasive blasting operation so blasted surfaces will not be wet after blasting and before painting.
   3. Perform additional blasting and cleaning as required to achieve surface preparation required. Prior to painting, reblast surfaces allowed to set overnight or surfaces that show rust bloom.
      a. Surfaces allowed to set overnight or surfaces which show rust bloom prior to painting shall be reinspected prior to paint application.
   4. Profile depth of blasted surface: Not less than 1 mil or greater than 2 mils unless required otherwise by coating manufacturer.
   5. Provide compressed air for blasting that is free of water and oil. Provide accessible separators and traps.
   6. Confine blast abrasives to area being blasted.
      a. Provide shields of polyethylene sheeting or other such barriers to confine blast material.
      b. Plug pipes, holes, or openings before blasting and keep plugged until blast operation is complete and residue is removed.
   7. Protect nameplates, valve stems, rotating equipment, motors and other items that may be damaged from blasting.
   8. Reblast surfaces not meeting requirements of these Specifications.
   9. Abrasive blasting media may be recovered, cleaned and reused providing Contractor submits, for Engineer's review, a comprehensive recovery plan outlining all procedures and equipment proposed in reclamation process.
   10. Properly dispose of blasting material contaminated with debris from blasting operation not scheduled to be reused.

I. All Plastic Surfaces and Non-Ferrous Surfaces Except Galvanized Steel:
   1. Sand using 80-100 grit sandpaper to scarify surfaces.

3.5 APPLICATION

A. General:
   1. Thin, mix and apply coatings by brush, roller, or spray in accordance with manufacturer's installation instructions.
      a. Application equipment must be inspected and approved in writing by coating manufacturer.
   2. Temperature and weather conditions:
      a. Do not paint surfaces when surface temperature is below 50 DegF unless product has been formulated specifically for low temperature application or approved in writing by Engineer and paint manufacturer's authorized representative.
      b. Avoid painting surfaces exposed to hot sun.
      c. Do not paint on damp surfaces.
   3. Immediately after surface has been inspected , apply structural steel and miscellaneous steel prime coat in the factory.
      a. Finish coats shall be applied in the field.
      b. Prime coat referred to here is prime coat as indicated in this Specification. Structural and miscellaneous steel prime coating applied in factory (shop) as part of Fabricator's standard rust inhibiting and protection coating is not acceptable as replacement for specified prime coating.
   4. Provide complete coverage to mil thickness specified.
      a. Thickness specified is dry mil thickness.
      b. All paint systems are "to cover." In situations of discrepancy between manufacturer's square footage coverage rates and mil thickness, mil thickness requirements govern.
      c. When color or undercoats show through, apply additional coats until paint film is of uniform finish and color.
   5. If so directed by Engineer, do not apply consecutive coats until Engineer has had an opportunity to observe and approve previous coats.
   6. Apply materials under adequate illumination.
   7. Evenly spread to provide full, smooth coverage.
   8. Work each application of material into corners, crevices, joints, and other difficult to work areas.
   9. Avoid degradation and contamination of blasted surfaces and avoid intercoat contamination.
      a. Clean contaminated surfaces before applying next coat.
   10. Smooth out runs or sags immediately, or remove and recoat entire surface.
   11. Allow preceding coats to dry before recoating.
      a. Recoat within time limits specified by coating manufacturer.
      b. If recoat time limits have expired reprepare surface in accordance with coating manufacturer's printed recommendations.
   12. Allow coated surfaces to cure prior to allowing traffic or other work to proceed.
   13. Coat all aluminum in contact with dissimilar materials.
   14. When coating fluted, ribbed or other rough face masonry surfaces which cannot be backrolled sufficiently, hand brush coating to work into all recesses.
   15. Backroll concrete and masonry surfaces with a roller if paint coatings are spray applied.

B. Prime Coat Application:
   1. Prime all surfaces indicated to be painted. Apply prime coat in accordance with coating manufacturer's written instructions and as written in this Section.
   2. Ensure field-applied coatings are compatible with factory-applied coatings.
      a. Employ services of coating manufacturer's qualified technical representative.
         1) Certify thru material data sheets.
         2) Perform test patch.
      b. If field-applied coating is found to be not compatible, require the coating manufacturer's technical representative to recommend, in writing, product to be used as barrier coat, thickness to be applied, surface preparation and method of application.

c. At Contractor's option, coatings may be removed, surface reprepared, and new coating applied using appropriate paint system listed in paragraph 2.2 E.
   1) All damage to surface as result of coating removal shall be repaired to original condition or better by Contractor at no additional cost to Owner.
3. Prime ferrous metals embedded in concrete to minimum of 1 IN below exposed surfaces.
4. Back prime all wood scheduled to be painted, prior to installation.
5. Apply zinc-rich primers while under continuous agitation.
6. Ensure abrasive blasting operation does not result in embedment of abrasive particles in paint film.
7. Brush or spray bolts, welds, edges and difficult access areas with primer prior to primer application over entire surface.
8. When surface is scheduled to receive painted finish, completely fill all pores of concrete block using block filler specified.
9. Touch up damaged primer coats prior to applying finish coats. Restore primed surface equal to surface before damage.

C. Finish Coat Application:
1. Apply finish coats in accordance with coating manufacturer's written instructions and in accordance with this Section.
2. Touch up damaged finish coats using same application method and same material specified for finish coat. Prepare damaged area in accordance with Article 3.4.

3.6 FIELD QUALITY CONTROL

A. Maintain daily record showing:
1. Start date and time of work in each area.
2. Date and time of application for each following coat.
3. Moisture content of substrate prior to each coat.
4. Provisions utilized to maintain temperature and humidity of work area within manufacturer's recommended ranges.

B. Manufacturer's field representative shall be on site to observe application of coating specified in System Nos.2, 22, 23, and 24, and to inspect substrate for these systems prior to coating application.

C. Measure wet paint with wet film thickness gages.

D. Measure paint dry film thickness in accordance with SSPC PA-2 using Mikrotest gage calibrated against National Bureau of Standards "Certified Coating Thickness Calibration Standards."
1. Engineer may measure paint thickness at any time during project to assure conformance with Specifications.

E. Measure surface temperature of items to be painted with surface temperature gage specifically designed for such.

F. Measure substrate humidity with humidity gage specifically designed for such.

G. Provide wet paint signs.

3.7 CLEANING

A. Clean paint spattered surfaces. Use care not to damage finished surfaces.

B. Upon completion of painting, replace hardware, accessories, plates, fixtures, and similar items.

C. Remove surplus materials, scaffolding, and debris. Leave areas broom clean.

END OF SECTION

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SECTION 11005
EQUIPMENT: BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Requirements of this Section apply to all equipment provided on the Project including that found in Divisions 11, 12, 13, 14, 15, and 16, even if not specifically referenced in individual "Equipment" articles of those Specifications.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 03002 – Concrete.
   4. Section 09905 - Painting and Protective Coatings.
   5. Section 13442 - Primary Elements and Transmitters.
   6. Section 15060 - Pipe and Pipe Fittings: Basic Requirements.
   7. Section 16010 - Electrical: Basic Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Bearing Manufacturers Association (ABMA).
   2. American Gear Manufacturers Association (AGMA).
   3. American Society for Testing and Materials (ASTM):
      a. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
   4. Institute of Electrical and Electronics Engineers (IEEE):
      a. 112, Standard Test Procedure for Polyphase Induction Motors and Generators.
   5. National Electrical Manufacturers Association (NEMA):
      a. 250, Enclosures for Electrical Equipment.
      b. ICS 6, Enclosures for Industrial Control and System.
      c. MG 1, Motors and Generators.
   6. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC).

B. Miscellaneous:
   1. A single manufacturer of a "product" to be selected and utilized uniformly throughout Project even though:
      a. More than one manufacturer is listed for a given "product" in Specifications.
      b. No manufacturer is listed.
   2. Equipment, electrical assemblies, related electrical wiring, instrumentation, controls, and system components shall FULLY comply with specific NEC requirements related to area classification and to NEMA 250 and ICS-6 designations.
   3. Variable speed equipment applications: The driven equipment manufacturer shall have single source responsibility for coordination of the equipment and VFD system and verify their compatibility.

1.3 DEFINITIONS

A. Product: Manufactured materials and equipment.

B. Major Equipment Supports - Supports for Equipment:
   1. Located on or suspended from elevated slabs with supported equipment weighing 2000 LBS or greater, or:

2. Located on or suspended from roofs with supported equipment weighing 500 LBS or greater, or:
3. Located on slab-on-grade or earth with supported equipment weighing 5000 LBS or more.

C. Equipment: One or more assemblies capable of performing a complete function. Mechanical, electrical, instrumentation or other devices requiring an electrical, pneumatic, electronic or hydraulic connection. Not limited to items listed under "Equipment" article within specifications.

D. Installer or Applicator: Installer or applicator is the person actually installing or applying the product in the field at the Project site.
1. Installer or applicator are synonymous.

1.4 SUBMITTALS

A. Shop Drawings:
1. General for all equipment:
a. See Section 01340.
b. Acknowledgement that products submitted comply with the requirements of the standards referenced.
c. Manufacturer's delivery, storage, handling, and installation instructions.
d. Equipment identification utilizing numbering system and name utilized in Drawings.
e. Equipment installation details:
1) Location of anchorage.
2) Type, size, and materials of construction of anchorage.
3) Anchorage setting templates.
4) Manufacturer's installation instructions.
f. Equipment area classification rating.
g. Shipping and operating weight.
h. Equipment physical characteristics:
1) Dimensions (both horizontal and vertical).
2) Materials of construction and construction details.
i. Equipment factory primer and paint data.
j. Manufacturer's recommended spare parts list.
k. Equipment lining and coatings.
l. Equipment utility requirements include air, natural gas, electricity, and water.
2. Mechanical and process equipment:
a. Operating characteristics:
1) Technical information including applicable performance curves showing specified equipment capacity, rangeability, and efficiencies.
2) Brake horsepower requirements.
3) Copies of equipment data plates.
b. Piping and duct connection size, type and location.
c. Equipment bearing life certification.
d. Equipment foundation data:
1) Equipment center of gravity.
2) Criteria for designing vibration, special or unbalanced forces resulting from equipment operation.
3. Electrical and control equipment:
a. Electric motor information:
1) Documentation that motors provided are high efficiency units.
2) Nameplate data.
3) Service factor on motors 1/2 HP and above.
4) Motor enclosure type.
5) NEMA frame size.
6) NEMA design code.
7) Insulation type and temperature rise.

8) Locked rotor current on motors 10 HP and above.
9) Efficiency and power factor at full load, 3/4 load, and no load.

b. Control panels:
1) Panel construction.
2) Point-to-point wiring diagrams.
3) Scaled panel face and subpanel layout.
4) Technical product data on panel components.
5) Panel and subpanel dimensions and weights.
6) Panel access openings.
7) Nameplate test.
8) Panel anchorage.

4. Systems Schematics and Data:
a. Provide system schematics where required in system specifications.
1) Acknowledge all system components being supplied as part of the system.
2) Utilize equipment, instrument and valving tag numbers defined in the contract documents for all components.
3) Provide technical data for each system component showing compliance with the Contract Document requirements.
4) For piping components, identify all utility connections, vents and drains which will be included as part of the system.

B. Operation and Maintenance Manuals:
1. See Section 01340.

C. Miscellaneous Submittals:
1. Sample form letter for equipment field certification.
2. Certification that equipment has been installed properly, has been initially started up, has been calibrated and/or adjusted as required, and is ready for operation.
3. Certification for major equipment supports that equipment foundation design loads shown on the Drawings or specified have been compared to actual loads exhibited by equipment provided for this Project and that said design loadings are equal to or greater than the loads produced by the equipment provided.
4. Field noise testing reports if such testing is specified in narrow scope sections.
5. Field vibration testing reports if vibration testing is specified in narrow scope sections.
6. Notification, at least 1 week in advance, that motor testing will be conducted at factory.
7. Certification from equipment manufacturer that all manufacturer-supplied control panels that interface in any way with other controls or panels have been submitted to and coordinated with the supplier/installer of those interfacing systems.
8. Motor test reports.
9. Certification prior to Project closeout that electrical panel drawings for manufacturer-supplied control panels truly represent panel wiring including any field-made modifications.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Motors:
a. Baldor.
b. General Electric.
c. Marathon Electric.
d. Reliance Electric.
e. Siemens.
f. Teco-Westinghouse.
g. U.S. Motors.

h. WEG.

2. Mechanical variable speed drives:
   a. Reeves.
   b. U.S. Motors (VariDrive).

B. Submit requests for substitution in accordance with Specification Section 01640.

2.2 MANUFACTURED UNITS

A. Electric Motors:
1. Provide motors designed and applied in compliance with NEMA, IEEE, and the NEC for specific duty imposed by driven equipment.
2. Where used in conjunction with adjustable speed AC or DC drives, provide motors that are fully compatible with the speed controllers.
3. When used on variable frequency type adjustable speed drive applications, provide motors in compliance with NEMA MG-1, Part 31.
4. Design for frequent starting duty equivalent to duty service required by driven equipment.
5. Rate for continuous duty at 40 DegC ambient. Design in accordance with the NEMA Standards for Class F insulation with Class B temperature rise above 40 DegC ambient on continuous operation or intermittent duty at nameplate horsepower.
6. Design for full voltage starting.
7. Design bearing life based upon actual operating load conditions imposed by driven equipment.
8. Size for altitude of Project.
9. Size motors so that, under maximum continuous load imposed by driven equipment, motor nameplate horsepower for continuous operation is minimum of 15 percent more than driven load or provide motor with 1.15 service factor in which case maximum continuous load imposed shall not exceed nameplate horsepower rating of motor.
10. Provide encapsulated windings in areas designated as wet and for outdoor applications.
    a. Provide encapsulation using a silicone or epoxy seal after the windings have been dried to less than 1 percent moisture.
11. Furnish corrosion resistant motors for use in areas designated as corrosive.
12. Furnish with clamp-type grounding terminals inside motor conduit box.
13. Furnish with oversized external conduit boxes.
14. Furnish with stainless steel nameplates with information to include all data as required by paragraph 430-7 of the National Electric Code, NFPA 70.
15. Use of manufacturer's standard motor will be permitted on integrally constructed motor driven equipment such as appliances and hand tools specified by model number in which a redesign of complete unit would be required in order to provide a motor with other features as may be specified herein.
16. Electrical motors greater than 10 HP.
    a. 230/460 V, 60 HZ, 3 PH supply voltage.
    b. Totally enclosed fan cooled (TEFC) or open dripproof (ODP).
    c. Oil or grease lubricated anti-friction bearings conforming to ABMA Standards. Design bearing life for 90 percent survival rating at 50,000 HRS of operation for motors up to and including 100 HP and at 100,000 HRS of operation for motors greater than 100 HP.
    d. For vertical motors, provide 15-year average life thrust bearings conforming to ABMA Standards.
17. Motors 15 HP and above having a locked rotor inrush KVA greater than 6.3 times motor horsepower are not acceptable.
18. Provide high efficiency rated motors. Where high efficiency motors are not available because of motor size or application, clearly document within the shop drawing submittal process.
19. Measure efficiencies by IEEE 112 - Method B.

B. V-Belt Drive:
1. Provide each V-belt drive with sliding base or other suitable tension adjustment.

2. Provide V-belt drives with a service factor of at least 1.6 at maximum speed.
3. Provide static-proof belts.

2.3 COMPONENTS

A. Gear Drives and Drive Components:
1. Size drive equipment capable of supporting full load including losses in speed reducers and power transmission.
2. Provide nominal input horsepower rating of each gear or speed reducer at least equal to nameplate horsepower of drive motor.
3. Design drive units for 24 HR continuous service, constructed so oil leakage around shafts is precluded.
4. Utilize gears, gear lubrication systems, gear drives, speed reducers, speed increasers and flexible couplings meeting applicable standards of American Gear Manufacturers Association.
5. Gear reducers:
a. Provide gear reducer totally enclosed and oil lubricated.
b. Utilize anti-friction bearings throughout.
c. Provide worm gear reducers having a service factor of at least 1.20.
d. Furnish other helical, spiral bevel, and combination bevel-helical gear reducers with a service factor of at least 1.50.

2.4 ACCESSORIES

A. Guards:
1. Provide each piece of equipment having exposed moving parts with full length, easily removable guards, meeting OSHA requirements.
2. Interior applications:
a. Construct from expanded galvanized steel rolled to conform to shaft or coupling surface.
b. Utilize non-flattened type 16 GA galvanized steel with nominal 1/2 IN spacing.
c. Connect to equipment frame with hot-dip galvanized bolts and wing nuts.
3. Exterior applications:
a. Construct from 16 GA stainless steel or aluminum.
b. Construct to preclude entrance of rain, snow, or moisture.
c. Roll to conform to shaft or coupling surface.
d. Connect to equipment frame with stainless steel bolts and wing nuts.

B. Anchorage:
1. Cast-in-place anchorage:
a. Provide ASTM F593, Type 316 stainless steel anchorage for all equipment.
b. Configuration and number of anchor bolts shall be per manufacturer's recommendations.
c. Provide two nuts for each bolt.
2. Drilled anchorage:
a. Epoxy grout.
b. Threaded rods same as cast-in-place.

C. Data Plate:
1. Attach a stainless steel data plate to each piece of rotary or reciprocating equipment.
2. Permanently stamp information on data plate including manufacturer's name, equipment operating parameters, serial number and speed.

D. Gages:
1. Provide gages in accordance with Section 13442.
2. Provide at the following locations:
a. Inlet and outlet of all centrifugal pumps.
b. At locations identified on Drawings.

3. Utilize tapping sleeves for mounting per Section 15060.

E. Lifting Eye Bolts or Lugs:
   1. Provide on all equipment 50 LBS or greater.
   2. Provide on other equipment or products as specified in the narrow specifications.

2.5 FABRICATION

A. Design, fabricate, and assemble equipment in accordance with modern engineering and shop practices.

B. Manufacture individual parts to standard sizes and gages so that repair parts, furnished at any time, can be installed in field.

C. Furnish like parts of duplicate units to be interchangeable.

D. Ensure that equipment has not been in service at any time prior to delivery, except as required by tests.

E. Furnish equipment which require periodic internal inspection or adjustment with access panels which will not require disassembly of guards, dismantling of piping or equipment or similar major efforts. Quick opening but sound, securable access ports or windows shall be provided for inspection of chains, belts, or similar items.

F. Provide common, lipped base plate mounting for equipment and equipment motor where said mounting is a manufacturer's standard option. Provide drain connection for 3/4 IN PVC tubing.

G. Machine the mounting feet of rotating equipment.

H. Fabricate equipment which will be subject to Corrosive Environment in such a way as to avoid back to back placement of surfaces that can not be properly prepared and painted. When such back to back fabrication can not be avoided, provide continuous welds to seal such surfaces from contact with corrosive environment.

2.6 SHOP OR FACTORY PAINT FINISHES

A. Electrical Equipment:
   1. The standard factory-applied paint coating system(s) of the approved manufacturers of the following equipment are acceptable:
      a. Panel boards.
      b. Electrical panels.
      c. Switchboards.
      d. Safety switches.
      e. Motor starter equipment.
      f. Transformers.
   2. As an alternate to the acceptable standard factory-applied paint coating systems, a manufacturer may provide a paint coating system in accordance with Section 09905.

B. Other Equipment: In accordance with Section 09905.

2.7 SOURCE QUALITY CONTROL

A. Motor Tests:
   1. Test motors in accordance with NEMA and IEEE standards.
   2. Provide routine test for all motors.
   3. The Owner reserves the right to select and have tested, either routine or complete, any motor included in the project.
      a. The Owner will pay all costs, including shipping and handling, for all motors successfully passing the tests.
      b. The Contractor shall pay all costs, including shipping and handling, for all motors failing the tests.

c. If two (2) successive motors of the same manufacturer fail testing, the Owner has the right to reject all motors from that manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install equipment as shown on Drawings and in accordance with manufacturer's directions.

B. Utilize templates for anchorage placement for slab-mounted equipment.

C. For equipment having drainage requirements such as seal water, provide 3/4 IN PVC or clear plastic tubing from equipment base to nearest floor or equipment drain. Route clear of major traffic areas and as approved by Engineer.

D. DO NOT construct foundations until major equipment supports are approved.

E. Extend all non-accessible grease fittings using stainless steel tubing to a location which allows easy access of fittings.

F. Construct sub-bases, either concrete, steel or cast iron, level in both directions. Particular care shall be taken at hold-down bolt locations so these areas are flat and level.

G. Machine Base:
   1. Mount machine bases of rotating equipment on sub-bases in manner that they are level in both directions according to machined surfaces on base. Use machinist level for this procedure.
   2. Level machine bases on sub-bases and align couplings between driver and driven unit using steel blocks and shims.
      a. Size blocks and shims to provide solid support at each anchor bolt location. Area size of blocks and shims shall be approximately 1-1/2 times area support surface at each anchor bolt point.
      b. Provide blocks and shims at each anchor bolt. Blocks and shims that are square shape with "U" cut out to allow blocks and shims to be centered on anchor bolts.
      c. After all leveling and alignment has been completed and before grouting, tighten anchor bolts to proper torque value.
      d. Do not use nuts below the machine base on anchor bolts for base leveling.

H. Couplings:
   1. Align in the annular and parallel positions.
      a. For equipment rotating at 1200 rpm or less, align both annular and parallel within 0.001 IN tolerance for couplings 4 IN size and smaller. Couplings larger than 4 IN size: Increase tolerance 0.0005 IN per inches of coupling diameter, i.e., allow 6 IN coupling 0.002 IN tolerance, and allow a 10 IN coupling 0.004 IN tolerance.
      b. For equipment rotating at speeds greater than 1200 rpm allow both annular and parallel positions within a tolerance rate of 0.00025 IN per inch coupling diameter.
   2. If equipment is delivered as a mounted unit from factory, verify factory alignment on site after installation and realigned if necessary.
   3. Check surfaces for runout before attempting to trim or align units.

I. Grouting:
   1. After machine base has been shimmed, leveled, couplings aligned and anchor bolts tightened to correct torque value, a dam or formwork shall be placed around base to contain grouting. Extend dam or formwork at least 1/2 IN above the top of leveling shims and blocks.
   2. Saturate top of roughened concrete subbase with water before grouting. Add grout until entire space under machine base is filled to the top of the base underside. Puddle grout by working a stiff wire through the grout and vent holes to work grout in place and release any entrained air in the grout or base cavity.

3. When the grout has sufficiently hardened, remove dam or formwork and finish the exposed grout surface to fine, smooth surface. Cover exposed grout surfaces with wet burlap and keep covering sufficiently wet to prevent too rapid evaporation of water from the grout. When the grout has fully hardened (after a minimum of 7 days) tighten all anchor bolts and recheck driver-driven unit for proper alignment.

3.2 INSTALLATION CHECKS

A. For all equipment specifically required in detailed specifications, secure services of experienced, competent, and authorized representative(s) of equipment manufacturer to visit site of work and inspect, check, adjust and approve equipment installation. In each case, representative(s) shall be present during placement and startup of equipment and as often as necessary to resolve any operational issues which may arise.

B. Secure from equipment manufacturer's representative(s) a written report certifying that equipment:
   1. Has been properly installed and lubricated.
   2. Is in accurate alignment.
   3. Is free from any undue stress imposed by connecting piping or anchor bolts.
   4. Has been operated under full load conditions and that it operated satisfactorily. Secure and deliver a field written report to Owner immediately prior to leaving jobsite.

C. No separate payment shall be made for installation checks. All or any time expended during installation check does not qualify as O&M training or instruction time when specified.

3.3 FIELD PAINTING AND PROTECTIVE COATINGS

A. For required field painting and protective coatings, comply with Section 09905.

3.4 WIRING CONNECTIONS AND TERMINATION

A. Clean wires before installing lugs and connectors.

B. Terminate motor circuit conductors with copper lugs bolted to motor leads.

C. Tape stripped ends of conductors and associated connectors with electrical tape. Wrapping thickness shall be 150 percent of the conductor insulation thickness.

D. Connections to carry full ampacity of conductors without temperature rise.

E. Terminate spare conductors with electrical tape.

3.5 FIELD QUALITY CONTROL

A. Furnish equipment manufacturer services as specified in the individual equipment specifications.

B. Inspect wire and connections for physical damage and proper connection.

C. Check rotation of motor before connection to driven equipment, before couplings are bolted or belts installed. Before motor is started to check rotation, determine that motor is lubricated.

D. Subbase that supports the equipment base and that is made in the form of a cast iron or steel structure that has supporting beams, legs and cross member that are cast welded or bolted, shall be tested for a natural frequency of vibration after equipment is mounted. Keep the ratio of the natural frequency of the structure to the frequency of the disturbing force out of the range from 0.5 to 1.5.

3.6 DEMONSTRATION

A. Demonstrate equipment in accordance with Section 01650.

END OF SECTION

SECTION 11060

PUMPING EQUIPMENT: BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Pumping equipment.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 09905 - Painting and Protective Coatings.
   4. Section 11005 - Equipment: Basic Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. Hydraulic Institute (HI):
      a. Standards for centrifugal, rotary and reciprocating pumps.

B. Fully coordinate all mechanical seal systems specified to ensure pump and seal compatibility.

C. For variable speed pumping applications, the pump manufacturer is designated to have single source responsibility for coordination of the pump and VFD drive system.

1.3 DEFINITIONS

A. The abbreviations are defined as follows:
   1. IPS: Iron Pipe Size.
   2. NPSHR: Net Positive Suction Head Required.
   3. TDH: Total Differential Head.
   4. TEFC: Totally Enclosed Fan Cooled.
   5. VFD: Variable Frequency Drive.

B. Pump Service Category - Pump or pumps having identical names (not tag numbers) used for specific pumping service.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Section 11005.
   2. Product technical data including:
      a. Performance data and curves with flow (gpm), head (FT), horsepower, efficiency, NPSH requirements, submergence requirement.
      b. Pump accessory data.
      c. Bearing supports, shafting details and lubrication provisions.
      d. Solids passage information.
   3. Certifications:
      a. Certified pump performance curves as described in Article 2.4.
   4. Test reports:
      a. Factory hydrostatic test.

B. Operation and Maintenance Manuals:
   1. See Section 01340.

C. Miscellaneous:
   1. Certifications:
      a. Statement relative to installation and start-up per paragraph 3.2-A.4.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Pumps:
      a. See individual pump specification sections.
   2. Mechanical seals:
      a. Chesterton.
      b. Garlock.

B. Submit requests for substitution in accordance with Specification Section 01640.

2.2 CENTRIFUGAL PUMP DESIGN

A. Provide units with increasing head characteristics from the end run out portion of the curve to shutoff condition.

2.3 ACCESSORIES

A. See Section 11005.

B. Each Unit:
   1. Lifting eye bolts or lugs.
   2. Plugged gage cock connection at suction and discharge nozzles.
   3. Tapped and plugged openings for casing and bearing housing vents and drains.
   4. Fittings for properly adding flushing lubricant.
   5. Pressure relief fittings for grease lubrication.

C. Packing Seal:
   1. Provide packing unless mechanical seal specified in narrow-scope pump sections.
   2. Minimum of five rings graphite impregnated synthetic packing.
   3. Provide minimum 1/4 IN DIA supply tap and 1/2 IN DIA minimum drain tap.
   4. Provide split Teflon or bronze water seal ring.
   5. Adjustable split follower cast iron or bronze gland.

D. Mechanical Seals:
   1. Provide as specified in the narrow-scope pump sections.
   2. Provide stationary balanced O-ring type.
   3. Provide water lubrication - cooling.
   4. Materials:
      a. Metal parts except springs: 316 stainless steel.
      b. Springs: Hastelloy C.
      c. Seal faces: Unfilled carbon graphite versus silica-free Grade 99.5 ceramic.
      d. Elastomers: Viton.

2.4 FABRICATION

A. Pump Support:
   1. Design base to support weight of drive, shafting and pump.
   2. Comply with HI vibration limitations.
   3. Mount horizontal pump, motor and coupling on single piece drip lip type base-plate.
   4. Mount vertical pumps on single piece pedestal base-plate.
   5. Fabricate to withstand all operating loads transmitted from the pump and drive.

2.5 SOURCE QUALITY CONTROL

A. Factory hydrostatic test at 150 percent of shutoff head for a minimum of 5 minutes.

B. If specifically required in the individual pump specification sections, provide factory tests:
   1. All units:
      a. Conduct tests in accordance with HI.
         1) Shut-off head and design condition: Positive unilateral performance tolerance meeting Grade 1U per HI 14.6 for Rotodynamic Pumps.
         2) Shut-off head and design conditions: Positive unilateral performance tolerances meeting Grade 1U per HI 11.6 for Rotodynamic Submersible Pumps.
   2. Adjustable speed units:
      a. Head (FT) verses flow (gpm) pump curves:
         1) Maximum, minimum and two (2) equally spaced intermittent speeds.
         2) Efficiencies along each curve.
         3) Brake horsepower along each curve.
   3. Constant speed units:
      a. Head (FT) versus flow (gpm) pump curves:
         1) Efficiencies along curve.
         2) Brake horsepower along each curve.
   4. Results certified by a registered professional engineer.

C. Statically and dynamically balance each pump per HI standards.

D. To meet requirements of HI 11.6 for Submersible Pumps

PART 3 - EXECUTION

3.1 INSTALLATION

A. See Section 11005.

B. Floor or Pad-Mounted Units (Non-Submersible):
   1. Align vertically and horizontally level, wedge and plumb units to match piping interfaces.
   2. Assure no unnecessary stresses are transmitted to equipment flanges.
   3. Tighten flange bolts at uniform rate and manufacturer's recommended torque for uniform gasket compression.
   4. Support and match flange faces to uniform contact over entire face area prior to bolting pipe flange and equipment.
   5. Permit piping connecting to equipment to freely move in directions parallel to longitudinal centerline when and while bolts in connection flange are tightened.
   6. Grout equipment into place prior to final bolting of piping but not before initial fitting and alignment.
   7. Assemble connecting piping with gaskets in place and minimum of four bolts per joint installed and tightened. Test alignment by loosening flange bolts to see if there is any change in relationship of piping flange with equipment connecting flange. Realign as necessary, install flange bolts and make equipment connection.
   8. Field paint units as defined in Section 09905.
   9. Provide pressure gage on discharge of all pumps and on suction of all non-submersible units.

C. Submersible Units:
   1. Comply with requirements defined in paragraphs 3.1-B.7, 8, and 9.

D. For submersible units, provide discharge pressure gage visible from grade or operating floor.

3.2 FIELD QUALITY CONTROL

A. Provide services of equipment manufacturer's field service representative(s) to:

1. Inspect equipment covered by these Specifications.
2. Supervise pre-start adjustments and installation checks.
3. Conduct initial startup of equipment and perform operational checks.
4. Provide a written statement that manufacturer's equipment has been installed properly, started up and is ready for operation by Owner's personnel.

END OF SECTION

SECTION 11072

PUMPING EQUIPMENT: SUBMERSIBLE WELL PUMPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Vertical turbine pumps.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 11005 - Equipment: Basic Requirements.
   4. Section 11060 - Pump Equipment: Basic Requirements.
   5. Section 15060 – Pipe and Pipe Fittings: Basic Requirements.
   6. Section 15101 – Gate Valves.
   7. Section 15106 – Check Valves.
   8. Section 15114 – Miscellaneous Valves and Accessories.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Iron and Steel Institute (AISI).
   2. American National Standard Institute (ANSI):
      a. B16.1, Cast-Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.
      b. B16.5, Pipe Flanges and Flanged Fittings.
   3. ASTM International (ASTM):
      a. A48, Standard Specification for Gray Iron Castings.
      b. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
      c. A108, Standard Specification for Steel Bars, Carbon, Cold Finished, Standard Quality.
      d. Steel, Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless for Ordinary Uses.
      e. A276, Standard Specification for Stainless Steel Bars and Shapes.
      f. B505, Standard Specification for Copper-Base Alloy Continuous Castings.
      g. B584, Standard Specification for Copper Alloy Sand Castings for General Applications.
   4. American Water Works Association (AWWA):
      a. E101, Deep Well Vertical Turbine Pumps - Line Shaft and Submersible Types
   5. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC).
   6. National Sanitation Foundation (NSF).
   7. International Organization for Standardization (ISO):
      a. ISO 1940, Mechanical Vibration – Balance Quality Requirements for Rotors in a Constant (Rigid) State.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 1340 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
      c. Pump:
         1) Manufacturer and model.
         2) Speed.

3) Number of stages.
4) Component materials.
5) Shaft and column size.
6) Outside diameter of pump bowls.
7) Painting and coatings.

d. Motor:
1) Manufacturer and model.
2) Rated size (horsepower).
3) Type of bearings.
4) Efficiency.

e. Materials, parts, devices, and accessories.

f. Complete performance data and curves:
1) Capacity.
2) Head.
3) NPSH requirements.
4) Brake horsepower requirements.

g. Shop Drawings:
1) Fabrication.
2) Assembly.
3) Installation.
4) Type, number, and size of anchor bolts.
5) Dimensions.

h. Factory Test Report:
1) Submit certified copies of factory test report and receive Engineers approval before shipping equipment.
2) Report shall include:
a) Test log.
b) Description of test piping, equipment and set-up.
c) Test procedure.
d) Certified performance curve, plotted against capacity:
(1) Head.
(2) Brake horsepower.
(3) Efficiency.
(4) Speed.
(5) Net positive suction head required.
(6) Plot curve to be easily read at scales consistent with performance requirements.

i. Field Test Reports:
1) Motor test report.
2) Vibration test report.

B. Contract Closeout Information:
1. Operation and Maintenance Data:
See Specification Section 1340 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Vertical Turbine Pumps:
a. Christensen.
b. Fairbank Morse.
c. Flowserve.

d. Goulds
e. Layne-Bowler
f. Floway
g. Peerless.
h. Grunfols

2. Motors:
a. General Electric.
b. Franklin
c. Baldor / Reliance Electric.
d. Teco-Westinghouse
e. Nidec / U.S. Motor
f. Grunfols

B. Specifications are based on Peerless Pump.

C. Submit requests for substitution in accordance with Specification Section 01640.

2.2 MATERIALS

A. Intermediate Bowl, Top Bowl and Flange: Ductile Iron ASTM A536, Grade 60-42-10.

B. Bearings: Bronze, ASTM B584.

C. Pump Shaft: Stainless steel, ASTM A276, Grade 316.

D. Pump Impeller: Bronze, ASTM B584.

E. Impeller Lock Collet: Stainless Steel ASTM A276 ,Type 316.

F. Suction Case: Ductile Iron ASTM A536, Grade 60-42-10.

G. Strainer: Stainless steel, ASTM A240, Type 316.

H. Sand Collar, Strainer Interconnector Bearings: Bronze ASTM B584.

I. Strainer Interconnector, Suction Interconnector: Ductile Iron ASTM A536, Grade 60-42-10.

J. Pump Motor Coupling: Stainless steel ASTM A276, Type 410.

K. Power Cable: Copper with synthetic rubber.

L. Power Cable Guard: Stainless steel ASTM A240, Type 304.

M. Cable Clamp and Cable Guard: Stainless steel.

N. Wear Rings: Bronze, ASTM B148, Alloy 953.

O. Surface Plate: Steel ASTM A36.

2.3 PERFORMANCE AND DESIGN REQUIREMENTS

A. Performance Parameters:
1. Submersible Well Pump:
a. Primary design conditions: 1000 GPM at 175 FT TDH and greater than 80 percent efficiency.
b. Maximum speed: 1800 rpm.
c. Maximum horsepower: 60 HP.
d. Minimum shutoff condition: 0 gpm at 246FT.
e. Minimum Column size: 8 IN.
f. Minimum Discharge flange: 8 IN.
g. Type of discharge head: above ground.
h. Bottom of motor assembly:
1) To be determined by Motor Manufacture.

B. Pump/Motor Shroud: To be determined by Motor Manufacture.

C. Provide pumps with increasing head characteristics from design condition to shutoff condition. Provide pumps with net positive suction head requirements (NPSHR) less than the net positive suction head available (NPSHA) at all operating conditions.

2.4 ACCESSORIES

A. See Sections 11005.

2.5 COMPONENTS

A. General:
   1. Furnish units consisting of a vertical turbine, direct connected to a submersible water filled motor.
   2. Weight of revolving parts of pump including unbalanced hydraulic thrust of impeller is carried by thrust bearing in driver.
   3. Make provision at driver shaft for adjusting impeller with reference to bowls.
   4. Pump and motor to be NSF approved for potable water service.

B. Column:
   1. Certa-Lok PVC.
   2. Eagle Loc Internal Joint restraint System.
   3. Or approved by Engineer
   4. Provide column sections not exceeding 10 FT in length.

C. Pump Bowl:
   1. Pump bowl castings shall be free of blowholes, sand holes, and other detrimental defects.
   2. Finished bowls shall be capable of withstanding a hydrostatic pressure equal to twice the head at rated capacity of 1.5 times the shutoff head, whichever is greater.
   3. Provide bowl and suction bell constructed of close grained cast iron, free from imperfections and accurately machined and fitted.
   4. All intermediate bowls shall have enamel or epoxy lined waterways for maximum efficiency and wear protection and shall be of identical design for interchangeability.
   5. Coat pump bowl water passages with an abrasion-resistant baked enamel, phenolic or epoxy.
   6. Provide NSF certified coating suitable for potable water service.
   7. Design to ensure easy removal of bearings and impeller.

D. Motor Adapter:
   1. A motor adapter of close-grained cast iron with rabbeted fits shall be supplied to connect the submersible motor to the bowl assembly. It shall include the motor adapter bearing assembly and a corrosion resistant metal strainer whose free area shall be at least three times the impeller suction eye area. The maximum strainer opening shall not be more than 75 percent of the minimum opening of water passage through the bowl or impeller.
   2. Provide 2-piece jaw type rigid coupling or spline capable of transferring the pump thrust to the motor up and down thrust bearings

E. Bearings:
   1. Provide units with heavy-duty sleeve bearings in each bowl and in strainer.
   2. In bowl, provide main bronze bearing immediately above and a lower bronze bearing immediately below each impeller.
   3. Provide for lubrication of bowl bearings with pumped liquid.
   4. Furnish double sleeve bearings in strainer.
   5. Provide sand cap on strainer bearing to prevent abrasives from entering bearing.

F. Bowl Shaft and Impeller:
   1. Impeller shall always be enclosed.
   2. Provide pump unit shaft constructed of rolled and ground 410 stainless steel.
   3. The shaft shall be based on a diameter per AWWA E101.
   4. Furnish impellers securely attached to pump shaft with keys, taper bushings, lock nuts, or set screws.

5. Ensure impeller is accurately fitted and statically and dynamically balanced to a minimum of ISO 1940 grade G6.3.
6. The outer tips of the impeller blades shall not be feathered and shall be of sufficient thickness to withstand considerable wear before affecting pump performance.

G. Surface Plate:
1. Design surface plate assembly for 150 psi working pressure and 250 psi test pressure.
2. Supply surface plate with a minimum of two lifting lugs capable of supporting weight of entire unit.
3. The surface plate shall support the entire weight of the suspended parts when filled with water.
4. The surface plate shall provide suitable openings for the power cable, well vent, power cable, and water-level indicator as required per the Contract Documents.
5. Provide surface plate for above ground mounting constructed of fabricated steel with integral discharge flange.
6. Provide surface plate with long radius 90 degree elbow with an ANSI B16.5 125/150 LB slip on, flat faced flanged outlet.
7. Provide NEMA 4 junction box for power cable.
8. Provide surface plate with a power cable splice box that conforms to the NEC.

H. Suction Strainer:
1. Supply basket type strainer constructed of stainless steel with net open area of not less than three times the impeller inlet area.
2. Maximum opening shall not be more than 75 percent of the minimum opening of the water passage through the bowl or impeller.

I. Data Plates:
1. Provide stainless steel data plate securely attached to pump.
2. Include manufacturer's name, pump size and type, serial number, speed, impeller diameter, capacity and head rating, and other pertinent data.

J. Discharge Head Assemblies:
1. Design discharge head assembly for an operating pressure of 150 psi and a transient pressure of 250 psi. Discharge head assembly shall be designed for both operating pressure and transient pressure acting simultaneously. Test pressure for the discharge head shall be 250 psi.
2. Provide discharge head for above ground mounting constructed of fabricated steel A53. Grade B and A36 with integral discharge flange.
3. Furnish discharge flange with flat face drilling (bolt circle and bolt hole) to match those of ANSI/ASME B16.5 class 150 flanges.
4. Mount discharge head on fabricated steel base plate which is of sufficient size to span opening in support structure.
    a. Sole plate shall be of one piece construction machined flat on the topside and a minimum thickness of 1-1/2 inches after machining.
    b. Level sole plate to within 0.002 IN/FT of span in two planes at 90 degree angels to one another prior to grouting.
    c. Use Sonneborne E-Grout, high-strength chemical resistant epoxy grout to fill void between sole plate and concrete support pad. Follow manufacturer’s procedures to obtain best performance from grouting system. Grouting shall cure for five (5) days prior to operating any equipment.

K. Submersible Motor:
1. Squirrel cage, induction type, water cooled motor, and inverter duty rated.
2. 460 V, 60 HZ, three phase, 1,800 rpm, and a 1.15 service factor.
3. Provide double mechanical or single non-pressurized motor seal.
4. Size motor to drive pump continuously over the complete head capacity range without the load exceeding 100 percent of the nameplate rating.

5. The motor efficiency shall not be less than specified in Paragraph 2.3 of this Section at full load.
6. Design motor for 70 DegF, ambient water temperature.
7. Dynamically balanced rotor and shaft.
8. Provide sleeve bearings on the rotor.
9. Provide thrust bearing to support weight of rotating parts and hydraulic thrust of pump for the operating conditions specified.
10. Maximum diameter is 8 inches

L. Submersible Cable:
1. The power cable shall be sized such that the voltage drop will not exceed 5 percent at the motor rated full load current and voltage.
2. Cables shall be designed specifically for submersible pump service and shall consist of four individual conductors individually insulated and the whole covered with an outer jacket.
3. Furnish wire power cable sized per manufacturer's recommendations and of length sufficient to reach the junction box on the surface plate, and one additional foot for each 50 FT of total pump setting compensate for possible twist or sag during installation. An additional 10 FT shall be provided beyond the surface plate.
4. Each conductor shall be insulated by synthetic rubber or plastic insulation suitable for continuous immersion in water.
5. When three or more single conductors are used, each shall be jacketed. The jacket materials shall be oil and water resistant synthetic rubber, metal, or other suitable mechanically protective material.
6. A flat cable with plug in terminal and stainless steel guard will connect the minimum 6 AWG ground cable to the motor

M. Pump/Motor Shroud:
1. Thin wall PVC fabricated to form a flow inducer sleeve to force water inflow past the motor and to the pump intake.

2.6 MAINTENANCE MATERIALS

A. Extra Materials:
1. Furnish the Owner the following spare parts for each pump service category:
a. Lower bearing assembly: One (1) set.
b. Upper bowl bearing: One (1) set.
c. Wearing rings: One (1) set.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Pump supplier shall install the equipment and must have a Well Pump Installer's license though the State of Texas.

3.2 FIELD QUALITY CONTROL

A. See Section 11060.

B. Provide equipment and apparatus required for performing inspections and tests. Correct defects and repeat the respective inspections and tests.

C. Prior to initial operation, the piping system shall be inspected for conformance to Drawings, Specifications, and ANSI B31.1.

D. Factory Testing:
1. Pumps shall be factory tested and accepted prior to shipment.

E. Field Testing:

1. After installation of the equipment, the system shall be given an operating test in the presence of the Engineer, during which it shall demonstrate its ability to operate without vibration or overheating, and to deliver its rated capacity under the specified conditions.
2. All defects or defective equipment revealed by or noted during the tests shall be corrected or replaced promptly at the expense of the Contractor.
3. The Contractor shall furnish all labor, piping, equipment, and materials necessary for conducting the tests.
4. All adjustments necessary to place the equipment in satisfactory working order shall be made at the time of the above tests.
5. Tests shall include head and discharge measurements sufficient to duplicate the head-discharge curve submitted with the Shop Drawings

END OF SECTION

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SECTION 15010

MECHANICAL: BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Mechanical equipment.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 09905 - Painting and Protective Coatings.
   4. Section 11005 - Equipment: Basic Requirements.
   5. Section 13440 - Instrumentation for Process Control: General Requirements.
   6. Division 16 - Electrical.

1.2 QUALITY ASSURANCE

A. Comply with requirements of Section 11005.

B. Perform work in strict accordance with rules, regulations, codes, ordinances, or laws of Local, State, and Federal governments, or of other authorities having lawful jurisdiction. Such rules, regulations, codes, ordinances, or laws include but are not necessarily limited to the following:
   1. State building and fire codes.
   2. State plumbing and mechanical codes.
   3. City building and fire codes.
   4. City plumbing and mechanical codes.
   5. American Gas Association (AGA).
   6. National Electric Code (NEC).
   7. National Fire Protection Association (NFPA).
   8. Occupational Safety and Health Act (OSHA).

C. Referenced Standards:
   1. Air Moving and Conditioning Association (AMCA).
   2. American National Standards Institute (ANSI):
      a. B40.1, Gauges-Pressure Indicating Dial Type Elastic Element.
   3. American Society of Heating, Refrigeration and Air-Conditioning Engineer (ASHRAE).
   4. American Society of Mechanical Engineers (ASME).
   5. American Society for Testing and Materials (ASTM):
      a. A36, Specification for Structural Steel.
   6. Factory Mutual Association (FM).
   7. Instrument Society of America (ISA):
      a. S20, Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves.
   8. National Electric Manufacturers Association (NEMA).
   9. Sheet Metal and Air-Conditioning Contractors National Association (SMACNA).

1.3 DEFINITIONS

A. Installer or Applicator: Installer or applicator is the person actually installing or applying the product in the field at the Project site.
   1. Installer or applicator are synonymous.

1.4 SUBMITTALS

A. See Section 01340.

B. Verify on sheet metal shop drawings dimensions, transverse joints, reinforcement, seams, seals, fittings, hangers and miscellaneous appurtenances. Include on fabrication drawings location and connection details of jointed sections to permit access and maintenance of connected equipment, dampers, and controls and to permit removal of connected equipment without disturbing main duct system.

C. Submit copies of any manufacturer's written directions regarding equipment and material handling, installation, operation and maintenance.

D. Detail coordination, connections, offsets and crossovers in work.

E. Locate and dimension equipment items with reference to other items of work accurately.

F. Operation and Maintenance Manuals:
   1. See Section 01340.

1.5 PERMITS

A. Permits, Fees, Licenses, and Inspections:
   1. Make arrangements for, obtain, and pay for necessary permits, licenses, and inspections. Pay necessary fees in conjunction with mechanical work.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Acceptable manufacturers are listed below.

B. Submit request for substitution in accordance with Specification Section 01640.

2.2 MATERIALS

A. Unions:
   1. Provide union between valves and connection to each item as required to make up or disconnect piping. Install unions to facilitate removal of parts, equipment of fixtures, for inspection or cleaning. Install in position which will permit device, fixture or part to be removed without disconnecting piping except unions.
   2. Use unions of type and material specified under each piping specification.
   3. Where mechanical type couplings are used, they may serve as unions. Make connections between couplings and flanged equipment with flanges and flexible couplings.
   4. At flanged connections additional flange unions are not required. Make connections to flanged valves and equipment using ANSI type flanges. Use flanges, rated 125 psi. In no case shall flange pressure ratings be less than equipment served or system operating pressure. Where 150 LB steel flanges mate with 125 LB cast-iron flat face flanges, use flat face steel flanges with full face gaskets.

B. Vents:
   1. Pipe vents from pressure regulating devices in compliance with applicable codes.

C. Sleeves:
   1. Furnish and install sleeves where required for installation of work under this Division.
   2. Where sleeves are set in walls for future connections, close opening with lightweight concrete.

3. Set sleeves true to line, grade, position and plumb or level and maintain so during construction.

D. Equipment Anchors:
   1. Comply to requirements of Section 11005.

E. Pressure Gages:
   1. Furnish and install pressure gages on suction and discharge or each pump and at locations indicated on Drawings. Refer to Section 13442 for gage requirements.

F. Electric Wiring, Motors and Controls:
   1. Comply to requirements of Sections 11005 and 13440 and Division 16.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Cutting, Fitting, Repairing, Patching, and Finishing:
   1. Arrange and pay for cutting, fitting, repairing, patching, and finishing of work of other trades where it is necessary to disturb such work to permit installation of mechanical work. Perform work only with craftsmen skilled in their respective trades.
   2. Avoid cutting, insofar as possible, by setting sleeves, frames, and related work and by requesting openings in advance. Assist other trades in securing correct location and placement of rough-frames, sleeves, openings, and related work for piping.
   3. Before cutting obtain permission from Engineer. Cut holes neatly and as small as possible to admit work. Include cutting where sleeves or openings have been omitted. Perform cutting in manner so as not to weaken walls, partitions or floors. Drill holes cut in floors without breaking out around holes.
   4. Where cutting of holes through reinforced concrete is necessary, cut by rotary type drill. Use of pneumatic hammer type drills, impact type electric drills, and hand or manual hammer type drills will not be allowed. Locate holes so as not to affect structural sections such as ribs or beams. Layout holes in advance and perform drilling only after approval by Engineer.
   5. Where alterations are necessary, including outside trenching, disturbing lawns, walks, paving, etc., or where new or old work join, cut, remove, patch, repair and restore adjacent surfaces and leave in as good condition as existed prior to start of work.

B. Installation of Equipment:
   1. Comply to requirements of Section 11005.
   2. Use galvanized structural steel installed in areas of high humidity or locations where moisture may collect due to condensation.
   3. Use structural steel members conforming to ASTM A36. Furnish with shop coat of red lead primer. Retouch primer after field welding.

C. Provisions for Later Installation:
   1. When mechanical work can not be installed as structure is being erected, provide and arrange for building-in of boxes, sleeves, insets, fixtures or devices necessary to permit installation later. Lay out chases, holes or other openings which must be provided in masonry, concrete or other work.
   2. Verify nature and arrangements of materials and construction to which this work attaches or passes through.

D. Access to Equipment for Maintenance:
   1. Install equipment and piping in such manner as to permit access for normal maintenance. Maintain easy access to motors, drives, compressors, and arrange piping, conduit, and related work to facilitate maintenance. Perform relocation of pipes and other obstacles required to permit access at request of Engineer at no additional cost to Owner.

E. Painting:
   1. See Section 09905.
   2. If factory finish on equipment is damaged in shipment or during construction, refinish equipment to satisfaction of Engineer.

END OF SECTION

SECTION 15060

PIPE AND PIPE FITTINGS: BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Piping systems.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 02221 - Trenching, Backfilling, and Compacting for Utilities.
   4. Section 15100 - Valves: Basic Requirements.
   5. Section 15183 - Pipe Insulation.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American National Standards Institute (ANSI):
      a. B16.3, Malleable Iron Threaded Fittings.
      b. B16.5, Pipe Flanges and Flanged Fittings.
      c. B16.9, Factory-Made Wrought Steel Butt-Welding Fittings.
      d. B16.22, Wrought Copper and Bronze Solder - Joint Pressure Fittings.
      e. B16.26, Cast Copper Alloy Fittings for Flared Copper Tubes.
      f. B36.19, Stainless Steel Pipe.
      g. B40.1, Gauges - Pressure Indicating Dial Type - Elastic Element.
   2. American National Standards Institute (ANSI)/American Water Works Association (AWWA):
      a. ANSI/AWWA C110/A21.10, Ductile Iron and Gray Iron Fittings, 3 IN through 48 IN for Water and Other Liquids.
      b. ANSI/AWWA C115/A21.15, Flanged Ductile Iron Pipe with Threaded Flanges.
      c. C151, Ductile-Iron Pipe, Centrifugally Cast In Metal Molds or Sand-Lined Molds for Water or Other Liquids.
      d. ANSI/AWWA C153/A21.53, Ductile-Iron Compact Fittings, 3 IN Through 16 IN, for Water and Other Liquids.
      e. C207, Standard for Steel Pipe Flanges for Waterworks Service - Sizes 4 IN through 144 IN.
   3. American Society for Testing and Materials (ASTM):
      a. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
      b. A74, Cast-Iron Soil Pipe and Fittings.
      c. A106, Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
      d. A126, Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
      e. A197, Standard Specification for Cupola Malleable Iron.
      f. A234, Standard Specification for Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
      g. A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
      h. A536, Standard Specification for Ductile Iron Castings.
      i. A778, Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products.

j. B88, Seamless Copper Water Tube (ANSI H23.1).
k. C564, Rubber Gaskets for Cast-Iron Soil Pipe and Fittings.
l. D1785, Standard Specification for Rigid Poly Vinyl Chloride (PVC) Compounds and Chlorinated Poly Vinyl Chloride (CPVC) Compounds.
m. D2466, Socket Type (PVC) Plastic Pipe Fittings, Schedule 40.
n. D2467, Socket Type (PVC) Plastic Pipe Fittings, Schedule 80.
o. D2513, Thermoplastic Gas Pressure Pipe, Tubing, and Fittings.
p. D2683, Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter- Controlled Polyethylene Pipe and Tubing.
q. D4101, Standard Specification for Propylene Plastic Injection and Extrusion Materials.
r. F438, Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40.
s. F439, Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40.
t. F441, Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.
u. F491, Poly(Vinylidene Fluoride)(PVDF) Plastic Lined Ferrous Metal Pipe and Fittings.

4. American Water Works Association (AWWA):
   a. B300, Standard for Hypochlorites.
   b. C111, Rubber-Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and Fittings.
   c. C200, Steel Water Pipe 6 IN and Larger.
   d. C207, Steel Pipe Flanges for Waterworks Service - Sizes 4 IN through 144 IN.
   e. C208, Dimensions for Fabricated Steel Water Pipe Fittings.
   f. C651, Standard for Disinfecting Water Mains.
5. Cast Iron Soil Pipe Institute (CISPI):
   a. 301, Hubless Cast-Iron Sanitary System: With No Hub Pipe and Fittings.
6. National Fire Protection Association (NFPA).
7. Underwriters Laboratory, Inc (UL).

B. Coordinate flange dimensions and drillings between piping, valves, and equipment.

1.3 SYSTEM DESCRIPTION

A. Piping Systems Organization and Definition:
1. Piping services are grouped into designated systems according to the chemical and physical properties of the fluid conveyed, system pressure, piping size and system materials of construction.
2. Table A below defines each service classification, its symbol, and the designated system classification number of each service.

TABLE A. PIPING SERVICES

SERVICE	SYSTEM
Raw Water Line	2

3. See PIPING SPECIFICATION SCHEDULES in PART 3.

1.4 SUBMITTALS

A. Shop Drawings:
1. See Section 01340.
2. Fabrication and/or layout drawings:
   a. Exterior yard piping drawings (minimum scale 1 IN equals 10 FT) with information including:
      1) Dimensions of piping lengths.
      2) Invert or centerline elevations of piping crossings.
      3) Acknowledgement of bury depth requirements.

4) Details of fittings, tapping locations, thrust blocks, restrained joint segments, harnessed joint segments, hydrants, and related appurtenances.
5) Acknowledge designated valve or gate tag numbers, manhole numbers, instrument tag numbers, pipe and line numbers.
6) Line slopes and vents.
7) Air release / vacuum relief valves.

3. Product technical data including:
   a. Acknowledgement that products submitted meet requirements of standards referenced.
   b. Copies of manufacturer's written directions regarding material handling, delivery, storage and installation.
   c. Master schedule showing piping appurtenances, pipe size, schedule of pipe, type linings, and coatings.
   d. Technical product data on gaskets, pipe, fittings, and other components.
4. Qualifications:
   a. Qualifications of lab performing disinfection analysis on water systems.
5. Test reports:
   a. Copies of pressure test results on all piping systems.
   b. Reports defining results of dielectric testing and corrective action taken.
   c. Disinfection test report.
   d. Notification of time and date of piping pressure tests.

B. Operation and Maintenance Manuals:
   1. See Section 01340.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect pipe coating during handling using methods recommended by manufacturer. Use of bare cables, chains, hooks, metal bars or narrow skids in contact with coated pipe is not permitted.

B. Prevent damage to pipe during transit. Repair abrasions, scars, and blemishes. If repair of satisfactory quality cannot be achieved, replace damaged material immediately.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Insulating unions:
      a. "Dielectric" by Epco.
   2. Dielectric flange kit:
      a. PSI.
      b. Maloney.
      c. Central Plastics.

B. Submit requests for substitution in accordance with Specification Section 01640.

2.2 PIPING SPECIFICATION SCHEDULES

A. Piping system materials, fittings and appurtenances are subject to requirements of specific piping specification schedules located at the end of PART 3 of this Section.

2.3 COMPONENTS AND ACCESSORIES

A. Insulating Components:
   1. Dielectric flange kits:
      a. Flat faced.
      b. 1/8 IN thick dielectric gasket, phenolic, non-asbestos.
      c. Suitable for 175 psi, 210 DegF.

d. 1/32 IN wall thickness bolt sleeves.
e. 1/8 IN thick phenolic insulating washers.

2. Dielectric unions:
   a. Screwed end connections.
   b. Rated at 175 psi, 210 DegF.
   c. Provide dielectric gaskets suitable for continuous operation at union rated temperature and pressure.

B. Reducers:
1. Furnish appropriate size reducers and reducing fittings to mate pipe to equipment connections. Connection size requirements may change from those shown on Drawings depending on equipment furnished.

C. Protective Coating and Lining:
1. Include pipe, fittings, and appurtenances where coatings, linings, paint, tests and other items are specified.
2. Field paint pipe in accordance with Specification Section 09905.

D. Valves:
1. See Section 15100 and the Drawings.

E. Corporation Stop
1. Provide corporation stop assembly at air valve vault locations as shown on the Drawings.
2. Assembly shall include isolation valve, check valve, and corp stop to allow for disconnection of piping while main line is in operation.
3. Materials:
   a. Consistent with piping system being used.

PART 3 - EXECUTION

3.1 EXTERIOR BURIED PIPING INSTALLATION

A. Unless otherwise shown on the Drawings, provide a minimum of 4 FT and maximum of 8 FT earth cover over exterior buried piping systems and appurtenances conveying water, fluids, or solutions subject to freezing.

B. Install expansion devices as necessary to allow expansion and contraction movement.

C. Laying Pipe In Trench:
1. Excavate and backfill trench in accordance with Section 02221.
2. Clean each pipe length thoroughly and inspect for compliance to Specifications.
3. Grade trench bottom and excavate for pipe bell and lay pipe on trench bottom.
4. Install gasket or joint material according to manufacturer's directions after joints have been thoroughly cleaned and examined.
5. Except for first two joints, before making final connections of joints, install two full sections of pipe with earth tamped along side of pipe or final with bedding material placed.
6. Lay pipe in only suitable weather with good trench conditions. Never lay pipe in water except where approved by Engineer.
7. Seal open end of line with watertight plug if pipe laying stopped.
8. Remove water in trench before removal of plug.

D. Lining Up Push-On Joint Piping:
1. Lay piping on route lines shown on Drawings.
2. Deflect from straight alignments or grades by vertical or horizontal curves or offsets.
3. Observe maximum deflection values stated in manufacturer's written literature.
4. Provide special bends when specified or where required alignment exceeds allowable deflections stipulated.

5. Install shorter lengths of pipe in such length and number that angular deflection of any joint, as represented by specified maximum deflection, is not exceeded.

E. Anchorage and Blocking:
   1. Provide reaction blocking, anchors, joint harnesses, or other acceptable means for preventing movement of piping caused by forces in or on buried piping tees, wye branches, plugs, or bends as shown on the Drawings or as directed by the Owner or Engineer.
   2. Place concrete blocking so that it extends from fitting into solid undisturbed earth wall. Concrete blocks shall not cover pipe joints.
   3. Provide bearing area of concrete in accordance with drawing detail.

F. Install 10-gauge solid tracer wire for PVC pipe with blue insulating jacket suitable for buried service.

G. Install insulating components where dissimilar metals are joined together.

H. Provide polyethylene warp for all buried ductile iron pipe in accordance with AWWA C105, Method A.

3.2 CONNECTIONS WITH EXISTING PIPING

A. Where connection between new work and existing work is made, use suitable and proper fittings to suit conditions encountered.

B. Perform connections with existing piping at time and under conditions which will least interfere with service to customers affected by such operation.

C. Undertake connections in fashion which will disturb system as little as possible.

D. Provide suitable equipment and facilities to dewater, drain, and dispose of liquid removed without damage to adjacent property.

E. Where connections to existing systems necessitate employment of past installation methods not currently part of trade practice, utilize necessary special piping components.

F. Where connection involves potable water systems, provide disinfection methods as prescribed in these Specifications.

G. Once tie-in to each existing system is initiated, continue work continuously until tie-in is made and tested.

3.3 FIELD QUALITY CONTROL

A. Hydrostatic Pressure Testing of Pipe:
   1. Utilize pressures, media and pressure test durations as specified herein under Piping Schedule.
   2. Test pressure to be measured at lowest point of system being tested. Test pressure at highest point of system being tested shall not be less than 75 percent of test pressure required at lowest point.
   3. Submit plan for pressure testing of transmission line to Engineer for review and approval prior to testing.
   4. Pressure test buried piping systems upon completion of installation and backfill.
   5. Do not paint exposed piping until successful performance of pressure testing.
   6. Provide temporary restraints for expansion joints for additional pressure load under test.
   7. Isolate equipment and pipe in system with rated pressure lower than pipe being tested.
   8. Perform pressure test using calibrated pressure gages and calibrated volumetric measuring equipment to determine leakage rates.
      a. Select each gage so that the specified test pressure falls within the upper half of the gage's range.
      b. Notify Owner and Engineer 48 HRS prior to each pressure test.
   9. Completely assemble and test new piping systems prior to connection to existing piping systems.

10. Acknowledge satisfactory performance of tests and inspections in writing to Engineer prior to final acceptance.
11. All observed leaks shall be repaired regardless of leakage measurements.
12. Bear the cost of all testing and inspecting, locating and remedying of leaks and any necessary retesting and re-examination.
13. Owner to furnish potable water for testing during time period(s) least disruptive to operation of existing facilities, as determined by the Owner.

B. Electrical Continuity Testing for Ductile Iron Pipe:
1. Perform testing to demonstrate electrical continuity across the pipe joints.
   a. Perform testing between corrosion monitoring stations.
2. Perform testing to demonstrate electrical discontinuity across isolation joints and insulated couplings.

C. Dielectric Testing Methods and Criteria:
1. Provide electrical check between metallic non-ferrous pipe or appurtenances and ferrous elements of construction to assure discontinuity has been maintained.
2. Wherever electrical contact is demonstrated by such test, locate the point or points of continuity and correct the condition.

3.4 CLEANING, DISINFECTION, AND FLUSHING

A. Cleaning and Protection:
1. Perform in accordance with AWWA C651, Standard for Disinfecting Water Mains.
2. Clean interior of pipe thoroughly before installing.
3. Maintain pipe in clean condition during installation. If, in the opinion of the Engineer, the pipe contains dirt that will not be removed by flushing, the pipe interior shall be cleaned and swabbed with bactericidal solution. If the pipeline becomes contaminated during construction, the Preventive and Corrective Measure During Construction, as outlined in AWWA C651, shall be employed.
4. At close of day's work or whenever workmen are absent from jobsite, plug, cap or otherwise provide watertight seal from open ends of pipe to prevent ingress of foreign material. If water is in trench, seal shall remain in place until trench is pumped dry.
5. Immediately prior to pressure testing, clean and remove grease, metal cuttings, dirt, or other foreign materials that may have entered the system.
6. At completion of work and prior to Final Acceptance, thoroughly clean work installed under these Specifications. Clean equipment, fixtures, pipe, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated by operation of system, from testing, or from other causes.

B. Backflow Prevention Requirements:
1. In accordance with AWWA C651, all final connections to existing mains may not occur until the new pipeline has been successfully pressure tested, disinfected, and flushed.
2. Contractor shall provide temporary connections from the existing distribution system at the tie-in points (or other locations approved by the Owner) for filling the new pipeline with water and flushing. These connections shall be provided with double check valves to prohibit the backflow of water to the distribution system. Temporary connections shall be monitored at all times when in place to ensure that contamination of the potable system does not occur.
3. The new pipeline shall be physically disconnected from the distribution system during disinfection contact and pressure testing.

C. Disinfection and Flushing of Water Systems:
1. After favorable performance of pressure test and prior to Final Acceptance, perform disinfection, flushing, and testing as prescribed herein.
2. Perform work, including preventative measures during construction, in full compliance with AWWA C651.

3. Prior to application of disinfectants, clean pipelines of any loose materials that might become suspended. Flush pipelines in accordance with AWWA C651 until discharged water is clear of color and suspended materials. Provide temporary pipes, ditches, and other conduits as needed to dispose of flushing water without damage to adjacent properties. Operate valves at least once during flushing.
4. Perform disinfection using sodium hypochlorite complying with AWWA B300 and ANSI/NSF 61.
5. Use continuous feed method of application. Allow freshwater and disinfectant to flow into pipe at a measured rate so that solution is at a consistent concentration. Do not place concentrated commercial disinfectant in pipeline before it is filled with water.
6. Tag system during disinfection procedure to prevent use.
7. During disinfection procedure, ensure that initial and residual chlorine concentrations meet AWWA C651 requirements by testing by an approved method as directed by the Owner.
8. Owner will designate locations for securing bacteriological samples and assist with sample collection.
9. Owner will provide sampling and bacteriological test (one time per system) at no cost to Contractor.
10. Following disinfection for required contact period and passing of all bacteriological samples, neutralize chlorine residual in water by treating with reducing agent (refer to appendix of AWWA C651). Flush all treated water from pipeline at its extremities until replacement water throughout pipe is, upon testing, proved comparable in quality to water in existing system. Take two samples to test for bacteriological quality as directed by Engineer. Repeat disinfection procedure until two satisfactory results are obtained.
11. After pipeline has been flushed to remove disinfectant, complete final connections to existing mains. Disinfect connections as required in AWWA C651.
12. Drain all flushing water to a location approved by Owner.
13. Quality of water delivered by the new water main to remain satisfactory for a minimum period of 2 days.
15. Cost of disinfection, flushing, and coordination of testing of potable water systems shall be included in the lump sum price bid for disinfecting, flushing, and pressure testing new transmission lines.
16. The Owner will provide the water required to fill the main initially and will pay for the water required to flush the main once. Filling and flushing shall be performed during periods of low usage, at time selected by the Owner.

3.5 LOCATION OF BURIED OBSTACLES

A. Furnish exact location and description of buried utilities encountered and thrust block placement.

B. Reference items to definitive reference point locations such as found property corners, entrances to buildings, existing structure lines, fire hydrants and related fixed structures.

C. Include such information as location, elevation, coverage, supports and additional pertinent information.

D. Incorporate information on "As-Recorded" Drawings.

3.6 PIPING SCHEDULES

A. All piping and fittings shall meet NSF Standard 61 and shall be suitable for potable water use and made in the United States.

B. PIPING SPECIFICATION SCHEDULE - SYSTEM 2

1. General:
   a. Piping symbol and service:
      1) Waterline.
   b. Test requirements:
      1) Test medium: Water.

2) Pressure Test : 1.5 x pressure class (measured at lowest point of system being tested) for ten (10) minutes.
3) Leakage test : 1.25 x pressure class (measured at lowest point of system being tested) for four (4) hours.

c. Gaskets and O-rings:
1) Flanged, push-on, and mechanical joints (ductile iron): Rubber, AWWA C111.
2) O-rings: Neoprene or rubber.

2. System components:
a. Pipe size: 3 through 48 IN.
1) Exposed service:
a) Materials: Ductile iron, Class 150.s.
b) Reference: ANSI C115.
c) Lining: Cement.
d) Coating: Paint.
e) Fittings: Either ANSI C110 ductile or gray iron. Optional ANSI C153 ductile iron compact fittings for sizes 3 to 16 IN.
f) Joints: ANSI C115 flanged joints with flanges at valves and other connections.
2) Buried service:
a) Materials: Ductile iron, Class 150 or 200 per the Drawings.
b) Reference: ANSI C151.
c) Lining: Cement.
d) Coating: Bituminous with polyethylene encasement.
e) Fittings: Either ANSI C110 ductile or gray iron. Optional ANSI C153 ductile iron compact fittings for sizes 3 to 16 IN.
f) Joints: Push-on joints with mechanical (stuffing box type) joints at fittings and valves.
g) Restrained joints and fittings: All buried piping will have restrained joints.

END OF SECTION

SECTION 15062
PIPE: DUCTILE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Ductile iron piping, fittings, and appurtenances.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 15060 - Pipe and Pipe Fittings: Basic Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American National Standards Institute (ANSI):
      a. B1.1, Unified Inch Screw Threads (UN and UNR Thread Form).
      b. B16.1, Cast-Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.
      c. B16.21, Nonmetallic Flat Gaskets for Pipe Flanges.
   2. American Society for Testing and Materials (ASTM):
      a. A183, Carbon Steel Track Bolts.
      b. A193, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.
      c. A194, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service.
      d. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
      e. B695, Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
      f. D1330, Rubber Sheet Gaskets.
   3. American Water Works Association (AWWA):
      a. C104, Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
      b. C105, Polyethylene Encasement for Gray and Ductile Cast-Iron Piping for Water and Other Liquids.
      c. C110, Ductile Iron and Gray Iron Fittings, 3 IN through 48 IN for Water and Other Liquids.
      d. C111, Gasket Joints for Cast Iron and Ductile Iron Pressure Pipe and Fittings.
      e. C115, Flanged Ductile Iron Pipe with Threaded Flanges.
      f. C150, Thickness Design of Ductile Iron Pipe.
      g. C151, Ductile Iron Pipe, Centrifugally Cast-In-Metal Molds or Sand-Lined Molds, for Water or Other Liquids.
      h. C153, Ductile-Iron Compact Fittings, 3 in. through 16 in. for Water and Other Liquids.
      i. C203, Coal-Tar Protective Coatings and Linings for Steel Water Pipelines-Enamel and Tape-Hot Applied.
   4. Military Specification (Mil Spec):
      a. QQ-P-416F, Plating, Cadmium Electro Deposited.

B. Owner Testing and Inspection:
   1. Mark as rejected and immediately remove from the jobsite, or repair to the Owner's satisfaction, all pipe lengths and fittings exhibiting signs of damage to the lining, coating, joints or pipe wall.

2. Material, fabricated parts, and pipe that are discovered to be defective, or which do not conform to the requirements of this specification shall be subject to rejection at any time prior to Owner's final acceptance of the product.

C. Factory Testing:
1. Subject pipe to hydrostatic testing according to AWWA standards.
2. Test shop-applied, spun cement-mortar lining in accordance with AWWA C104.

1.3 SUBMITTALS

A. Shop Drawings:
1. See Section 15060 and 01340.
2. Certification of factory hydrostatic testing.
3. If mechanical coupling system is used, submit piping, fittings, and appurtenant items which will be utilized to meet system requirements.
4. Pipe lay schedules.
5. Pipe design calculations.
6. Design certification stating that the pipe to be furnished complies with AWWA standards and these specifications.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents the following manufacturers are acceptable:
1. Flanged adapters:
a. Rockwell (Style 913 (steel)).
b. Dresser (Style 128 (steel)).
2. Compression sleeve coupling:
a. Rockwell (Style 431 (cast).
b. Dresser (Style 153 (cast).
3. Mechanical coupling:
a. Victaulic (Style 31).
b. Tyler.
4. Insulating couplings:
a. Rockwell (Style 416).
b. Dresser (Style 39).
5. Reducing couplings:
a. Rockwell (Style 415).
b. Dresser (Style 62).
6. Transition coupling:
a. Rockwell (Style 413).
b. Dresser (Style 62).
7. Polyethylene encasement tape:
a. Chase (Chasekote 750).
b. Kendall (Polyken 900).
c. 3 M (Scotchrap 50).

8. Restrained joints:
a. American (Lock Fast) - 12 IN and below.
b. US Pipe (TR-Flex) - 4 IN to 54 IN.
c. American (Lock Fast) - Above 12 IN.
d. Or approved equal.

B. Submit requests for substitution in accordance with Specification Section 01640.

2.2 MATERIALS

A. Ductile Iron Pipe:
   1. AWWA C115.
   2. AWWA C150.
   3. AWWA C151.

B. Fittings and Flanges:
   1. AWWA C110.
   2. AWWA C115.
   3. Flanges drilled and faced per ANSI B16.1 for both 125 and 250 psi applications.

C. Nuts and Bolts:
   1. Buried: Cadmium-plated meeting Military Specification QQP416F, Type 1, Class 2 (Cor-Ten) for buried application. Exposed: Mechanical galvanized ASTM B695, Class 40.
   2. Heads and dimensions per ANSI B1.1.
   3. Threaded per ANSI B1.1.
   4. Project ends 1/4 to 1/2 IN beyond nuts.

D. Gaskets: See individual piping system requirements in Section 15060.

E. If mechanical coupling system is used, utilize pipe thickness and grade in accordance with AWWA C606.

F. Polyethylene Encasement: See AWWA C105.

G. See Piping Schedules in Section 15060.

2.3 MANUFACTURED UNITS

A. Couplings:
   1. Flanged adapters:
      a. Unit consisting of steel or carbon steel body sleeve, flange, followers, Grade 30 rubber gaskets.
      b. Provide units equal to those specified in Article 2.1.
      c. Supply flanges meeting standards of adjoining flanges.
      d. Rate entire assembly for test pressure specified on piping schedule for each respective application.
   2. Compression sleeve coupling:
      a. Unit consisting of steel sleeve, followers, Grade 30 rubber gaskets.
      b. Provide units equal to those specified in Article 2.1.
      c. Supply flanges meeting standards of adjoining flanges.
      d. Entire assembly to be rated for test pressure specified on piping schedule for each respective application.
      e. Provide field coating for buried couplings per AWWA C203.
   3. Mechanical couplings:
      a. Use of mechanical couplings and fittings in lieu of flanged joints is acceptable where specifically specified in Section 15060. Utilize units defined in Article 2.1.

2.4 FABRICATION

A. Pipe design. Design pipe in accordance with ANSI/AWWA C-150 and AWWA M41. Furnish all ductile iron pipe in full accordance with the following design conditions:
   1. For this application:
      a. Working Pressure: As indicated in Section 15062, Section 3.6.
      b. Surge Pressure = 100 psi.
      c. Design of pipe shall be for both working pressure and surge pressure acting simultaneously.
   2. Safety factor of 2.0 for pipe design shall be applied to the total internal pressure, including working pressure plus surge pressure.

3. Minimum thickness of pipe shall be as shown for applicable pressure class in Table 50.5, including all footnotes, of AWWA Standard C-150.
4. The design for external loads shall be based on soil loads calculated from the pipeline drawings assuming a soil weight of 120 lbs per cubic foot and assuming a live load based on AASHTO H-20 truck load applied in accordance with AWWA C150.
5. The Contractor shall verify pipe grades on the Drawings after existing utilities are located. Vertical alignment changes required because of existing utility or other conflicts shall be accommodated by an appropriate change in pipe design depth in accordance with details shown on the Drawings. In no case shall pipe be installed deeper than its design allows.

B. Fittings:
1. Design pressure for fittings shall include the operating pressure shown on the Bid Form and Drawings plus a surge pressure of 100 psi.

2.5 LININGS AND COATINGS

A. Provide cement mortar lining in accordance with AWWA C104.
1. Provide double the standard minimum thickness per AWWA C104.
2. Lining shall be NSF certified.

B. Provide polyethylene wrap for all buried ductile iron pipe in accordance with AWWA C105, Method A.
1. Double wrap all joints.

C. Buried pipe should be asphaltic coated and polywrapped.

D. Exposed pipe should be factory primed per coating system listed in Section 09905

E. Provide heat shrinkable protective sleeve around all buried couplings.

2.6 SOURCE QUALITY CONTROL

A. Factory Test:
1. Subject pipe to hydrostatic test of not less than 500 psi with the pipe under the full test pressure for at least 10 seconds.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Joining Method - Push-On Mechanical (Gland-Type) Joints:
1. Install in accordance with AWWA C111.
2. Assemble mechanical joints carefully according to manufacturer's recommendations.
3. If effective sealing is not obtained, disassemble, thoroughly clean, and reassemble the joint.
4. Do not overstress bolts.
5. Where piping utilizes mechanical joints with tie rods, align joint holes to permit installation of harness bolts.

B. Joining Method - Push-On Joints:
1. Install in accordance with AWWA C151.
2. Assemble push-on joints in accordance with manufacturer's directions.
3. Bevel and lubricate spigot end of pipe to facilitate assembly without damage to gasket. Use lubricant that is non-toxic, does not support the growth of bacteria, has no deteriorating effects on the gasket material, and imparts no taste or odor to water in pipe.
4. Assure the gasket groove is thoroughly clean.
5. For cold weather installation, warm gasket prior to placement in bell.
6. Taper of bevel shall be approximately 30 degrees with centerline of pipe and approximately 1/4 IN back.

C. Joining Method - Flanged Joints:

1. Install in accordance with AWWA C115.
2. Extend pipe completely through screwed-on flanged and machine flange face and pipe in single operation.
3. Make flange faces flat and perpendicular to pipe centerline.
4. When bolting flange joints, exercise extreme care to ensure that there is no restraint on opposite end of pipe or fitting which would prevent uniform gasket compression or would cause unnecessary stress, bending or torsional strains to be applied to cast flanges or flanged fittings.
5. Allow one flange free movement in any direction while bolts are being tightened.
6. Do not assemble adjoining flexible joints until flanged joints in piping system have been tightened.
7. Gradually tighten flange bolts uniformly to permit even gasket compression.

D. Joining Method - Mechanical Coupling Joint:
1. Arrange piping so that pipe ends are in full contact.
2. Groove and shoulder ends of piping in accordance with manufacturer's recommendations.
3. Provide coupling and grooving technique assuring a connection which passes pressure testing requirements.

E. Flange Adapters 12 IN and Less:
1. Locate and drill holes for anchor studs after pipe is in place and bolted tight.
2. Drill holes not more than 1/8 IN larger than diameter of stud projection.

F. Cutting:
1. Do not damage interior lining material during cutting.
2. Use abrasive wheel cutters or saws.
3. Make square cuts.
4. Bevel and free cut ends of sharp edges after cutting.

G. Support exposed pipe in accordance with Section 15060.

H. Install buried piping in accordance with Sections 15060.

I. Install restrained joint systems for all buried piping.

3.2 FIELD QUALITY CONTROL

A. Test piping systems in accordance with Section 15060.

END OF SECTION

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SECTION 15100
VALVES: BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Valving, actuators, and valving appurtenances.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 15060 - Pipe and Pipe Fittings: Basic Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American National Standards Institute (ANSI):
      a. B1.20.1, Pipe Threads, General Purpose.
      b. B16.1, Cast Iron Pipe Flanges and Flanged Fittings.
      c. B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.
      d. B16.34, Valves-Flanged, Threaded and Welding End.
   2. American Water Works Association (AWWA):
      a. C111, Rubber-Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and Fittings.
      b. C207, Steel Pipe Flanges for Waterworks Service - Sizes 4 IN through 144 IN.
      c. C500, Gate Valves for Water and Sewerage Systems.
      d. C504, Rubber-Seated Butterfly Valves.
      e. C507, Ball Valves, 6 IN through 48 IN (150 MM through 1200 MM).
      f. C509, Resilient-Seated Gate Valves 3 through 12 NPS, for Water and Sewage Systems.
      g. C540, Power-Actuating Devices for Valves and Sluice Gates.
      h. C550, Protective Epoxy Interior Coatings for Valves and Hydrants.
      i. C606, Grooved and Shouldered Joints.
      j. D648, Standard Test Method for Deflection Temperature of Plastics Under Flexural Load.
   3. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.(MSS).

1.3 DEFINITIONS

A. The following are definitions of abbreviations used in this section or one of the individual valve sections.
   1. CWP: Cold water working pressure.
   2. WOG: Water, oil, gas working pressure.
   3. WWP: Water working pressure.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Section 01340.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
      c. Valve pressure and temperature rating.
      d. Valve material of construction.
      e. Special linings.
      f. Valve dimensions and weight.
      g. Valve flow coefficient.

h. Wiring and control diagrams for electric or cylinder actuators.
3. Test reports.

B. Operation and Maintenance Manuals:
1. See Section 01340.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Refer to individual valve specification sections.

2.2 MATERIALS

A. Refer to individual valve specification sections.

2.3 VALVE ACTUATORS

A. Valve Actuators - General:
1. Provide actuators as shown on Drawings or specified.
2. Counter clockwise opening as viewed from the top.
3. Direction of opening and the word OPEN to be cast in handwheel or valve bonnet.
4. Size actuator to produce required torque with a maximum pull of 80 LB at the maximum pressure rating of the valve provided and withstand without damage a pull of 200 LB on handwheel or chainwheel or 300 foot-pounds torque on the operating nut.
5. Unless otherwise specified, actuators for valves to be buried, submerged or installed in vaults or manholes shall be sealed to withstand at least 20 FT of submergence.
6. Extension Stem:
a. Install where shown or specified.
b. Solid steel with actuator key and nut, diameter not less than stem of valve actuator shaft.
c. Pin all stem connections.
d. Center in valve box with guide bushing.

B. Exposed Valve Manual Actuators:
1. Provide for all exposed valves not having electric or cylinder actuators.
2. Provide handwheels for gate and globe valves.
a. Size handwheels for valves in accordance with AWWA C500.
3. Provide lever actuators for plug valves, butterfly valves and ball valves 3 IN DIA and smaller.
a. Lever actuators for butterfly valves shall have a minimum of 5 intermediate lock positions between full open and full close.
b. Provide at least two levers for each type and size of valve furnished.
4. Gear actuators required for plug valves, butterfly valves, and ball valves 4 IN DIA and larger.
5. Gear actuators to be totally enclosed, permanently lubricated and with sealed bearings.

C. Buried Valve Actuators:
1. Provide screw type adjustable cast iron valve box, 5 IN minimum diameter, 3/16 IN minimum thickness, and identifying cast iron cover and traffic rated.
2. Box base to enclose buried valve gear box or bonnet.
3. Provide 2 IN standard actuator nuts complying with Section 3.16 of AWWA C500.
4. Provide at least two teehandle keys for actuator nuts, with 5 FT extension between key and handle.
5. Extension Stem:
a. Provide for buried valves greater than 4 FT below finish grade.
b. Extend to within 6 IN of finish grade.

6. Provide concrete pad encasement of valve box as shown for all buried valves unless shown otherwise.

2.4 FABRICATION

A. End Connections:
   1. Provide the type of end connections for valves as required in the Piping Schedules presented in Section 15060 or as shown on the Drawings.
   2. Comply with the following standards:
      a. Threaded: ANSI B1.20.1.
      b. Flanged: ANSI B16.1 Class 125 unless otherwise noted or AWWA C207.
      c. Bell and spigot or mechanical (gland) type: AWWA C111.
      d. Soldered: ANSI B16.18.
      e. Grooved: Rigid joints per Table 5 of AWWA C606.

B. Refer to individual valve sections for specifications of each type of valve on Project.

C. Nuts, Bolts, and Washers:
   1. Wetted or internal to be bronze or stainless steel. Exposed to be zinc or cadmium plated.

D. On Insulated Piping: Provide valves with extended stems to permit proper insulation application without interference from handle.

E. Epoxy Interior Coating:
   1. Provide epoxy interior coating for all ferrous surfaces in accordance with AWWA C550. Coating to be NSF 61 compliant for potable water use.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Setting Buried Valves:
   1. Locate valves installed in pipe trenches where buried pipe indicated on Drawings.
   2. Set valves and valve boxes plumb.
   3. Place valve boxes directly over valves with top of box being brought to surface of finished grade.
   4. Install in closed position.
   5. Place valve on firm footing in trench to prevent settling and excessive strain on connection to pipe.
   6. After installation, backfill up to top of box for a minimum distance of 4 FT on each side of box.

C. Support exposed valves and piping adjacent to valves independently to eliminate pipe loads being transferred to valve and valve loads being transferred to the piping.

D. For ground coupling valves, install rigid type couplings or provide separate support to prevent rotation of valve from installed position.

E. For threaded valves, provide union on one side within 2 FT of valve to allow valve removal.

F. Install valves accessible for operation, inspection, and maintenance.

3.2 ADJUSTING

A. Adjustment valves, actuators and appurtenant equipment to comply with Section 01650. Operate valve, open and close at system pressures.

END OF SECTION

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SECTION 15101
GATE VALVES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Gate valves.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 15100 - Valves: Basic Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Water Works Association (AWWA):
      a. C500, Metal-Seated Gate Valves for Water Supply Service.
      b. C509, Resilient-Seated Gate Valves for Water and Sewerage Systems.
      c. C550, Protective Epoxy Interior Castings for Valves and Hydrants.
   2. Manufacturer's Standardization Society of the Valve and Fittings Industry, Inc (MSS):
      a. SP-9, Spot Facing for Bronze, Iron and Steel Flanges.
      b. SP-70, Cast Iron Gate Valves, Flanged and Threaded Ends.
      c. SP-80, Bronze Gate, Globe, Angle and Check Valves.

1.3 DEFINITIONS

A. OS&Y: Outside Screw and Yoke.

B. NRS: Non-rising Stem.

C. RS: Rising Stem.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Section 15100.

B. Operation and Maintenance Manuals:
   1. See Section 01340.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the manufacturers listed under the specific valve types are acceptable.

2.2 VALVES: WATER; 3 TO 12 IN DIA

A. Resilient Seat Gate Valves (Wastewater - Water), 3 to 12 IN DIA:
   1. Comply with AWWA C509.
   2. Materials:
      a. Stem and stem nut - bronze.
         1) Wetted bronze parts in low zinc bronze.
         2) Aluminum bronze components: heat treated per AWWA C504.
      b. Body, gate - cast iron.

c. Resilient seat - Styrene Butadiene Rubber (SBR).

3. Design requirements:
   a. Working pressure: Same as piping system (150 psi. or 200 psi. per Drawings.
   b. Buried - NRS O-ring stem seal.
   c. Exposed - OS&Y, stuffing box stem seal, handwheel .
   d. Counter clockwise open rotation.
4. Fusion bonded epoxy coating interior and exterior except stainless steel and bearing surfaces.
   a. Comply with AWWA C550.
      1) Wetted bronze parts in low zinc bronze.
      2) Aluminum bronze components: heat treated per AWWA C504.
   b. NSF 61 certified for potable water use.

B. Acceptable Manufacturers:
1. Clow.
2. Mueller.
3. American Flow Control.
4. M & H.
5. Or approved equal made in the United States.

2.3 ACCESSORIES

A. Refer to Drawings for type of actuators. Furnish actuator integral with valve.

B. Refer to Section 15100 for actuator requirements.

2.4 FABRICATION

A. General:
1. Provide valves with clear waterways the full diameter of the valve.

B. Spot valves in accordance with MSS SP-9.

PART 3 - EXECUTION

3.1 INSTALLATION

A. See Section 15100.

B. Do not install gate valves inverted or with the stems sloped more than 45 degrees from the upright unless the valve was ordered and manufactured specifically for this orientation.

END OF SECTION

SECTION 15104
BALL VALVES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Ball valves.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 15100 - Valves: Basic Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. ASTM International (ASTM):
      a. A48, Standard Specification for Gray Iron Castings.
      b. A126, Gray Iron Castings for Valves Flanges, and Pipe Fittings.
   2. American National Standards Institute (ANSI):
      a. B16.34, Valves-Flanged, Threaded, and Welding End.
   3. American Water Works Association (AWWA):
      a. C507, Ball Valves 6 Inch through 48 Inch Diameter.
   4. Federal Specification:
      a. WW-V-35C.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Section 15100.
   2. Test results for AWWA valves.

B. Operation and Maintenance Manuals:
   1. See Section 01340.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the manufacturers listed in the applicable articles below are acceptable.

B. Submit requests for substitution in accordance with Specification Section 01640.

2.2 METALLIC BALL VALVES 1/4 TO 3 IN DIA

A. Comply with MSS SP-110.

B. Acceptable Manufacturers:
   1. Apollo.
   2. Jamesbury.
   3. Watts.
   4. Stockham.
   5. Nibco.

C. Materials (All Stainless Steel):
   1. Body: Three-part stainless steel, ASTM A351 CF8M.
   2. Ball: Stainless steel ASTM A276.
   3. Seats: RPTFE.

D. Design Requirements:
   1. Rated for a minimum of:
      a. 500 psi CWP.
      b. 150 psi of saturated steam.
      c. 29 IN vacuum.
   2. Two-position lockable handle.
   3. Stem with blowout-proof design.
   4. Balancing stop for all applications.
   5. Bodies with mounting pad for applications requiring actuators.

2.3 ACCESSORIES

A. Refer to Drawings for type of actuators. Furnish actuator integral with valve.

B. Refer to Section 15100 for actuator requirements.

2.4 SOURCE QUALITY CONTROL

A. Shop test AWWA C507 ball valves in accordance with AWWA C507.

B. Furnish record of test.

PART 3 - EXECUTION

3.1 INSTALLATION

A. See Section 15100.

END OF SECTION

SECTION 15106
CHECK VALVES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Check valves.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 15100 - Valves: Basic Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American National Standard Institute (ANSI):
      a. B16.1, Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250 and 800.
   2. American Water Works Association (AWWA):
      a. C111, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
      b. C508, Swing Check Valves for Waterworks Service, 2 through 24 IN NPS.
   3. Manufacturer's Standardization, Society of the Valve and Fittings Industry, Inc (MSS):
      a. SP-9, Spot Facing for Bronze, Iron and Steel Flanges.
      b. SP-71, Cast Iron Swing Check Valves, Flanged and Threaded Ends.
      c. SP-80, Bronze Gate, Globe, Angle and Check Valves.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Section 15100.

B. Operation and Maintenance Manuals:
   1. See Section 01340.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, manufacturers listed under the valve with types are acceptable.

B. Submit requests for substitution in accordance with Specification Section 01640.

2.2 SLANTING DISC CHECK VALVE: 2 TO 24 IN

A. Class 125.

B. Comply with AWWA C508.

C. Acceptable Manufacturers:
   1. APCO (Series 800T) with oil dash pot assisted closing mechanism
   2. Or approved equal.

D. Materials:
   1. Body, cover, disc, levers: Cast iron or cast steel.
   2. Seat: Bronze or stainless steel.

3. Seat ring: Bronze or rubber (Buna-N).
4. Hinge: Stainless steel.
5. Cushion pneumatic cylinder: Metallic corrosion resistant material.

E. Design Requirements:
1. Seat ring: Replaceable.
2. Cushion: Air type with adjustable opening and closing speed control.

PART 3 - EXECUTION

3.1 INSTALLATION

A. See Section 15100.

B. Install in accordance with manufacturer's instructions.

END OF SECTION

SECTION 15114

MISCELLANEOUS VALVES AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Combination Vacuum Breaking and Air Release Valve.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 11005 - Equipment: Basic Requirements.
   4. Section 15100 - Valves: Basic Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Gas Association (AGA).
   2. American National Standards Institute (ANSI):
      a. B16.1, Cast-Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.
      b. B16.5, Pipe Flanges and Flanged Fittings.
   3. American Water Works Association (AWWA):
      a. C512, Air-Release, Air/Vacuum, and Combination Air Valves for Waterworks Service.
      b. C550, Protective Epoxy Interior Coatings for Valves and Hydrants.

1.3 DEFINITIONS

A. General – The following definitions shall apply:
   1. Air-release valve: A hydro-mechanical device designed to automatically release to the atmosphere small pockets of air as they accumulate at local high points along a pipeline when the pipeline or piping system is full and operating under pressure.
   2. Air/vacuum valve: A direct-acting, float-operated, hydro-mechanical device designed to automatically release or admit large volumes of air during the filling or draining of a pipeline or piping system. This valve will open relive negative pressures and will remain closed when they system is full and under pressure.
   3. Combination air valve: A device having the features of both an air-release valve and an air/vacuum valve.
   4. Maximum working pressure: The maximum pressure at which the valve can continue to function.
   5. Valve design pressure: The maximum pressure to which a valve may be subjected.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Section 15100.

B. Operation and Maintenance Manuals:
   1. See Section 01340.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the manufacturers listed under the specific valve types are acceptable.

B. Submit requests for substitution in accordance with Specification Section 01640.

2.2 AIR RELEASE AND VACUUM RELIEF VALVES

A. General:
   1. Conform to AWWA C512.

B. Combination Vacuum Breaking and Air Release Valve (1”-CARV-01):
   1. Acceptable manufacturers:
      a. Crispin (1 IN) Model No. C10.
      b. Or approved equal.
   2. Materials:
      a. Body and cover: Ductile iron, ASTM A536, Grade 65-42-12.
      b. Float, linkage and hardware: Stainless steel.
      c. Seat: Buna-N.
   3. Design requirements:
      a. Working pressure: Rated for 150 psi., flanges flat faced and drilled.
      b. Air inflow rate: 6.1 scfm at 5 psi differential from atmosphere at 150 psi.
      c. Pipe connection for manual exhaust.
      d. Test pressure: 200 psig.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:
   1. See Section 11005 and Section 15100.

B. Air Release, Vacuum Relief, and Pressure Relief Valves:
   1. Pipe exhaust to a suitable disposal point.
   2. Where exhausted to a trapped floor drain, terminate exhaust line 6 IN minimum above floor.

3.2 FIELD QUALITY CONTROL

A. Clean, inspect, and operate valve to ensure all parts are operable and valve seats properly.

B. Check and adjust valves and accessories in accordance with manufacturer's instructions and place into operation.

END OF SECTION

SECTION 15183
PIPE INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Insulation:
a. Piping insulation.
b. Equipment insulation.
c. Insulate all exposed piping which conveys water that is 2 inches in diameter and smaller

B. Related Sections include but are not necessarily limited to:
1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
2. Division 01 - General Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
1. ASTM International (ASTM):
a. C177, Steady-State Thermal Transmission Properties by means of Guarded Hot Plate.
b. C411, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
c. C423, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
d. C518, Steady-State Thermal Transmission Properties by means of the Heat Flow Meter.
e. C534, Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
f. C553, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
g. C665, Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
h. C1071, Standard Specification for Thermal and Acoustical Insulation (Glass Fiber, Duct Lining Material).
i. D1056, Flexible Cellular Sponge or Expanded Rubber.
j. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
k. E96, Water Vapor Transmission of Materials in Sheet Form.
l. F25, Standard Test Method for Sizing and Counting Airborne Particulate Contamination in Clean Rooms and Other Dust-Controlled Areas Designed for Electronic and Similar Applications.
2. Armstrong Cork Company:
a. Bulletin 10/77 15P Mechanical Systems Insulation, Section 3.
3. National Fire Protection Association (NFPA):
a. 90A, Air Conditioning and Ventilating Systems.
b. 90B, Warm Air Heating and Air Conditioning Systems.
c. 255, Surface Burning Characteristics of Building Materials.
4. Underwriters Laboratories, Inc. (UL):
a. 723, Test for Surface Burning Characteristics of Building Materials.

1.3 SUBMITTALS

A. Shop Drawings:
1. See Section 01340.

2. Product technical data including:
    a. Acknowledgement that products submitted meet requirements of standards referenced.
    b. Manufacturer's installation instructions.
    c. Submit complete specification of insulation materials, adhesives, cement, together with manufacturer's recommended methods of application and coverage for coatings and adhesives.
3. Submit itemized schedule by building of proposed insulation systems showing density, thermal conductivity, thickness, adhesive, jackets and vapor barriers.
4. Certifications:
    a. Products will meet the requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
    1. Elastomeric insulation:
        a. Rubatex.
        b. Armstrong.
    2. Fiberglass insulation:
        a. Certainteed Corporation.
        b. Schuller (Manville).
        c. Owens Corning.
        d. Knauf.
    3. PVC jacket:
        a. Ceel-Co.
        b. PIC Plastics.

B. Submit requests for substitution in accordance with Section 01640.

2.2 PIPING INSULATION: ELASTOMERIC

A. General:
    1. Insulation fire and smoke hazard ratings for composite (insulation, jacket or facing, and adhesive used to adhere the facing or jacket to the insulation), as tested by procedure ASTM E84, NFPA 255 and UL 723, not exceeding:
        a. Flame spread: 25.
        b. Smoke developed: 100.
    2. Accessories (adhesives, mastics, cements, and tapes: Same component ratings as listed above.
    3. Indicate on product labels or their shipping cartons: Flame and smoke ratings do not exceed above requirements.
    4. Permanent treatment of jackets or facings to impart flame and smoke safety is required. Water-soluble treatments is prohibited.
    5. Insulated shields at pipe support points.

B. Pipe, Fitting, and Valve Insulation:
    1. Flexible elastomeric closed cell pipe insulation. Average thermal conductivity not to exceed 0.27 (Btu-IN) per square foot-DegF-hour at mean temperature of 75 DegF, temperature range -40 to 220 DegF; permeability not to exceed 0.20 by ASTM E96; water absorption 3 percent by ASTM D1056 and ozone resistance.
    2. Provide minimum insulation thickness conforming to schedules or as shown on the Drawings.

2.3 PIPING INSULATION: FIBERGLASS

A. Pipe and Fitting Insulation:
   1. Preformed fiberglass pipe insulation:
      a. Density: 4 LBS/CF.
      b. Temperature rated: 650 DegF.
      c. Average thermal conductivity not to exceed 0.22 (Btu-IN) per square foot-DegF-hour at mean temperature of 75 DegF.
      d. Fire hazard rating:
         1) UL 723, ASTM E84, NFPA 255.
         2) Flame spread not exceeding 25 and smoke developed not exceeding 100.
   2. Moisture adsorption:
      a. ASTM C553.
      b. Not greater than 0.5 percent moisture by volume when exposed to moisture laden air at 120 DegF and 96 percent RH.
   3. Fungi and bacteria resistance:
      a. ASTM C665.
      b. Does not breed or promote growth.
      c. Flame attenuated glass fibers bonded with thermosetting resin.
   4. Piping jackets (general applications):
      a. Aluminum: 16 mil embossed aluminum.
      b. PVC: Preformed 0.028 IN thick PVC jackets fabricated from B. F. Goodrich PVC sheeting V-66 with proven resistance to ultraviolet degradation when temperatures do not exceed the limits of PVC.
      c. Piping jacket not required on concealed piping.
   5. Provide minimum insulation thickness of 1-1/2 IN.

2.4 SUBSTITUTION

A. Submit request for substitution in accordance with Specification Section 01640.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. General:
   1. Piping below ground covered with earth will not be insulated.
   2. Consider ductwork, piping and equipment as exposed, except as otherwise indicated.
   3. Consider ductwork, piping and equipment in walls, partitions, floors, pipe chases, pipe shafts and duct shafts as concealed. Consider ductwork, piping and equipment above ceilings as concealed.
   4. Provide release for insulation application after installation and testing is complete. Apply insulation on clean, dry surfaces after inspection.
   5. Provide insulation continuous through wall, roof and ceiling openings, pipe hangers, supports and sleeves.
   6. Apply specified adhesives, mastics and coatings at the manufacturer's recommended coverage per unit volume.

C. Piping Insulation: Elastomeric:
   1. Slip insulation on pipe prior to connection. Whenever the slip-on technique is not possible provide insulation neatly slit and snapped over the pipe.
   2. Fabricate and install fitting cover insulation according to manufacturer's recommendations.
   3. Seal joints, slits, miter-cuts and other exposed edges of insulation with adhesive, recommended by the insulation manufacturer, to ensure complete vapor barrier.

D. Piping Insulation: Fiberglass:
   1. Apply over clean dry pipe. Butt all joints together firmly.
   2. Seal joints, slits, miter-cuts and other exposed edges of insulation as recommended by the insulation manufacturer.
   3. Insulate fittings, valves, and flanges with insulation thickness equal to adjacent pipe.
   4. PVC pipe jacket:
      a. Apply jacketing with a minimum of 1 IN overlap. Weld longitudinal and circumferential seams with adhesives as recommended by manufacturer.
      b. Provide slip-joints every 30 FT and between fittings if distance exceeds 8 FT. Construct slip-joints by overlapping jacket sections 6 to 10 IN.
      c. Provide premolded PVC covers of same material and manufacturer as jacket for fittings, valves, flanges, and related items in insulated piping systems.
   5. Aluminum pipe jacket:
      a. Field-applied aluminum jacket with vapor-sealed longitudinal and butt joints.
      b. Provide smooth and straight joint with a minimum 2 IN overlap.
      c. Secure joints with corrosion-resistant screws spaced 0.25 to 0.50 IN back from edge.
      d. Center spacing of screws 5 IN maximum or as required to provide smooth tight-fitted joints.
      e. Place joints on least exposed side of piping to obtain neat appearance.

3.2 REPAIR

A. Whenever any factory applied insulation or job-applied insulation is removed or damaged, replace with the same quality of material and workmanship.

END OF SECTION

SECTION 16010
ELECTRICAL: BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Basic requirements for electrical systems.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 11005 - Equipment: Basic Requirements.
   4. Section 16120 - Wire and Cable - 600 Volt and Below.
   5. Section 16130 - Raceways and Boxes.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. Aluminum Association (AA).
   2. American Iron and Steel Institute (AISI).
   3. ASTM International (ASTM):
      a. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
      b. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   4. ETL Testing Laboratories (ETL).
   5. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
      a. C2, National Electrical Safety Code (NESC).
   6. National Electrical Manufacturers Association (NEMA):
      a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
   7. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC).
   8. Underwriters Laboratories, Inc. (UL).

B. Where UL test procedures have been established for the product type, use UL or ETL approved electrical equipment and provide with the UL or ETL label.

1.3 DEFINITIONS

A. For the purposes of providing materials and installing electrical work the following definitions shall be used.
   1. Outdoor area: Exterior locations where the equipment is normally exposed to the weather and including below grade structures, such as vaults, manholes, handholes and in-ground pump stations.
   2. Architecturally finished interior area: Offices, laboratories, conference rooms, restrooms, corridors and other similar occupied spaces.
   3. Non-architecturally finished interior area: Pump, chemical, mechanical, electrical rooms and other similar process type rooms.
   4. Highly corrosive and corrosive area: Areas identified on the Drawings where there is a varying degree of spillage or splashing of corrosive materials such as water, wastewater or chemical solutions; or chronic exposure to corrosive, caustic or acidic agents, chemicals, chemical fumes or chemical mixtures.
   5. Hazardous areas: Class I, II or III areas as defined in NFPA 70.
   6. Shop fabricated: Manufactured or assembled equipment for which a UL test procedure has not been established.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01340 for requirements for the mechanics and administration of submittal process.
   2. See Specification Section 11005 and individual specification sections for submittal requirements for products defined as equipment.
   3. General requirements:
      a. Provide manufacturer's technical information on products to be used, including product descriptive bulletin.
      b. Include data sheets that include manufacturer's name and product model number.
         1) Clearly identify all optional accessories.
      c. Acknowledgement that products are UL or ETL listed or are constructed utilizing UL or ETL recognized components.
      d. Manufacturer's delivery, storage, handling and installation instructions.
      e. Product installation details.
      f. See individual specification sections for any additional requirements.

B. Operation and Maintenance Manuals:
   1. See Specification Section 01340 for requirements for:
      a. The mechanics and administration of the submittal process.
      b. The content process of Operation and Maintenance Manuals.

C. When a Specification Section includes products specified in another Specification Section, each Specification Section shall have the required Shop Drawing transmittal form per Specification Section 01340 and all Specification Sections shall be submitted simultaneously.

1.5 DELIVERY, STORAGE, AND HANDLING

A. See Specification Section 01600.

B. Protect nameplates on electrical equipment to prevent defacing.

1.6 AREA DESIGNATIONS

A. Designation of an area will determine the NEMA rating of the electrical equipment enclosures, types of conduits and installation methods to be used in that area.
   1. Outdoor areas:
      a. Wet.
      b. Also, corrosive and/or hazardous when specifically designated on the Drawings or in the Specifications.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, refer to specific Electrical Specification Sections and specific material paragraphs below for acceptable manufacturers.

B. Submit request for substitution in accordance with Specification Section 01640.

C. Provide all components of a similar type by one (1) manufacturer.

2.2 MATERIALS

A. Electrical Equipment Support Pedestals and/or Racks:
   1. Approved manufacturers:
      a. Modular strut:
         1) Unistrut Building Systems.
         2) Eaton B-Line.
         3) Globe Strut.
         4) Thomas & Betts Superstrut.

2. Material requirements:
    a. Modular strut:
        1) Galvanized steel: ASTM A123/123M or ASTM A153/A153M.
        2) Stainless steel: AISI Type 316.
        3) PVC coated galvanized steel: ASTM A123/A123M or ASTM A153/A153M and 20 mil PVC coating.
        4) Aluminum: AA Type 6063-T6.
    b. Mounting hardware:
        1) Galvanized steel.
        2) Stainless steel.

B. Field touch-up of galvanized surfaces.
1. Zinc-rich primer.
    a. One (1) coat, 3.0 mils, ZRC by ZRC Products.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install and wire all equipment, including prepurchased equipment, and perform all tests necessary to assure conformance to the Drawings and Specification Sections and ensure that equipment is ready and safe for energization.

B. Install equipment in accordance with the requirements of:
1. NFPA 70.
2. IEEE C2.
3. The manufacturer's instructions.

C. In general, conduit routing is not shown on the Drawings.
1. The Contractor is responsible for routing all conduits including those shown on one-line and control block diagrams and home runs shown on floor plans.
2. Conduit routings and stub-up locations that are shown are approximate; exact routing to be as required for equipment furnished and field conditions.

D. When complete branch circuiting is not shown on the Drawings:
1. A homerun indicating panelboard name and circuit number will be shown and the circuit number will be shown adjacent to the additional devices (e.g., light fixture and receptacles) on the same circuit.
2. The Contractor is to furnish and install all conduit and conductors required for proper operation of the circuit.
3. The indicated home run conduit and conductor size shall be used for the entire branch circuit.
4. See Specification Section 16120 for combining multiple branch circuits in a common conduit.

E. Do not use equipment that exceed dimensions or reduce clearances indicated on the Drawings or as required by the NFPA 70.

F. Install equipment plumb, square and true with construction features and securely fastened.

G. Install electrical equipment, including pull and junction boxes, minimum of 6 IN from process, gas, air and water piping and equipment.

H. Install equipment so it is readily accessible for operation and maintenance, is not blocked or concealed and does not interfere with normal operation and maintenance requirements of other equipment.

I. Device Mounting Schedule:
1. Unless indicated otherwise on the Drawings, mounting heights are as indicated below:
    a. Light switch (to center): 48 IN.

b. Receptacle in architecturally finished areas (to center): 18 IN.
c. Receptacle on exterior wall of building (to center): 18 IN.
d. Receptacle in non-architecturally finished areas (to center): 48 IN.
e. Telephone outlet in architecturally finished areas (to center): 18 IN.
f. Telephone outlet for wall-mounted phone (to center): 54 IN.
g. Safety switch (to center of operating handle): 54 IN.
h. Separately mounted motor starter (to center of operating handle): 54 IN.
i. Pushbutton or selector switch control station (to center): 48 IN.
j. Panelboard (to top): 72 IN.

J. Avoid interference of electrical equipment operation and maintenance with structural members, building features and equipment of other trades.
1. When it is necessary to adjust the intended location of electrical equipment, unless specifically dimensioned or detailed, the Contractor may make adjustments in equipment locations in accordance with the following without obtaining the Engineer's approval:
a. 1 FT at grade, floor and roof level in any direction in the horizontal plane.
b. 1 FT for equipment other than lighting at ceiling level in any direction in the horizontal plane.
c. 1 FT for lighting fixtures at ceiling level in any direction in the horizontal plane .
d. 1 FT on walls in a horizontal direction within the vertical plane.
e. Changes in equipment location exceeding those defined above require the Engineer's approval.

K. Provide electrical equipment support system per the following area designations:
1. Dry areas:
a. Galvanized system consisting of galvanized steel channels and fittings, nuts and hardware.
b. Field touch-up cut ends and scratches of galvanized components with the specified primer during the installation, before rust appears.
2. Wet areas:
a. Galvanized system consisting of galvanized steel channels and fittings, nuts and hardware.
b. Field touch-up cut ends and scratches of galvanized components with the specified primer during the installation, before rust appears.
3. Corrosive areas:
a. Aluminum system consisting of aluminum channels and fittings with stainless steel nuts and hardware.

3.2 FIELD QUALITY CONTROL

A. Replace equipment and systems found inoperative or defective and re-test.

B. Cleaning:
1. See Specification Section 01710.

C. The protective coating integrity of support structures and equipment enclosures shall be maintained.
1. Repair galvanized components utilizing a zinc rich paint.
2. Repair painted components utilizing touch up paint provided by or approved by the manufacturer.
3. Repair PVC coated components utilizing a patching compound, of the same material as the coating, provided by the manufacturer of the component.
4. Repair surfaces which will be inaccessible after installation prior to installation.
5. See Specification Section 16130 for requirements for conduits and associated accessories.

D. Replace nameplates damaged during installation.

3.3 DEMONSTRATION

A. Demonstrate equipment in accordance with Specification Section 01650.

END OF SECTION

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SECTION 16060
GROUNDING AND BONDING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Material and installation requirements for grounding and bonding system(s).

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 16010 - Electrical: Basic Requirements.
   4. Section 16120 - Wire and Cable - 600 Volt and Below.
   5. Section 16130 - Raceways and Boxes.
   6. Section 16180 - Acceptance Testing.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. ASTM International (ASTM):
      a. B8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
   2. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
      a. 837, Standard for Qualifying Permanent Connections Used in Substation Grounding.
   3. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC).
   4. Underwriters Laboratories, Inc. (UL):
      a. 467, Grounding and Bonding Equipment.

B. Assure ground continuity is continuous throughout the entire Project.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01340 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data.
      a. Provide submittal data for all products specified in PART 2 of this Specification Section except:
         1) Grounding clamps, terminals and connectors.
         2) Exothermic welding system.
      b. See Specification Section 16010 for additional requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Ground rods and bars and grounding clamps, connectors and terminals:
      a. Erico Products, Inc.
      b. Harger Lightning & Grounding.
      c. Heary Brothers.
      d. Hubbell - Burndy.
      e. Robbins Lightning Protection.

f. Thomas & Betts - Blackburn.
g. Thompson Lightning Protection.

2. Exothermic weld connections:
a. Erico Products Inc., Cadweld.
b. Harger Lightning & Grounding - Ultraweld.
c. Hubbell - Burndy (Thermoweld).
d. Thomas & Betts - Furseweld.

2.2 COMPONENTS

A. Wire and Cable:
1. Bare conductors: Soft drawn stranded copper meeting ASTM B8.
2. Insulated conductors: Color coded green, per Specification Section 16120.

B. Conduit: As specified in Specification Section 16130.

C. Ground Rods:
1. 3/4 IN x 10 FT.
2. Copper-clad:
a. 10 mil minimum uniform coating of electrolytic copper molecularly bonded to a rigid steel core.
b. Corrosion resistant bond between the copper and steel.
c. Hard drawn for a scar-resistant surface.

D. Grounding Clamps, Connectors and Terminals:
1. Mechanical type:
a. Standards: UL 467.
b. High copper alloy content.
2. Compression type for interior locations:
a. Standards: UL 467.
b. High copper alloy content.
c. Non-reversible.
d. Terminals for connection to bus bars shall have two bolt holes.
3. Compression type suitable for direct burial in earth or concrete:
a. Standards: UL 467, IEEE 837.
b. High copper alloy content.
c. Non-reversible.
d. Factory filled with oxide inhibiting compound.

E. Exothermic Weld Connections:
1. Copper oxide reduction by aluminum process.
2. Molds properly sized for each application.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:
1. Install products in accordance with manufacturer's instructions.
2. Size grounding conductors and bonding jumpers in accordance with NFPA 70, Article 250, except where larger sizes are indicated on the Drawings.
3. Remove paint, rust, or other non-conducting material from contact surfaces before making ground connections.
4. Where ground conductors pass through floor slabs or building walls provide nonmetallic sleeves and install per Specification Section 01 73 20.
5. Do not splice grounding conductors except at ground rods.
6. Install ground rods and grounding conductors in undisturbed, firm soil.
a. Provide excavation required for installation of ground rods and ground conductors.

b. Use driving studs or other suitable means to prevent damage to threaded ends of sectional rods.
c. Unless otherwise specified, connect conductors to ground rods with compressor type connectors or exothermic weld.
d. Provide sufficient slack in grounding conductor to prevent conductor breakage during backfill or due to ground movement.
e. Backfill excavation completely, thoroughly tamping to provide good contact between backfill materials and ground rods and conductors.

7. Do not use exothermic welding if it will damage the structure the grounding conductor is being welded to.

B. Grounding Electrode System:
1. Provide a grounding electrode system in accordance with NFPA 70, Article 250 and as indicated on the Drawings.
2. Grounding conductor terminations:
a. Ground bars mounted on wall, use compression type terminal and bolt it to the ground bar with two bolts.
b. Ground bars in electrical equipment, use compression type terminal and bolt it to the ground bar.
c. Piping systems use mechanical type connections.
d. Building steel, below grade and encased in concrete, use compression type connector or exothermic weld.
3. Ground ring grounding system:
a. Ground ring consists of ground rods and a grounding conductor looped around the structure.
b. Placed at a minimum of 10 FT from the structure foundation and 2 FT-6 IN below grade.
c. Provide a minimum of four (4) ground rods placed at the corners of the structure and additional rods so that the maximum distance between ground rods does not exceed 50 FT.
d. Building/Structure grounding:
1) Bond building/structure metal support columns to the ground ring at all corners of the structure.
e. Grounding conductor: Bare conductor, size as indicated on the Drawings.

C. Supplemental Grounding Electrode:
1. Provide the following grounding in addition to the equipment ground conductor supplied with the feeder conductors whether or not shown on the Drawings.
2. Metal light poles:
a. Connect metal pole to a ground rod.
b. Grounding conductor: Bare #6 AWG minimum.
3. Equipment support rack and pedestals mounted outdoors:
a. Connect metallic structure to a ground rod.
b. Grounding conductor: #6 AWG minimum.

D. Low Voltage Transformer Separately Derived Grounding System:
1. Ground step-down transformer integrally mounted in motor control center to motor control center ground bus.

E. Raceway Bonding/Grounding:
1. All metallic conduit shall be installed so that it is electrically continuous.
2. All conduits to contain a grounding conductor with insulation identical to the phase conductors, unless otherwise indicated on the Drawings.
3. NFPA 70 required grounding bushings shall be of the insulating type.
4. Provide double locknuts at all panels.
5. Bond all conduit, at entrance and exit of equipment, to the equipment ground bus or lug.
6. Provide bonding jumpers if conduits are installed in concentric knockouts.

7. Make all metallic raceway fittings and grounding clamps tight to ensure equipment grounding system will operate continuously at ground potential to provide low impedance current path for proper operation of overcurrent devices during possible ground fault conditions.

F. Equipment Grounding:
   1. All utilization equipment shall be grounded with an equipment ground conductor.

G. Manhole and Handhole Grounding:
   1. Provide a ground rod and ground bar, when indicated or as needed, in each manhole and handhole with exposed metal parts.
      a. Expose a minimum of 4 IN of the rod above the floor for field connections to the rod.
   2. Connect all exposed metal parts (e.g., conduits and cable racks) to the ground rod.

3.2 FIELD QUALITY CONTROL

A. Leave grounding system uncovered until observed by Owner.

B. Acceptance testing:
   1. See Specification Section 16080.

END OF SECTION

SECTION 16080
ACCEPTANCE TESTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Basic requirements for acceptance testing.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 11005 - Equipment: Basic Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
      a. 400, Guide for Field Testing and Evaluation of the Insulation of Shielded Power Cable Systems.
      b. 400.3, Guide for Partial Discharge Testing of Power Cable Systems in a Field Environment.
   2. InterNational Electrical Testing Association (NETA):
      a. ATS, Standard for Acceptance Testing Specifications for Electric Power Equipment and Systems.
   3. Nationally Recognized Testing Laboratory (NRTL).
   4. Telecommunications Industry Association/Electronic Industries Alliance/American National Standards Institute (TIA/EIA/ANSI):
      a. 455-78-B, Optical Fibres - PART 1-40: Measurement Methods and Test Procedures - Attenuation.

B. Qualifications:
   1. Testing firm qualifications: See Specification Section 11005.
   2. Field personnel:
      a. See Specification Section 11005.
      b. As an alternative, supervising technician may be certified by the equipment manufacturer.
   3. Analysis personnel:
      a. See Specification Section 11005.
         As an alternative, supervising technician may be certified by the equipment manufacturer.

C. Phasing Diagram:
   1. Coordinate with Utility Company for phase rotations and Phase A, B and C markings.
      a. Create a phasing diagram showing the coordinated phase rotations with generators and motors through the transformers.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01340 for requirements for the mechanics and administration of the submittal process.
   2. See Specification Section 01340 for electrical equipment and connection testing plan submittal requirements.

B. Informational Submittals:

1. See Specification Section 01340 for requirements for the mechanics and administration of the submittal process.
2. Within two (2) weeks after successful completion of Demonstration Period (Commissioning Period):
    a. Single report containing information including:
        1) Summary of Project.
        2) Information from pre-energization testing.
        3) See testing and monitoring reporting requirements in Specification Section 01 61 03.

PART 2 - PRODUCTS

2.1 FACTORY QUALITY CONTROL

A. Provide Electrical equipment with all factory tests required by the applicable industry standards or NRTL.

B. Factory testing will not be accepted in lieu of field acceptance testing requirements specified in this Specification Section and Specification Section 11005.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

A. General:
1. See Specification Section 11005.
2. Complete electrical testing in three (3) phases:
    a. Pre-energization testing phase.
    b. Equipment energized with no load.
    c. Equipment energized under load.
3. Perform testing in accordance with this Specification Section and NETA ATS.
4. Provide field setting and programming of all adjustable protective devices and meters to settings as determined by the approved coordination study.

B. Equipment Monitoring and Testing Plan: See Specification Section 11005.

C. Instruments Used in Equipment and Connections Quality Control Testing: See Specification Section 11005.

D. Testing and Monitoring Program Documentation: See Specification Section 11005.

E. Electrical Equipment and Connections Testing Program:
1. See Specification Section 11005.
2. See individual Division 16 Specification Sections for equipment specific testing requirements.
3. Test all electrical equipment.
    a. Perform all required NETA testing.
    b. Perform all required NETA testing plus the optional testing identified with each specific type of equipment in Article 3.2 of this Specification Section.

3.2 SPECIFIC EQUIPMENT TESTING REQUIREMENTS

A. Switchgear and Switchboards:
1. Perform inspections and tests per NETA ATS 7.1.
2. Components: Test all components per applicable paragraphs of this Specification Section and NETA ATS.

B. Transformers - Small Dry Type:
1. Perform inspections and tests per NETA ATS 7.2.1.1.
2. Perform the following additional tests:

a. Record phase-to-phase, phase-to-neutral, and neutral-to-ground voltages at no load after energizing, and at operating load after startup.

3. Adjust tap connections as required to provide secondary voltage within 2-1/2 percent of nominal under normal load after approval of Engineer.
4. Record as-left tap connections.

C. Cable - Low Voltage:
1. Perform inspections and tests per NETA ATS 7.3.2.

D. Low Voltage Power Circuit Breakers:
1. Perform inspections and tests per NETA ATS 7.6.1.2.
   a. Tests shall include primary current injection testing of all breakers at final settings.
   b. Where short-time or instantaneous settings on large frame breakers are beyond the current capability of field testing, primary injection tests at reduced currents shall be permitted if combined with secondary injection calibration test of trip unit at final settings.
2. Components: Test all components per applicable paragraphs of this Specification Section and NETA ATS.
3. Perform the following additional tests:
   a. Shunt trip devices minimum tripping voltage.
4. Record as-left settings.

E. Low Voltage Molded Case Circuit Breakers:
1. Perform inspections and tests per NETA ATS 7.6.1.1.
2. Components:
   a. Test all components per applicable paragraphs of this Specification Section and NETA ATS.
   b. Thermal magnetic breakers: Visual and mechanical inspection per NETA ATS only.
   c. Solid state trip type: Visual and mechanical inspection and electrical tests per NETA ATS.
3. Record as-left settings.

F. Grounding:
1. Perform inspections and tests per NETA ATS 7.13.
2. Components: Test all components per applicable paragraphs of this Specification Section and NETA ATS.

G. Ground Fault Protection:
1. Perform inspections and tests per NETA ATS 7.14.
2. Components: Test all components per applicable paragraphs of this Specification Section and NETA ATS.
3. Perform the following optional tests per NETA ATS:
   a. Control wiring insulation resistance.
4. Perform the following additional tests for four-wire systems:
   a. Primary current injection into switchgear bus with test set configured to simulate transformer source and high current jumper used to simulate unbalanced load and ground fault conditions.
   b. Verify no tripping for unbalanced load on each feeder and each main breaker.
   c. Verify no tripping for unbalanced load across tie breaker for dual-source schemes.
   d. Verify tripping for ground fault on load side of feeder each feeder and on each main bus.
   e. Verify tripping for ground fault on a single feeder and on each main bus through tie breaker(s) for multiple-source schemes.

H. Motors:
1. Perform inspections and tests per NETA ATS 7.15.
2. See Specification Section 01 61 03.

I. Motor Controllers:

1. Perform inspections and tests per NETA ATS 7.16.
2. Components: Test all components per applicable paragraphs of this Specification Section and NETA ATS.

END OF SECTION

SECTION 16120

WIRE AND CABLE: 600 VOLT AND BELOW

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Material and installation requirements for:
      a. Building wire.
      b. Power cable.
      c. Control cable.
      d. Shielded VFD cable.
      e. Instrumentation cable.
      f. Wire connectors.
      g. Insulating tape.
      h. Pulling lubricant.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 16010 - Electrical: Basic Requirements.
   4. Section 16080 - Acceptance Testing.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
      a. 1202, Standard for Flame-Propagation Testing of Wire and Cable.
   2. Insulated Cable Engineers Association (ICEA):
      a. S-58-679, Standard for Control Cable Conductor Identification.
   3. National Electrical Manufacturers Association (NEMA):
      a. ICS 4, Industrial Control and Systems: Terminal Blocks.
   4. National Electrical Manufacturers Association/Insulated Cable Engineers Association (NEMA/ICEA):
      a. WC 57/S-73-532, Standard for Control Cables.
      b. WC 70/S-95-658, Non-Shielded Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy.
   5. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC).
      b. 262, Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.
   6. Telecommunications Industry Association/Electronic Industries Alliance/American National Standards Institute (TIA/EIA/ANSI):
      a. 568, Commercial Building Telecommunications Cabling Standard.
   7. Underwriters Laboratories, Inc. (UL):
      a. 44, Standard for Safety Thermoset-Insulated Wires and Cables.
      b. 83, Standard for Safety Thermoplastic-Insulated Wires and Cables.
      c. 467, Standard for Safety Grounding and Bonding Equipment.
      d. 486A, Standard for Safety Wire Connectors and Soldering Lugs for use with Copper Conductors.
      e. 486C, Standard for Safety Splicing Wire Connections.
      f. 510, Standard for Safety Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape.
      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.
i. 2250, Standard for Safety Instrumentation Tray Cable.

1.3 DEFINITIONS

A. Cable: Multi-conductor, insulated, with outer sheath containing either building wire or instrumentation wire.

B. Instrumentation Cable:
1. Multiple conductor, insulated, twisted or untwisted, with outer sheath.
2. The following are specific types of instrumentation cables:
a. Analog signal cable:
1) Used for the transmission of low current (e.g., 4-20mA DC) or low voltage (e.g., 0-10 Vdc) signals, using No. 16 AWG and smaller conductors.
2) Commonly used types are defined in the following:
a) TSP: Twisted shielded pair.
b) TST: Twisted shielded triad.
b. Digital signal cable: Used for the transmission of digital signals between computers, PLC's, RTU's, etc.

C. Power Cable: Multi-conductor, insulated, with outer sheath containing building wire, No. 8 AWG and larger.

D. Shielded VFD Cable: Multi-conductor, insulated, with shield, drain wire and building wires, No. 12 and larger.

E. Control Cable: Multi-conductor, insulated, with outer sheath containing building wires, No. 14, No. 12 or No. 10 AWG.

F. Building Wire: Single conductor, insulated, with or without outer jacket depending upon type.

1.4 SUBMITTALS

A. Shop Drawings:
1. See Specification Section 01340 for requirements for the mechanics and administration of the submittal process.
2. Product technical data:
a. Provide submittal data for all products specified in PART 2 of this Specification Section except:
1) Wire connectors.
2) Insulating tape.
3) Cable lubricant.
b. See Specification Section 16010 for additional requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

A. See Specification Section 16010.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Building wire, power and control cable:
a. Aetna Insulated Wire.
b. Alphawire.
c. Cerrowire.
d. Encore Wire Corporation.
e. General Cable.

f. Okonite Company.
g. Southwire Company.

2. Shielded VFD cable:
   a. Belden Inc.
   b. General Cable.
   c. Okonite Company.
   d. Olfex Wire and Cable, Inc.
   e. Priority Wire and Cable (Prysmian).
   f. Rockbestos-Surprenant Cable Corp.
   g. Southwire Company.

3. Instrumentation cable:
   a. Analog cable:
      1) Alphawire.
      2) Belden Inc.
      3) General Cable.

4. Wire connectors:
   a. Burndy Corporation.
   b. Buchanan.
   c. Ideal.
   d. Ilsco.
   e. 3M Co.
   f. Teledyne Penn Union.
   g. Thomas and Betts.
   h. Phoenix Contact.

5. Insulating and color coding tape:
   a. 3M Co.
   b. Plymouth Bishop Tapes.
   c. Red Seal Electric Co.

B. Submit request for substitution in accordance with Specification Section 01640.

2.2 MANUFACTURED UNITS

A. Building Wire:
1. Conductor shall be copper with 600 V rated insulation.
2. Conductors shall be stranded, except for conductors used in lighting and receptacle circuits which may be stranded or solid.
3. Surface mark with manufacturer's name or trademark, conductor size, insulation type and UL label.
4. Conform to NEMA/ICEA WC 70/S-95-658 and UL 83 for type THHN/THWN and THHN/THWN-2 insulation.
5. Conform to NEMA/ICEA WC 70/S-95-658 and UL 44 for type XHHW-2 insulation.

B. Power Cable:
1. Conductor shall be copper with 600 V rated insulation.
2. Surface mark with manufacturer's name or trademark, conductor size, insulation type and UL label.
3. Conform to NEMA/ICEA WC 70/S-95-658 and UL 83 and UL 1277 for type THHN/THWN insulation with an overall PVC jacket.
4. Number of conductors as required, including a bare ground conductor.
5. Individual conductor color coding:
   a. ICEA S-58-679, Method 4.
   b. See PART 3 of this Specification Section for additional requirements.
6. Conform to NFPA 70 Type TC and IEEE 1202 or CSA FT-4.

C. Control Cable:
1. Conductor shall be copper with 600 V rated insulation.

2. Surface mark with manufacturer's name or trademark, conductor size, insulation type and UL label.
3. Conform to NEMA/ICEA WC 57/S-73-532 and UL 83 and UL 1277 for type THHN/THWN insulation with an overall PVC jacket.
4. Number of conductors as required, provided with or without bare ground conductor of the same AWG size.
    a. When a bare ground conductor is not provided, an additional insulated conductor shall be provided and used as the ground conductor (e.g., 6/c No. 14 w/g and 7/c No. 14 are equal).
5. Individual conductor color coding:
    a. ICEA S-58-679, Method 1, Table E-2.
    b. See PART 3 of this Specification Section for additional requirements.
6. Conform to NFPA 70 Type TC and IEEE 1202, CSA FT-4 or NFPA 262.

D. Electrical Equipment Control Wire:
1. Conductor shall be copper with 600 V rated insulation.
2. Conductors shall be stranded.
3. Surface mark with manufacturer's name or trademark, conductor size, insulation type and UL label.
4. Conform to UL 44 for Type SIS insulation.
5. Conform to UL 83 for Type MTW insulation.

E. Shielded VFD Cable:
1. Conductor shall be copper, stranded with 600 V rated insulation.
2. Surface mark with manufacturer's name or trademark, conductor size, insulation type and UL label.
3. Cables No. 12 through 750 kcmil:
    a. Conform to NEMA/ICEA WC 70/S-95-658 and UL 44 type XHHW-2 insulation.
    b. Shielding: Continuous corrugated copper-free aluminum sheath covered with a PVC jacket or 5 mil copper tape, longitudinally applied with a minimum overlap of 15 percent.
    c. Number of conductors: 3 PH and 3 equally spaced ground conductors.
4. Individual conductor color coding:
    a. ICEA S-58-679, Method 4.
    b. See PART 3 of this Specification Section for additional requirements.
5. When installed exposed outdoors, UL listed and marked as sunlight resistant.
6. For continuously corrugated cable, use manufacturer approved fittings.
7. Conform to NFPA 70, Type TC.

F. Instrumentation Cable:
1. Surface mark with manufacturer's name or trademark, conductor size, insulation type and UL label.
2. Analog cable:
    a. Tinned copper conductors.
    b. 300 V or 600 V PVC insulation with PVC jacket.
    c. Twisted with 100 percent foil shield coverage with drain wire.
    d. Six (6) twists per foot minimum.
    e. Individual conductor color coding: ICEA S-58-679, Method 1, Table E-2.
    f. Conform to IEEE 1202 or CSA FT-4 or NFPA 262, UL 2250, UL 1581 and NFPA 70 Type ITC.
3. Digital cable:
    a. As recommended by equipment (e.g., PLC, RTU) manufacturer.
    b. Horizontal voice and data cable:
        1) Category 6 per TIA/EIA/ANSI 568.
        2) Cable shall be label-verified.
        3) Cable jacket shall be factory marked at regular intervals indicating verifying organization and performance level.

4) Conductors: No. 24 AWG solid untinned copper.
5) Rated CMP per NFPA 70.

c. Conform to IEEE 1202 or CSA FT-4 or NFPA 262 and NFPA 70 Type ITC.

G. Wire Connectors:
1. Twist/screw on type:
a. Insulated pressure or spring type solderless connector.
b. 600 V rated.
c. Ground conductors: Conform to UL 486C and/or UL 467 when required by local codes.
d. Phase and neutral conductors: Conform to UL 486C.
2. Compression and mechanical screw type:
a. 600 V rated.
b. Ground conductors: Conform to UL 467.
c. Phase and neutral conductors: Conform to UL 486A.
3. Terminal block type:
a. High density, screw-post barrier-type with white center marker strip.
b. 600 V and ampere rating as required, for power circuits.
c. 600 V, 20 ampere rated for control circuits.
d. 300 V, 15 ampere rated for instrumentation circuits.
e. Conform to NEMA ICS 4 and UL 486A.

H. Insulating and Color Coding Tape:
1. Pressure sensitive vinyl.
2. Premium grade.
3. Heat, cold, moisture, and sunlight resistant.
4. Thickness, depending on use conditions: 7, 8.5, or 10 mil.
5. For cold weather or outdoor location, tape must also be all-weather.
6. Color:
a. Insulating tape: Black.
b. Color coding tape: Fade-resistant color as specified herein.
7. Comply with UL 510.

I. Pulling Lubricant: Cable manufacturer's standard containing no petroleum or other products which will deteriorate insulation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Permitted Usage of Insulation Types:
1. Type XHHW-2:
a. Building wire and power and control cable in architectural and non-architectural finished areas.
b. Building wire and power and control cable in conduit below grade.
c. Building wire and power and control cable in wet non-architectural areas.
2. Type THHN/THWN and THHN/THWN-2:
a. Building wire and power and control cable No. 8 AWG and smaller in architectural and non-architectural finished areas.
3. Type SIS and MTW:
a. For the wiring of control equipment within control panels and field wiring of control equipment within switchgear, switchboards, motor control centers.

B. Shielded VFD Cable:
1. For wiring between a VFD and motor when routing in cable trays or conduit other than RGS or RAC.

C. Conductor Size Limitations:

1. Feeder and branch power conductors shall not be smaller than No. 12 AWG unless otherwise indicated on the Drawings.
2. Control conductors shall not be smaller than No. 14 AWG unless otherwise indicated on the Drawings.
3. Instrumentation conductors shall not be smaller than No. 18 AWG unless otherwise indicated on the Drawings.

D. Color Code All Wiring as Follows:
1. Building wire:

	240 V, 208 V, 240/120 V, 208/120 V	480 V, 480/277 V
Phase 1	Black	Brown
Phase 2	Red *	Orange
Phase 3	Blue	Yellow
Neutral	White	White or Gray
Ground	Green	Green

* Orange when it is a high leg of a 120/240 V Delta system.

a. Conductors No. 6 AWG and smaller: Insulated phase, neutral and ground conductors shall be identified by a continuous colored outer finish along its entire length.
b. Conductors larger than No. 6 AWG:
1) Insulated phase and neutral conductors shall be identified by one (1) of the following methods:
a) Continuous colored outer finish along its entire length.
b) 3 IN of colored tape applied at the termination.
2) Insulated grounding conductor shall be identified by one (1) of the following methods:
a) Continuous green outer finish along its entire length.
b) Stripping the insulation from the entire exposed length.
c) Using green tape to cover the entire exposed length.
3) The color coding shall be applied at all accessible locations, including but not limited to: Junction and pull boxes, wireways, manholes and handholes.
2. Power cables ICEA S-58-679, Method 4 with:
a. Phase and neutral conductors identified with 3 IN of colored tape, per the Table herein, applied at the terminations.
b. Ground conductor: Bare.
3. Shielded VFD cable ICEA S-58-679, Method 4 with:
a. Phase conductors identified with 3 IN of colored tape, per the Table herein, applied at the terminations.
b. Ground conductor: Green color insulation or bare.
4. Control cables ICEA S-58-679, Method 1, Table E-2:
a. When a bare ground is not provided, one (1) of the colored insulated conductors shall be re-identified by stripping the insulation from the entire exposed length or using green tape to cover the entire exposed length.
b. When used in power applications the colored insulated conductors used as phase and neutral conductors may have to be re-identified with 3 IN of colored tape, per the Table herein, applied at the terminations.

E. Install all wiring in raceway unless otherwise indicated on the Drawings.

F. Feeder, branch, control and instrumentation circuits shall not be combined in a raceway, cable tray, junction or pull box, except as permitted in the following:
1. Where specifically indicated on the Drawings.
2. Where field conditions dictate and written permission is obtained from the Engineer.
3. Control circuits shall be isolated from feeder and branch power and instrumentation circuits but combining of control circuits is permitted.

a. The combinations shall comply with the following:
1) 12 Vdc, 24 Vdc and 48 Vdc may be combined.
2) 125 Vdc shall be isolated from all other AC and DC circuits.
3) AC control circuits shall be isolated from all DC circuits.

4. Instrumentation circuits shall be isolated from feeder and branch power and control circuits but combining of instrumentation circuits is permitted.
a. The combinations shall comply with the following:
1) Analog signal circuits may be combined.
2) Digital signal circuits may be combined but isolated from analog signal circuits.

5. Multiple branch circuits for lighting, receptacle and other 120 Vac circuits are allowed to be combined into a common raceway.
a. Contractor is responsible for making the required adjustments in conductor and raceway size, in accordance with all requirements of the NFPA 70, including but not limited to:
1) Up sizing conductor size for required ampacity de-ratings for the number of current carrying conductors in the raceway.
2) The neutral conductor may be shared on sequential circuits (e.g., circuit numbers 1,3,5) if multiple circuit breakers are provided.
3) Up sizing raceway size for the size and quantity of conductors.

G. Ground the drain wire of shielded instrumentation cables at one (1) end only.
1. The preferred grounding location is at the load (e.g., control panel), not at the source (e.g., field mounted instrument).

H. Splices and terminations for the following circuit types shall be made in the indicated enclosure type using the indicated method.
1. Feeder and branch power circuits:
a. Device outlet boxes:
1) Twist/screw on type connectors.
b. Junction and pull boxes and wireways:
1) Twist/screw on type connectors for use on No. 8 and smaller wire.
2) Compression, mechanical screw or terminal block or terminal strip type connectors for use on No. 6 AWG and larger wire.
c. Motor terminal boxes:
1) Twist/screw on type connectors for use on No. 10 AWG and smaller wire.
2) Insulated mechanical screw type connectors for use on No. 8 AWG and larger wire.
d. Manholes or handholes:
1) Twist/screw on type connectors pre-filled with epoxy for use on No. 8 AWG and smaller wire.
2) Watertight compression or mechanical screw type connectors for use on No. 6 AWG and larger wire.
2. Control circuits:
a. Junction and pull boxes: Terminal block type connector.
b. Manholes or handholes: Twist/screw on type connectors pre-filled with epoxy.
c. Control panels and motor control centers: Terminal block or strips provided within the equipment or field installed within the equipment by the Contractor.
3. Instrumentation circuits can be spliced where field conditions dictate and written permission is obtained from the Engineer.
a. Maintain electrical continuity of the shield when splicing twisted shielded conductors.
b. Junction and pull boxes: Terminal block type connector.
c. Control panels and motor control centers: Terminal block or strip provided within the equipment or field installed within the equipment by the Contractor.
4. Non-insulated compression and mechanical screw type connectors shall be insulated with tape or hot or cold shrink type insulation to the insulation level of the conductors.

I. Insulating Tape Usage:

1. For insulating connections of No. 8 AWG wire and smaller: 7 mil vinyl tape.
2. For insulating splices and taps of No. 6 AWG wire or larger: 10 mil vinyl tape.
3. For insulating connections made in cold weather or in outdoor locations: 8.5 mil, all weather vinyl tape.

J. Color Coding Tape Usage: For color coding of conductors.

3.2 FIELD QUALITY CONTROL

A. Acceptance Testing:
1. See Specification Section 16080.

END OF SECTION

SECTION 16130
RACEWAYS AND BOXES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Material and installation requirements for:
      a. Conduits.
      b. Conduit fittings.
      c. Conduit supports.
      d. Wireways.
      e. Outlet boxes.
      f. Pull and junction boxes.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 16010 - Electrical: Basic Requirements.
   4. Section 16120 – Wire & Cable – 600 Volt and Below.
   5. Section 16135 - Electrical: Exterior Underground.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Iron and Steel Institute (AISI).
   2. ASTM International (ASTM):
      a. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
      b. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
      c. D2564, Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
   3. National Electrical Manufacturers Association (NEMA):
      a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
      b. RN 1, Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit (IMC).
      c. TC 2, Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
      d. TC 3, Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing.
   4. National Electrical Manufacturers Association/American National Standards Institute (NEMA/ANSI):
      a. C80.1, Electric Rigid Steel Conduit (ERSC).
      b. C80.3, Steel Electrical Metallic Tubing (EMT).
      c. OS 1, Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
   5. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC).
   6. Underwriters Laboratories, Inc. (UL):
      a. 1, Standard for Flexible Metal Conduit.
      b. 6, Standard for Electrical Rigid Metal Conduit - Steel.
      c. 50, Enclosures for Electrical Equipment, Non-Environmental Considerations.
      d. 360, Standard for Liquid-Tight Flexible Steel Conduit.
      e. 467, Grounding and Bonding Equipment.
      f. 514A, Metallic Outlet Boxes.
      g. 514B, Conduit, Tubing, and Cable Fittings.
      h. 651, Standard for Schedule 40 and 80 Rigid PVC Conduit and Fittings.

i. 797, Electrical Metallic Tubing - Steel.
j. 870, Standard for Wireways, Auxiliary Gutters, and Associated Fittings.
k. 886, Standard for Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations.

1.3 SUBMITTALS

A. Shop Drawings:
1. See Specification Section 01340 for requirements for the mechanics and administration of the submittal process.
2. Product technical data:
a. Provide submittal data for all products specified in PART 2 of this Specification Section.
b. Provide submittal data for all products specified in PART 2 of this Specification Section except:
1) Conduit fittings.
2) Support systems.
c. See Specification Section 16010 for additional requirements.
3. Fabrication and/or layout drawings:
a. Identify dimensional size of pull and junction boxes to be used.

1.4 DELIVERY, STORAGE, AND HANDLING

A. See Specification Section 16010.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Rigid metallic conduits:
a. Allied Tube and Conduit Corporation.
b. Triangle PWC Inc.
c. Western Tube and Conduit Corporation.
d. Wheatland Tube Company.
e. LTV Steel Company.
2. PVC coated rigid metallic conduits:
a. Thomas & Betts Ocal.
b. Rob-Roy Ind.
3. Rigid nonmetallic conduit:
a. Prime Conduit (Carlon).
b. Cantex.
c. Osburn Associates.
4. Flexible conduit:
a. AFC Cable Systems.
b. Anamet, Inc.
c. Electri-Flex.
d. Flexible Metal Hose Company.
e. International Metal Hose Company.
f. Triangle PWC Inc.
g. LTV Steel Company.
5. Wireway:
a. Hoffman Engineering Company.
b. Wiegmann.
c. Square D.
6. Conduit fittings and accessories:
a. Appleton Electric Co.

b. Carlon.
c. Cantex.
d. Crouse-Hinds.
e. Killark.
f. Osburn Associates.
g. OZ Gedney Company.
h. RACO.
i. Steel City.
j. Thomas & Betts.

7. Support systems:
   a. Unistrut Building Systems.
   b. Eaton B-Line.
   c. Kindorf.
   d. Minerallac Fastening Systems.
   e. Caddy.
   f. Thomas & Betts Superstrut.
8. Outlet, pull and junction boxes:
   a. Appleton Electric Co.
   b. Eaton Crouse-Hinds.
   c. Killark.
   d. O-Z/Gedney.
   e. Thomas & Betts Steel City.
   f. Raco.
   g. Bell.
   h. Hoffman Engineering Co.
   i. Wiegmann.
   j. Eaton B-Line.
   k. Adalet.
   l. Rittal.
   m. Stahlin.

B. Submit request for substitution in accordance with Specification Section 01640.

2.2 RIGID METALLIC CONDUITS

A. Rigid Galvanized Steel Conduit (RGS):
1. Mild steel with continuous welded seam.
2. Metallic zinc applied by hot-dip galvanizing or electro-galvanizing.
3. Threads galvanized after cutting.
4. Internal coating: Baked lacquer, varnish or enamel for a smooth surface.
5. Standards: NEMA/ANSI C80.1, UL 6.

B. PVC-Coated Rigid Steel Conduit (PVC-RGS):
1. Nominal 40 mil Polyvinyl Chloride Exterior Coating:
   a. Coating: Bonded to hot-dipped galvanized rigid steel conduit conforming to NEMA/ANSI C80.1.
   b. The bond between the PVC coating and the conduit surface: Greater than the tensile strength of the coating.
2. Nominal 2 mil, minimum, urethane interior coating.
3. Urethane coating on threads.
4. Conduit: Epoxy prime coated prior to application of PVC and urethane coatings.
5. Female Ends:
   a. Have a plastic sleeve extending a minimum of 1 pipe diameter or 2 IN, whichever is less beyond the opening.
   b. The inside diameter of the sleeve shall be the same as the outside diameter of the conduit to be used with it.
6. Standards: NEMA/ANSI C80.1, UL 6, NEMA RN 1.

2.3 RIGID NONMETALLIC CONDUIT

A. Schedules 40 (PVC-40) and 80 (PVC-80):
   1. Polyvinyl-chloride (PVC) plastic compound which includes inert modifiers to improve weatherability and heat distribution.
   2. Rated for direct sunlight exposure.
   3. Fire retardant and low smoke emission.
   4. Shall be suitable for use with 90 DegC wire and shall be marked "maximum 90 DegC".
   5. Standards: NEMA TC 2, UL 651.

2.4 FLEXIBLE CONDUIT

A. Flexible Galvanized Steel Conduit (FLEX):
   1. Formed of continuous, spiral wound, hot-dip galvanized steel strip with successive convolutions securely interlocked.
   2. Standard: UL 1.

B. PVC-Coated Flexible Galvanized Steel (liquid-tight) Conduit (FLEX-LT):
   1. Core formed of continuous, spiral wound, hot-dip galvanized steel strip with successive convolutions securely interlocked.
   2. Extruded PVC outer jacket positively locked to the steel core.
   3. Liquid and vaportight.
   4. Standard: UL 360.

2.5 WIREWAY

A. General:
   1. Suitable for lay-in conductors.
   2. Designed for continuous grounding.
   3. Covers:
      a. Hinged or removable in accessible areas.
      b. Non-removable when passing through partitions.
   4. Finish: Rust inhibiting primer and manufacturers standard paint inside and out except for stainless steel type.
   5. Standards: UL 870, NEMA 250.

B. Raintight (NEMA 3R) Wiring Trough:
   1. 14 or 16 GA galvanized steel without knockouts.
   2. Cover: Non-gasketed and held in place by captive screws.

2.6 CONDUIT FITTINGS AND ACCESSORIES

A. Fittings for Use with RGS:
   1. General:
      a. In hazardous locations listed for use in Class I, Groups C and D locations.
   2. Locknuts:
      a. Threaded steel or malleable iron.
      b. Gasketed or non-gasketed.
      c. Grounding or non-grounding type.
   3. Bushings:
      a. Threaded, insulated metallic.
      b. Grounding or non-grounding type.
   4. Hubs: Threaded, insulated and gasketed metallic for raintight connection.
   5. Couplings:
      a. Threaded straight type: Same material and finish as the conduit with which they are used on.
      b. Threadless type: Gland compression or self-threading type, concrete tight.
   6. Unions: Threaded galvanized steel or zinc plated malleable iron.
   7. Conduit bodies (ells and tees):
      a. Body: Zinc plated cast iron or cast copper free aluminum with threaded hubs.

b. Standard and mogul size.
c. Cover:
1) Clip-on type with stainless steel screws.
2) Gasketed or non-gasketed galvanized steel, zinc plated cast iron or cast copper free aluminum.

8. Conduit bodies (round):
a. Body: Zinc plated cast iron or cast copper free aluminum with threaded hubs.
b. Cover: Threaded screw on type, gasketed, galvanized steel, zinc plated cast iron or cast copper free aluminum.

9. Expansion couplings:
a. 2 IN nominal straight-line conduit movement in either direction.
b. Galvanized steel with insulated bushing.
c. Gasketed for wet locations.
d. Internally or externally grounded.

10. Expansion/deflection couplings:
a. 3/4 IN nominal straight-line conduit movement in either direction.
b. 30-degree nominal deflection from the normal in all directions.
c. Metallic hubs, neoprene outer jacket and stainless steel jacket clamps.
d. Internally or externally grounded.
e. Watertight, raintight and concrete tight.

11. Standards: UL 467, UL 514B, UL 886.

B. Fittings for Use with PVC-RGS:
1. The same material and construction as those fittings listed under paragraph "Fittings for Use with RGS " and coated as defined under paragraph "PVC Coated Rigid Steel Conduit (PVC-RGS)."

C. Fittings for Use with FLEX:
1. Connector:
a. Zinc plated malleable iron.
b. Squeeze or clamp-type.
2. Standard: UL 514B.

D. Fittings for Use with FLEX-LT:
1. Connector:
a. Straight or angle type.
b. Metal construction, insulated and gasketed.
c. Composed of locknut, grounding ferrule and gland compression nut.
d. Liquid tight.
2. Standards: UL 467, UL 514B.

E. Fittings for Use with Rigid Nonmetallic PVC Conduit:
1. Coupling, adapters and conduit bodies:
a. Same material, thickness, and construction as the conduits with which they are used.
b. Homogeneous plastic free from visible cracks, holes or foreign inclusions.
c. Bore smooth and free of blisters, nicks or other imperfections which could damage the conductor.
2. Solvent cement for welding fittings shall be supplied by the same manufacturer as the conduit and fittings.
3. Standards: ASTM D2564, NEMA TC 3, UL 651, UL 514B.

F. Weather and Corrosion Protection Tape:
1. PVC based tape, 10 mils thick.
2. Protection against moisture, acids, alkalis, salts and sewage and suitable for direct bury.
3. Used with appropriate pipe primer.

2.7 ALL RACEWAY AND FITTINGS

A. Mark Products:

1. Identify the nominal trade size on the product.
2. Stamp with the name or trademark of the manufacturer.

2.8 OUTLET BOXES

A. Cast Outlet Boxes:
   1. Zinc plated cast iron or die-cast copper free aluminum with manufacturers standard finish.
   2. Threaded hubs and grounding screw.
   3. Styles:
      a. "FS" or "FD".
      b. "Bell".
      c. Single or multiple gang and tandem.
      d. "EDS" or "EFS" for hazardous locations.
   4. Accessories: 40 mil PVC exterior coating and 2 mil urethane interior coating.
   5. Standards: UL 514A, UL 886.

2.9 PULL AND JUNCTION BOXES

A. NEMA 3R Rated:
   1. Body and cover: 14 GA minimum, steel finished with rust inhibiting primer and manufacturers standard paint inside and out.
   2. Drip shield top and seam-free sides, front and back.
   3. With or without concentric knockouts on bottom.
   4. Slip-on removable cover fastened on bottom edge with screws or continuous hinged cover fastened with screws.

B. Miscellaneous Accessories:
   1. Rigid handles for covers larger than 9 SF or heavier than 25 LBS.
   2. Split covers when heavier than 25 LBS.
   3. Weldnuts for mounting optional panels and terminal kits.
   4. Terminal blocks: Screw-post barrier-type, rated 600 volt and 20 ampere minimum.

C. Standards: NEMA 250, UL 50.

2.10 SUPPORT SYSTEMS

A. Multi-conduit Surface or Trapeze Type Support and Pull or Junction Box Supports:
   1. Material requirements.
      a. Galvanized steel: ASTM A123/A123M or ASTM A153/A153M.
      b. Stainless steel: AISI Type 316.
      c. PVC coat galvanized steel: ASTM A123/A123M or ASTM A153/A153M and 20 mil PVC coating.

B. Single Conduit and Outlet Box Support Fasteners:
   1. Material requirements:
      a. Zinc plated steel.
      b. Stainless steel.
      c. Malleable iron.
      d. PVC coat malleable iron or steel: 20 mil PVC coating.
      e. Steel protected with zinc phosphate and oil finish.

2.11 OPENINGS AND PENETRATIONS IN WALLS AND FLOORS

A. Sleeves, smoke and fire stop fitting through walls and floors.

PART 3 - EXECUTION

3.1 RACEWAY INSTALLATION - GENERAL

A. Shall be in accordance with the requirements of:
   1. NFPA 70.

2. Manufacturer instructions.

B. Size of Raceways:
   1. Raceway sizes are shown on the Drawings, if not shown on the Drawings, then size in accordance with NFPA 70.
   2. Unless specifically indicated otherwise, the minimum raceway size shall be:
      a. Conduit: 3/4 IN.
      b. Wireway: 2-1/2 IN x 2-1/2 IN.

C. Field Bending and Cutting of Conduits:
   1. Utilize tools and equipment recommended by the manufacturer of the conduit, designed for the purpose and the conduit material to make all field bends and cuts.
   2. Do not reduce the internal diameter of the conduit when making conduit bends.
   3. Prepare tools and equipment to prevent damage to the PVC coating.
   4. Degrease threads after threading and apply a zinc rich paint.
   5. Debur interior and exterior after cutting.

D. Male threads of conduit systems shall be coated with an electrically conductive anti-seize compound.

E. The protective coating integrity of conduits, fittings, outlet, pull and junction boxes and accessories shall be maintained.
   1. Repair galvanized components utilizing a zinc rich paint.
   2. Repair painted components utilizing touch up paint provided by or approved by the manufacturer.
   3. Repair PVC coated components utilizing a patching compound, of the same material as the coating, provided by the manufacturer of the conduit; or a self-adhesive, highly conformable, cross-linked silicone composition strip, followed by a protective coating of vinyl tape.
      a. Total nominal thickness: 40 mil.
   4. Repair surfaces which will be inaccessible after installation prior to installation.

F. Remove moisture and debris from conduit before wire is pulled into place.
   1. Pull mandrel with diameter nominally 1/4 IN smaller than the interior of the conduit, to remove obstructions.
   2. Swab conduit by pulling a clean, tight-fitting rag through the conduit.
   3. Tightly plug ends of conduit with tapered wood plugs or plastic inserts until wire is pulled.

G. Only nylon or polyethylene rope shall be used to pull wire and cable in conduit systems.

H. Where portions of a raceway are subject to different temperatures and where condensation is known to be a problem, as in cold storage areas of buildings or where passing from the interior to the exterior of a building, the raceway shall be sealed to prevent circulation of warm air to colder section of the raceway.

I. Fill openings in walls, floors, and ceilings and finish flush with surface.
   1. See Specification Section 01 73 20.

3.2 RACEWAY ROUTING

A. Raceways shall be routed in the field unless otherwise indicated.
   1. Conduit and fittings shall be installed, as required, for a complete system that has a neat appearance and is in compliance with all applicable codes.
   2. Run in straight lines parallel to or at right angles to building lines.
   3. Do not route conduits:
      a. Through areas of high ambient temperature or radiant heat.
      b. In suspended concrete slabs.
   4. Conduit shall not interfere with, or prevent access to, piping, valves, ductwork, or other equipment for operation, maintenance and repair.

5. Provide pull boxes or conduit bodies as needed so that there is a maximum of 360 degrees of bends in the conduit run or in long straight runs to limit pulling tensions.

B. All rigid conduits within a structure shall be installed exposed except as follows:
   1. As indicated on the Drawings.
   2. Concealed above gypsum wall board or acoustical tile suspended ceilings.
   3. Concealed within stud frame, poured concrete, concrete block and brick walls of an architecturally finished area.

C. Maintain minimum spacing between parallel conduit and piping runs in accordance with the following when the runs are greater than 30 FT:
   1. Between instrumentation and telecommunication: 1 IN.
   2. Between instrumentation and 125 V, 48 V and 24 Vdc, 2 IN.
   3. Between instrumentation and 600 V and less AC power or control: 6 IN.
   4. Between instrumentation and greater than 600 Vac power: 12 IN.
   5. Between telecommunication and 125 V, 48 V and 24 Vdc, 2 IN.
   6. Between telecommunication and 600 V and less AC power or control: 6 IN.
   7. Between telecommunication and greater than 600 Vac power: 12 IN.
   8. Between 125 V, 48 V and 24 Vdc and 600 V and less AC power or control: 2 IN.
   9. Between 125 V, 48 V and 24 Vdc and greater than 600 Vac power: 2 IN.
   10. Between 600 V and less AC and greater than 600 Vac: 2 IN.
   11. Between process, gas, air and water pipes: 6 IN.

D. Conduits shall be installed to eliminate moisture pockets.
   1. Where water cannot drain to openings, provide drain fittings in the low spots of the conduit run.

E. Conduit shall not be routed on the exterior of structures except as specifically indicated on the Drawings.

F. Where sufficient room exists within the housing of roof-mounted equipment, the conduit shall be stubbed up inside the housing.

G. Provide all required openings in walls, floors, and ceilings for conduit penetration.
   1. See Specification Section 01 73 20.

3.3 RACEWAY APPLICATIONS

A. Permitted Raceway Types Per Wire or Cable Types:
   1. Power wire or cables: All raceway types.
   2. Control wire or cables: All raceway types.
   3. Instrumentation cables: Metallic raceway except nonmetallic may be used underground.
   4. Motor leads from a VFD: RGS, RAC or shielded VFD cables in all other raceways.
   5. Telecommunication cables: All raceway types.

B. Permitted Raceway Types Per Area Designations:
   1. Dry areas:
      a. RGS.
   2. Wet areas:
      a. RGS.
   3. NFPA 70 hazardous areas:
      a. RGS.

C. Permitted Raceway Types Per Routing Locations:
   1. In concrete block or brick walls:
      a. PVC-40.
   2. Embedded in poured concrete walls and floors:
      a. PVC-40.
      b. PVC-RGS when emerging from concrete into areas designated as wet, corrosive or highly corrosive.

3. Beneath floor slab-on-grade:
    a. PVC-40.
4. Through floor penetrations, see Specification Section 01800:
    a. PVC-RGS in areas designated as wet, corrosive or highly corrosive.
5. Direct buried conduits and ductbanks:
    a. PVC-80.
    b. 90 degree elbows for transitions to above grade:
        1) PVC-RGS.
    c. Long sweeping bends greater than 15 degrees:
        1) PVC-RGS.
6. Concrete encased ductbanks:
    a. PVC-40.
    b. PVC-EB.
    c. 90 degree elbows for transitions to above grade:
        1) PVC-RGS.
    d. Long sweeping bends greater than 15 degrees:
        1) RGS for sizes 2 IN and larger.

D. FLEX conduits shall be installed for connections to light fixtures, HVAC equipment and other similar devices above the ceilings.
1. The maximum length shall not exceed:
    a. 6 FT to light fixtures.
    b. 3 FT to all other equipment.

E. FLEX-LT conduits shall be install as the final conduit connection to light fixtures, dry type transformers, motors, electrically operated valves, instrumentation primary elements, and other electrical equipment that is liable to vibrate.
1. The maximum length shall not exceed:
    a. 6 FT to light fixtures.
    b. 3 FT to motors.
    c. 2 FT to all other equipment.

F. HAZ-FLEX coupling shall be installed as the final conduit to motors, electrically operated valves, instrumentation primary elements and electrical equipment that is liable to vibrate.
1. The maximum length shall not exceed:
    a. 3 FT to motors.
    b. 2 FT to all other equipment.

G. NEMA 3R Wiring Trough:
1. Surface mounted in exterior locations.

H. Underground Conduit: See Specification Section 16135.

3.4 CONDUIT FITTINGS AND ACCESSORIES

A. Rigid nonmetallic conduit and fittings shall be joined utilizing solvent cement.
1. Immediately after installation of conduit and fitting, the fitting or conduit shall be rotated 1/4 turn to provide uniform contact.

B. Install Expansion Fittings:
1. Where conduits are exposed to the sun and conduit run is greater than 200 FT.
2. Elsewhere as identified on the Drawings.

C. Install Expansion/Deflection Fittings:
1. Where conduits enter a structure.
    a. Except electrical manholes and handholes.
    b. Except where the ductbank is tied to the structure with rebar.
2. Where conduits span structural expansions joints.
3. Elsewhere as identified on the Drawings.

D. Threaded connections shall be made wrench-tight.

E. Conduit joints shall be watertight:
   1. Where subjected to possible submersion.
   2. In areas classified as wet.
   3. Underground.

F. Terminate Conduits:
   1. In metallic outlet boxes:
      a. RGS:
         1) Conduit hub and locknut.
         2) Insulated bushing and two (2) locknuts.
         3) Use grounding type locknut or bushing when required by NFPA 70.
      b. EMT: Compression type connector and locknut.
   2. In NEMA 1 rated enclosures:
      a. RGS:
         1) Conduit hub and locknut.
         2) Insulated bushing and two (2) locknuts.
         3) Use grounding type locknut or bushing when required by NFPA 70.
      b. EMT: Compression type connector and locknut.
   3. In NEMA 12 rated enclosures:
      a. Watertight, insulated and gasketed hub and locknut.
      b. Use grounding type locknut or bushing when required by NFPA 70.
   4. In NEMA 4 and NEMA 4X rated enclosures:
      a. Watertight, insulated and gasketed hub and locknut.
   5. In NEMA 7 and NEMA 9 rated enclosures:
      a. Into an integral threaded hub.
   6. When stubbed up through the floor into floor mount equipment:
      a. With an insulated grounding bushing on metallic conduits.
      b. With end bells on nonmetallic conduits.

G. Threadless couplings shall only be used to join new conduit to existing conduit when the existing conduit end is not threaded and it is not practical or possible to cut threads on the existing conduit with a pipe threader.

3.5 CONDUIT SUPPORT

A. Permitted multi-conduit surface or trapeze type support system per area designations and conduit types:
   1. Dry or wet and/or hazardous areas:
      a. Galvanized system consisting of: Galvanized steel channels and fittings, nuts and hardware and conduit clamps.
   2. Corrosive areas:
      a. Stainless steel system consisting of: Stainless steel channels and fittings, nuts and hardware and conduit clamps.
      b. PVC coated steel system consisting of: PVC coated galvanized steel channels and fittings and conduit clamps with stainless steel nuts and hardware.
   3. Highly corrosive areas:
      a. PVC coated steel system consisting of: PVC coated galvanized steel channels and fittings and conduit clamps with stainless steel nuts and hardware.
      b. Fiberglass system consisting of: Fiberglass channels and fittings, nuts and hardware and conduit clamps.
   4. Conduit type shall be compatible with the support system material.
      a. Galvanized steel system may be used with RGS.
      b. Stainless steel system may be used with RGS and PVC-RGS.
      c. PVC coated galvanized steel system may be used with PVC-RGS and PVC-40.
      d. Aluminum system may be used with RAC and PVC-RGS.
      e. Fiberglass system may be used with PVC-40 and PVC-80 and PVC-RGS.

B. Permitted single conduit support fasteners per area designations and conduit types:
   1. Architecturally finished areas:
      a. Material: Zinc plated steel, or steel protected with zinc phosphate and oil finish.
      b. Types of fasteners: Spring type hangers and clips, straps, hangers with bolts, clamps with bolts and bolt on beam clamps.
      c. Provide anti-rattle conduit supports when conduits are routed through metal studs.
   2. Dry or wet and/or hazardous areas:
      a. Material: Zinc plated steel, stainless steel and malleable iron.
      b. Types of fasteners: Straps, hangers with bolts, clamps with bolts and bolt on beam clamps.
   3. Corrosive areas:
      a. Material: Stainless steel and PVC coat malleable iron or steel.
      b. Types of fasteners: Straps, hangers with bolts, clamps with bolts and bolt on beam clamps.
   4. Highly corrosive areas:
      a. Material: PVC coat malleable iron or steel.
      b. Types of fasteners: Straps, hangers with bolts, clamps with bolts and bolt on beam clamps.
   5. Conduit type shall be compatible with the support fastener material.
      a. Zinc plated steel, steel protected with zinc phosphate and oil finish and malleable iron fasteners may be used with RGS.
      b. Stainless steel system may be used with RGS and PVC-RGS and RAC.
      c. PVC coated fasteners may be used with PVC-RGS and PVC-40.
      d. Nonmetallic fasteners may be used with PVC-40, PVC-80 and fiberglass.

C. Conduit Support General Requirements:
   1. Maximum spacing between conduit supports per NFPA 70.
   2. Support conduit from the building structure.
   3. Do not support conduit from process, gas, air or water piping; or from other conduits.
   4. Provide hangers and brackets to limit the maximum uniform load on a single support to 25 LBS or to the maximum uniform load recommended by the manufacturer if the support is rated less than 25 LBS.
      a. Do not exceed maximum concentrated load recommended by the manufacturer on any support.
      b. Conduit hangers:
         1) Continuous threaded rods combined with struts or conduit clamps: Do not use perforated strap hangers and iron bailing wire.
      c. Do not use suspended ceiling support systems to support raceways.
      d. Hangers in metal roof decks:
         1) Utilize fender washers.
         2) Not extend above top of ribs.
         3) Not interfere with vapor barrier, insulation, or roofing.
   5. Conduit support system fasteners:
      a. Use sleeve-type expansion anchors as fasteners in masonry wall construction.
      b. Do not use concrete nails and powder-driven fasteners.

3.6 OUTLET, PULL AND JUNCTION BOX INSTALLATION

A. General:
   1. Install products in accordance with manufacturer's instructions.
   2. See Specification Section 16010 and the Drawings for area classifications.
   3. Fill unused punched-out, tapped, or threaded hub openings with insert plugs.
   4. Size boxes to accommodate quantity of conductors enclosed and quantity of conduits connected to the box.

B. Outlet Boxes:
   1. Permitted uses of cast outlet boxes:

a. Housing of wiring devices surface mounted in non-architecturally finished dry, wet, corrosive, highly corrosive and hazardous areas.
b. Pull and junction box surface mounted in non-architecturally finished dry, wet, corrosive and highly corrosive areas.

2. Mount device outlet boxes where indicated on the Drawings and at heights as scheduled in Specification Section 16010.
3. Set device outlet boxes plumb and vertical to the floor.
4. Outlet boxes recessed in walls:
   a. Install with appropriate stud wall support brackets or adjustable bar hangers so that they are flush with the face of the wall.
   b. Locate in ungrouted cell of concrete block with bottom edge of box flush with bottom edge of block and flush with the face of the block.
5. Place barriers between switches in boxes with 277 V switches on opposite phases.
6. Back-to-back are not permitted.
7. When an outlet box is connected to a PVC coated conduit, the box shall also be PVC coated.

C. Pull and Junction Boxes:
1. Install pull or junction boxes in conduit runs where indicated or required to facilitate pulling of wires or making connections.
   a. Make covers of boxes accessible.
2. Permitted uses of NEMA 3R enclosure:
   a. Pull or junction box surface mounted in exterior locations.

END OF SECTION

SECTION 16135

ELECTRICAL: EXTERIOR UNDERGROUND

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Material and installation requirements for:
      a. Manholes.
      b. Handhole.
      c. Underground conduits and ductbanks.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 02221 - Trenching, Backfilling and Compacting for Utilities.
   4. Section 03002 - Concrete.
   5. Section 16060 - Grounding.
   6. Section 16130 - Raceways and Boxes.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Association of State Highway and Transportation Officials (AASHTO):
      a. HB, Standard Specifications for Highway Bridges.
   2. ASTM International (ASTM):
      a. A536, Standard Specification for Ductile Iron Castings.
   3. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC).
   4. Society of Cable Telecommunications Engineers (SCTE):
      a. 77, Specification for Underground Enclosure Integrity.

1.3 DEFINITIONS

A. Concrete encased ductbank: An individual (single) or multiple conduit(s), arranged in one or more planes, encased in a common concrete envelope.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01340 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data:
      a. Provide submittal data for all products specified in PART 2 of this Specification Section.
   3. Fabrication and/or layout drawings:
      a. Provide dimensional drawings of each manhole indicating all specified accessories and conduit entry locations.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Prefabricated composite handholes:
      a. Quazite Composolite.

b. Armorcast Products Company.
c. Synertech.

2. Manhole and handhole and ductbank accessories:
a. Neenah.
b. Unistrut.
c. Condux International, Inc.
d. Underground Devices, Inc.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MANHOLES AND HANDHOLES

A. Prefabricated Composite Material Handholes:
1. Handhole body and cover: Fiberglass reinforced polymer concrete conforming to all test provisions of SCTE 77.
2. Minimum load ratings: SCTE 77 Tier 15.
3. Open bottom.
4. Stackable design as required for specified depth.
5. Cover:
a. Engraved legend of "ELECTRIC" or "COMMUNICATIONS".
b. Non-gasketed bolt down with stainless steel penta head bolts.
c. Lay-in non-bolt down, when cover is over 100 LBS.
d. One or multiple sections so the maximum weight of a section is 125 LBS.
6. Cover lifting hook: 24 IN minimum in length.

2.3 CONCRETE MANHOLE AND HANDHOLE ACCESSORIES

A. Cover and Frame:
1. Cast ductile iron: ASTM A536.
2. AASHTO live load rating: H-20.
3. Diameter: 30 IN.
4. Cast the legend "ELECTRICAL" or "COMMUNICATIONS" into manhole and handhole covers.

B. Cable Racks and Hooks:
1. Material: Heavy-duty nonmetallic (glass reinforced nylon).
2. Hook loading capacity: 400 LBS minimum.
3. Rack loading capacity: Four (4) hooks maximum.
4. Hook deflection: 0.25 IN maximum.
5. Hooks: Length, as required, with positive locking device to prevent upward movement.
6. Mounding hardware: Stainless steel.

C. Cable Pulling Irons:
1. 7/8 IN DIA hot-dipped galvanized steel.
2. 6000 LB minimum pulling load.

D. Ground Rods and Grounding Equipment: See Specification Section 16060.

2.4 UNDERGROUND CONDUIT AND ACCESSORIES

A. Concrete: Comply with Section 03002.

B. Conduit: See Specification Section 16130.

C. Duct Spacers/Supports:
1. High density polyethylene or high impact polystyrene.
2. Interlocking.
3. Provide 2 IN minimum spacing between conduits.
4. Accessories, as required:
a. Hold down bars.
b. Ductbank strapping.

PART 3 - EXECUTION

3.1 GENERAL

A. Drawings indicate the intended location of manholes and handholes and routing of {precast cable trench,} ductbanks and direct buried conduit.
   1. Field conditions may affect actual routing.

B. Manhole and Handhole Locations:
   1. Approximately where shown on the Drawings.
   2. As required for pulling distances.
   3. As required to keep pulling tensions under allowable cable tensions.
   4. As required for number of bends in ductbank routing.
   5. Shall not be installed in a swale or ditch.
   6. Determine the exact locations after careful consideration has been given to the location of other utilities, grading, and paving.
   7. Locations are to be approved by the Engineer prior to excavation and placement or construction of manholes and handholes.

C. Install products in accordance with manufacturer's instructions.

D. Install manholes and handholes in conduit runs where indicated or as required to facilitate pulling of wires or making connections.

E. Comply with Specification Section 02221 for trenching, backfilling and compacting.

3.2 MANHOLES AND HANDHOLES

A. Prefabricated Composite Material Handholes:
   1. For use in areas subjected to occasional non-deliberate vehicular traffic.
   2. Place handhole on a foundation of compacted 1/4 to 1/2 IN crushed rock or gravel a minimum of 8 IN thick and 6 IN larger than handholes footprint on all sides.
   3. Provide concrete encasement ring around handhole per manufacturers installation instructions (minimum of 10 IN wide x 12 IN deep).
   4. Install so that the surrounding grade is 1 IN lower than the top of the handhole.
   5. Size: As indicated on the Drawings or as required for the number and size of conduits.
   6. Provide cable rails and pulling eyes as needed.

3.3 UNDERGROUND CONDUITS

A. General Installation Requirements:
   1. Ductbank types per location:
      a. Concrete encased ductbank:
         1) Under roads.
         2) Conduits containing medium voltage cables.
         3) Pad mounted transformer secondaries.
         4) Plant process equipment feeders and controls.
   2. Do not place concrete or soil until conduits have been observed by the Engineer.
   3. Ductbanks shall be sloped a minimum of 4 IN per 100 FT or as detailed on the Drawings.
      a. Low points shall be at manholes or handholes.
   4. During construction and after conduit installation is complete, plug the ends of all conduits.
   5. Provide conduit supports and spacers.
      a. Place supports and spacers for rigid nonmetallic conduit on maximum centers as indicated for the following trade sizes:
         1) 1 IN and less: 3 FT.
         2) 1-1/4 to 3 IN: 5 FT.
         3) 3-1/2 to 6 IN: 7 FT.
      b. Place supports and spacers for rigid steel conduit on maximum centers as indicated for the following trade sizes:
         1) 1 IN and less: 10 FT.

2) 1-1/4 to 2-1/2 IN: 14 FT.
3) 3 IN and larger: 20 FT.

c. Securely anchor conduits to supports and spacers to prevent movement during placement of concrete or soil.

6. Stagger conduit joints at intervals of 6 IN vertically.
7. Make conduit joints watertight and in accordance with manufacturer's recommendations.
8. Accomplish changes in direction of runs exceeding a total of 15 degrees by long sweep bends having a minimum radius of 25 FT.
   a. Sweep bends may be made up of one or more curved or straight sections or combinations thereof.
9. Furnish manufactured bends at end of runs.
   a. Minimum radius of 18 IN for conduits less than 3 IN trade size and 36 IN for conduits 3 IN trade size and larger.
10. Field cuts requiring tapers shall be made with the proper tools and shall match factory tapers.
11. After the conduit run has been completed:
    a. Prove joint integrity and test for out-of-round duct by pulling a test mandrel through each conduit.
       1) Test mandrel:
          a) Length: Not less than 12 IN
          b) Diameter: Approximately 1/4 IN less than the inside diameter of the conduit.
    b. Clean the conduit by pulling a heavy duty wire brush mandrel followed by a rubber duct swab through each conduit.
12. Pneumatic rodding may be used to draw in lead wire.
    a. Install a heavy nylon cord free of kinks and splices in all unused new ducts.
    b. Extend cord 3 FT beyond ends of conduit.
13. Transition from rigid nonmetallic conduit to rigid metallic conduit, per Specification Section 16130, prior to entering a structure or going above ground.
    a. Except rigid nonmetallic conduit may be extended directly to manholes, handholes, pad mounted transformer boxes and other exterior pad mounted electrical equipment where the conduit is concealed within the enclosure.
    b. Terminate rigid PVC conduits with end bells.
    c. Terminate steel conduits with insulated bushings.
14. Place warning tape in trench directly over ductbanks, direct-buried conduit, and direct-buried wire and cable.
15. Placement of conduits stubbing into handholes and manholes shall be located to allow for proper bending radiuses of the cables.

B. Concrete Encased Ductbank:
1. Ductbank system consists of conduits completely encased in minimum 2 IN of concrete and with separations between different cabling types as required in Specification Section 16130 or as detailed on the Drawings.
2. Install so that top of concrete encased duct, at any point:
   a. Is not less than 24 IN below grade.
   b. Is below pavement sub-grading.
3. Where identified and for a distance 10 FT either side of the area, the concrete shall be reinforced.
   a. The reinforcement shall consist of #4 bars and #4 ties placed 12 IN on center, in accordance with Division 03 Specification Sections or as detailed on the Drawings.
4. Conduit supports shall provide a uniform minimum clearance of 2 IN between the bottom of the trench and the bottom row of conduit.
5. Conduit separators shall provide a uniform minimum clearance of 2 IN between conduits or as required in Specification Section 16130 for different cabling types.

END OF SECTION

SECTION 16265

VARIABLE FREQUENCY DRIVES: LOW VOLTAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Variable frequency drives (VFDs) for operation of inverter duty motors.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 10 14 00 - Identification Devices.
   4. Section 16010 - Electrical: Basic Requirements.
   5. Section 16442 - Motor Control Equipment.
   6. Section 11005- Equipment: Basic Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American National Standards Institute (ANSI).
   2. ETL Testing Laboratories (ETL).
   3. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
      a. 399, Recommended Practice for Industrial and Commercial Power Systems Analysis.
      b. 519, Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems.
      c. C62.41, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
   4. National Electrical Manufacturer's Association (NEMA):
      a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
      b. MG 1, Motors and Generators.
   5. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC):
         1) Article 430, Motors Motor Circuits, and Controllers..
   6. Occupational Safety and Health Administration (OSHA).
   7. Underwriters Laboratory, Inc. (UL):
      a. 508, Standard for Industrial Control Equipment.
      b. 508A, Standard for Industrial Control Panels.

B. Qualifications:
   1. Provide drives that are listed and labeled by UL, ETL, or other Nationally Recognized Testing Laboratory (NRTL) as defined by OSHA regulations, or that have been inspected and subsequent field-labeled by such NRTL.
   2. Where listed drives and other components are installed in a common enclosure, the assembly shall be listed and labeled per UL 508 and UL 508A or equivalent NRTL standard.
      a. Entire assembly shall be affixed with a UL 508A label "Listed Enclosed Industrial Control Panel" or equivalent NRTL label prior to shipment to the jobsite.
   3. VFD Supplier shall maintain an authorized service organization within 100miles of the Project Site.

C. Coordination:
   1. The intent of this Specification Section is to allow the VFD manufacturer to provide the best solution for the harmonic and motor protection outlined herein.
      a. This solution shall include, but not be limited to, all aspects of the distribution system including standby generation, motor feeder cable type and available floor space.

2. Motor and VFD coordination: See Specification Section 11005.
3. VFD shall be supplied complete with all required control components.
    a. Provide control as indicated:
        1) On the electrical drawings.
        2) As specified in this Specification Section.
        3) As specified in the process control system loop descriptions.
            a) See Specification Section 40 90 05.
    b. VFD manufacturer shall review the application and provide, at no additional cost to the Owner, the hardware and software necessary to allow the VFD to control the driven equipment motor over its required operating range.
        1) These may include, but are not limited to, analog and digital interface modules, communication interface modules, switches, lights and other devices.
    c. Coordinate control devices with devices furnished with driven equipment such as vibration switches, thermal sensors, leak detectors, etc.
4. Verify plan dimensions with equipment space requirements as indicated on the Drawings.
    a. Equipment which exceeds the allotted maximum dimensions may not be acceptable.
    b. Equipment which reduces clear work space below the minimums established by the NFPA 70 will not be acceptable.

1.3 DEFINITIONS

A. Variable Torque (VT):
1. Defines a load characteristic in which the torque delivered from the motor to the load is reduced as speed is reduced below full rated.
2. This type of load permits the VFD and the motor to operate at reduced output current at reduced speed.

B. Constant Torque (CT):
1. Defines a load characteristic in which the torque delivered from the motor to the load remains constant as speed is varied.
2. This type of load requires the VFD to be able to continuously deliver rated output current over the entire speed range.

C. Constant Horsepower:
1. Defines a load characteristic in which the torque delivered from the motor to the load is reduced as the speed is increased.
2. This characteristic is required for operation of the VFD and motor above rated frequency to maintain output current within the rated value.

D. Inverter Duty Motor: An AC induction motor complying with all requirements of NEMA MG 1 Part 31 for definite-purpose inverter-fed motors.

E. Standard Motor: An AC induction motor that fails to comply with one (1) or more requirements of NEMA MG 1 Part 31.

F. Low Voltage: 600 Vac or less.

1.4 SUBMITTALS

A. Shop Drawings:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. Provide a schedule for each VFD including the following information:
    a. Equipment Tag Number.
    b. VFD Complete Catalog Number.
    c. VFD Amp Frame Size.
    d. Variable or Constant Torque Rating Basis.
    e. Rated Input Current.
    f. Rated Continuous Output Current.
    g. Rated Short Circuit Current.

h. VFD cable type specified (shielded or non-shielded).
i. VFD Maximum Motor Lead Length for the type of cable used.
j. Motor Manufacturer.
k. Motor Frame Size.
l. Motor Full Load Amps.
m. Motor Service Factor.
n. As installed motor Lead Length.
o. VFD options provided to meet harmonic or motor protection specifications.

3. Submit VFD Shop Drawings concurrently with driven equipment and motor Shop Drawings.
4. Product technical data:
   a. Complete electrical ratings and performance specifications confirming compliance with specified ratings and performance.
   b. Maximum rate of heat rejection from VFD and all related components and associated cooling requirements.
   c. Manufacturer's installation instructions.
   d. Manufacturer's programming and operating instructions.
   e. See Specification Section 16010 for additional requirements.
5. Fabrication and/or layout drawings:
   a. Top, front and side exterior views, with details showing maximum overall dimensions of enclosure, mounting provisions and conduit/cable entry provisions.
   b. Identify minimum clearances from other VFDs or electrical equipment required for proper cooling at top, bottom, side and back of enclosure.
   c. Three-line diagrams showing AC schematic of VFD, input, output and bypass devices including device ratings.
   d. Interior layout drawings showing location of all components within enclosure, field wiring terminal boards, and power and grounding connections.
   e. Field wiring diagrams showing locations and sizes of all electrical connections, ground terminations, and requirements for shielded wire usage or any other special installation considerations.
6. Certifications:
   a. Submit with Shop Drawings:
      1) Identification and location of closest authorized service organization.
      2) Harmonic analysis at each PCC per Harmonic Protection Requirements Article.
   b. Submit prior to shipment:
      1) Certified factory test reports confirming compliance with specified requirements.
   c. Submit after installation:
      1) Certified field service reports showing:
         a) Each VFD is operational.
         b) Each VFD and its driven equipment motor are compatible.
         c) Each VFD responds correctly to the input control signals.
         d) Critical frequencies of the drive system and that the VFD has been set to lockout these frequencies.
         e) Measured harmonic levels per Harmonic Protection Requirements Article.
         f) Measured motor terminal peak voltages per Motor Protection Requirements Article.

B. Contract Closeout Information:
1. Operation and Maintenance Data:
   a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
2. Approved copy of VFD schedule per Submittals Article.
3. Manufacturer's instruction manuals.
4. Troubleshooting procedures with a cross-reference between symptoms and corrective recommendations.

5. Connection data to permit removal and installation of recommended smallest field-replaceable parts.
6. Recommended spare parts list.
7. Commissioning sheets showing "as-left" values of all user-programmable or adjustable drive parameters.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Allen Bradley.
   2. ASEA Brown Bovari (ABB).
   3. Eaton.
   4. Danfoss.
   5. General Electric Company.
   6. Siemens/Robicon.
   7. Siemens.
   8. Square D Company.
   9. Toshiba.
   10. Yaskawa.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 GENERAL

A. VFDs shall consist of a rectifier-DC bus-inverter combination producing a sine-coded pulse-width-modulated (PWM) output voltage waveform.

B. VFDs, whether installed in motor control center (MCC) construction or separately-mounted, shall constitute a complete combination motor controller per NFPA 70, Article 430 and shall provide the following per the requirements of that article without the addition of any external components or devices.
   1. Motor control.
   2. Motor overload protection.
   3. Motor and motor branch circuit short circuit and ground fault protection.
   4. Motor and controller disconnecting means.

C. It is the intent of this Specification that VFDs shall be an "engineered" or "configured" drive package in which the VFD chassis, all input, output and bypass power devices, VFD accessories, ancillary switches, contactors, relays, and related control devices are selected, furnished, factory-assembled and -tested by the VFD manufacturer in a single enclosure requiring only connection of the power supply circuit, motor branch circuit, and external control wiring in the field.

2.3 PERFORMANCE AND DESIGN REQUIREMENTS

A. Application:
   1. VFD(s) shall be of sufficient capacity and shall provide a quality of output waveform for stepless motor control from 10 to 100 percent of base speed of the driven equipment.
   2. VFDs shall be compatible with:
      a. Inverter duty induction motors.
   3. VFDs shall be suitable for Constant Torque (CT) or Variable Torque (VT) applications.
      a. VFD manufacturer shall coordinate with the manufacturer of the driven equipment to identify CT and VT applications.
   4. VFDs shall be designed to operate successfully under the following site conditions:
      a. Ambient:
         1) Temperature: 0-40 DegC.
         2) 95 percent non-condensing relative humidity.

b. Elevation: Less than 3,300 FT above MSL.
c. Power supply characteristics:
1) 480Vac, 3 PH, 60 Hz, 3 wire, (+/- 10 percent).
2) Effectively grounded.

B. Ratings and Performance Specifications:
1. Voltage rating:
a. Nominal: 460 or 480 Vac, 3 PH, 60 Hz.
b. Range for continuous full load operation: +/-10 percent of nominal.
c. Voltage imbalance tolerance for full load operation: 3 percent minimum.
2. Current ratings:
a. Continuous:
1) Equal to or greater than the motor nameplate full load.
b. Short-term overload:
1) VT: 110 percent for 1 minute.
2) CT: 150 percent for 1 minute.
3) Permissible for 1 minute every 10 minutes continuously.
c. Short circuit:
1) As indicated on the Drawings.
2) Where a short circuit rating is not indicated or specified for individual VFDs, each VFD shall have a rating not less than indicated on the Drawings for the MCC, switchboard or panelboard the VFD is supplied from.
3) Where specified short circuit rating indicates additional input impedance is required to protect semiconductors, provide input AC line reactors, whether required to meet harmonic performance specifications or not.
3. Efficiency:
a. 97 percent, minimum, at full speed and full load.
b. 93 percent, minimum at 1/2 speed and full load.
4. Displacement power factor:
a. 95 percent, minimum from 50 percent to 100 percent speed and load.
5. Efficiency and power factor criteria apply from the input terminals to the output terminals of the VFD alone, excluding losses of input and output power circuit accessories.
6. Frequency drift:
a. +0.5 percent of set frequency.
7. Speed regulation (motor dependent): 3 percent.
8. Speed range: 10:1.
9. Control type:
a. Volts/Hertz ratio; constant over the entire operating range of the VFD except:
1) When operating under voltage boost.
2) At frequencies over 60 Hz.

C. Operational Features:
1. Insensitive to input phase sequence.
2. Continued operation with momentary voltage dips of 25 percent of rated voltage, or single phase condition: 4 second, minimum.
3. Controls power loss ride-through: 500 msec, minimum.
4. Electronic reversing.
5. DC injection braking.
6. Anti-windmilling: Synchronization of VFD starting frequency with spinning or coasting load, forward or reverse.
7. Critical frequency band lockout:
a. Minimum of three (3) settings.
b. Adjustable bandwidth, 1 - 5 Hz.
8. Capable of operating without the motor connected for start-up and troubleshooting.

D. The VFD shall be provided with the following minimum user-programmable parameters:
1. Carrier frequency.

2. Independent maximum and minimum speeds for forward and reverse operation.
3. Start frequency and hold time.
4. Independent linear acceleration and deceleration time.
5. Preset “jog” speed.
6. Three (3) critical frequency bands.
7. One (1) preset speed selectable by logic input.
8. Volts/Hertz ratio.
9. Voltage boost, magnitude and frequency range.
10. Process controller gain, offset and bias.
11. Current limit.
12. Overcurrent pickup.
13. Overcurrent delay.
14. Ground fault pickup.
15. DC injection level and time.

E. The VFD shall be designed such that the power circuit components are fully protected from line side disturbances and load side faults:
   1. General:
      a. Shutdown conditions associated with supply circuit conditions which can be corrected external to the VFD-motor system shall be provided with automatic reset, with shutdown cause logged in memory:
         1) Input under voltage.
         2) Input over voltage.
         3) Input under frequency.
         4) Input over frequency.
         5) Input Phase loss.
         6) DC Bus under voltage.
      b. Shutdown conditions which indicate overload or fault within the VFD, the output circuit, or the motor shall require local manual reset at the VFD, requiring operator intervention.
         1) Over temperature.
         2) Blown fuse.
         3) Component failure.
         4) Overload.
         5) Short circuit.
         6) Ground fault.
         7) DC Bus over voltage.
         8) External safety input (e.g., motor thermal protection).
         9) Logic fault.
      c. When automatic shutdown occurs, VFD shall restart only when remote run signal is removed and reapplied.
      d. VFD shall hold cause of trip data for a minimum of four (4) shutdowns in memory.
         1) Data to be accessible through the keypad, local communication link and remotely.
   2. Input protection:
      a. Input circuit breaker or current-limiting fuses with externally operable disconnect.
         1) Fault current interrupting rating equal to or greater than the specified withstand rating of the VFD.
         2) Handle padlockable in the OFF position.
      b. Provide full protection for semiconductors integral to the VFD; units requiring current-limiting fuses or circuit breakers in the supply circuit are not acceptable.
      c. Incoming line transient suppression.
         1) 6000V peak per IEEE C62.41.
         2) Phase-to-phase and phase-to-ground protection.
      d. Sustained over voltage trip.
   3. Internal protection:
      a. Surge suppression and power device snubbers.

b. Power devices rated at 2.5 times line voltage.
c. Instantaneous over current trip.
d. DC bus over voltage trip.
e. Power device over temperature trip.
f. Control logic circuit malfunction trip.

4. Output protection:
   a. Inverse-time overload trip:
      1) UL Class 10 characteristic.
   b. Over voltage trip.
   c. Over frequency trip.
   d. Short circuit trip.
      1) Line to line and line to ground.
   e. Ground fault trip.

2.4 OPERATOR AND REMOTE CONTROL INTERFACE

A. Drive controls shall be microprocessor-based with on-board human machine interface and both local and remote digital communications capability.
   1. All monitoring and control functions, other than those shutdowns specified to be manual reset only, shall be available both locally and remotely.

B. Control circuits shall be 120 Vac or 24 Vac or 24 Vdc.
   1. 120 Vac supplied by CPT in the VFD.
      a. CPT shall have minimum additional capacity of 60 VA greater than that required by control devices.
      b. CPT shall have two (2) fuses on the primary side and one (1) fuse on the secondary side.
      c. CPT shall have surge protection on the primary side independent of any other surge protection in the VFD.
   2. 24 Vac or 24 Vdc supplied by Class 2 power supply in the VFD.
      a. Power supply shall have minimum additional capacity of 33 percent greater than that required by control devices.
      b. Provide two (2) current-limiting fuses on the AC supply to the power supply.
      c. Power supply shall have surge protection on the primary side independent of any other surge protection in the VFD.

C. Operator Interface:
   1. Door mounted sealed keypad, membrane type with LED or LCD display.
      a. Messages shall be in English and engineering units.
      b. Drive operating parameters shall be programmable.
      c. Menu driven.
      d. Password security.
      e. Display fault and diagnostic data.
      f. Operating parameters, fault and diagnostic data maintained in non-volatile memory with historic log of fault and diagnostic data.
      g. Gold plated plug-in contacts.
   2. Provide indication and control interface, integral in the keypad, as required in the sequence of operation and Drawings.
      a. Minimum indications:
         1) Run.
         2) Stop.
         3) Ready.
         4) Alarm.
         5) Fault.
         6) Local control.
         7) Remote control.
         8) Control source local.

9) Control source remote.
10) Speed indication.

b. Minimum control functions:
1) Local/Remote switch.
2) Stop button.
3) Start button.
4) Reset button.
5) Speed control buttons.

3. Diagnostic indicators located externally on the face of the drive shall show the type of fault responsible for drive warning, shutdown or failure.
a. On occurrence of more than one (1) condition, each shall be recorded or indicated by the diagnostics.

D. Remote Control Interface:
1. Local portable computer interface via RS232/RS242 serial communications port:
a. Capability to:
1) Start-Stop VFD.
2) Control VFD Speed.
3) Access fault and diagnostic data.
2. Analog and discrete inputs:
a. Speed reference (setpoint) signal 4-20 mA DC.
b. Isolated process PID controller with user-programmable setpoint, gain, rate, reset and span for accepting a remote 4-20 mA DC process variable signal.
3. Analog and discrete outputs:
a. 4-20 mA DC output for remote speed indication, as a function of frequency, calibrated 0 to 100 percent.
b. Drive FAULT contacts.
c. Drive RUNNING contacts.
d. Drive selector switch in AUTO status contacts.
4. Contacts:
a. Contacts shall be rated 2 A inductive at 120 Vac.
b. All contacts shall be wired to field wiring terminal boards.
5. Drive shutdown on external fault input:
a. Provide isolated input for dry contact from external motor or system safety devices to cause immediate shutdown of VFD.
b. Safety shutdown to be operable in all operating modes of drive, including local operation from keypad.
c. Local safety switch, to driven equipment, auxiliary contact to lock-out VFD from running when safety switch is open.
6. Network communications capability:
a. Provide VFD with communication card, protocol and required programming for digital communication of all VFD program and operational parameters to plant control system via:
1) Ethernet IP.

2.5 HARMONIC PROTECTION REQUIREMENTS

A. All VFDs shall be capable of satisfactory operation from a source having voltage distortion and notch characteristics identified as acceptable for a “dedicated system” in IEEE 519 Table 10.2.

B. With all VFDs operating under worst-case harmonic current conditions, and the facility supplied from the utility, the VFDs shall not produce harmonic effects in excess of the following limits at any point of common coupling (PCC).
1. Voltage distortion and notch characteristics: IEEE 519 Table 10.2 for General System.
2. Current distortion: IEEE 519 Table 10.3 based on calculated I_{SC}/I_L at each PCC

C. PCC shall be considered:
1. Building service entrance switchgear, switchboard or MCC.

2. Each MCC, switchboard, switchgear, or panelboard supplying a VFD branch circuit.

D. The Engineer has performed preliminary calculations based on typical VFD data which indicate that the minimum mitigation measures required to meet the specified harmonic criteria are one (1) of the following topologies:
   1. 6-pluse rectifier topology with tuned passive filter with controls such that the filter is not energized when VFD is off or starting for each VFDs.
   2. Active harmonic filter (specified elsewhere) at each PCC.

E. VFD manufacturer shall determine, for their proposed equipment, uncorrected harmonic distortion levels and mitigation techniques required to meet the specified limits and shall furnish the VFD types and all accessory items and equipment necessary to do so, whether specified herein or not.

F. VFD manufacturer shall provide a harmonic analysis of the distribution system based on their proposed specific equipment characteristics and mitigation techniques confirming that the specified levels are not exceeded.
   1. Analysis shall be based on the methodology of IEEE 519 and IEEE 399.
   2. Power system data for analysis shall be taken from the electrical drawings and approved equipment submittals.
      a. VFDs provided in a package with equipment specified elsewhere, shall be included in the analysis.

G. Following start-up, with facility at full load operation, provide measurement of harmonic voltage, current and notch characteristics at each PCC according to the requirements of IEEE 519 Section 9.
   1. Values in excess of specified limits require correction by contractor and re-measurement.
   2. Provide certification of compliant measurements as part of Field Service Engineer's final report.

2.6 MOTOR PROTECTION REQUIREMENTS

A. The VFD shall produce a quality of output waveform adequate to allow the motor to produce rated torque at rated RPM continuously without exceeding the temperature rise given in NEMA MG 1 Table 31-2.

B. Provide motor overload, short circuit and ground fault protection integral to drive electronics.

C. The VFD shall not produce voltage spikes in excess of the following values at the motor terminals when operated with the feeder types shown on the Drawings and the actual installed feeder lengths.
   1. If unmitigated voltage peaks exceed the specified limits, provide output line reactors, filters, or other devices as required to meet the specified limits:
      a. Inverter duty motors: 1280 V.
      b. Rise time shall be greater than or equal to 0.1 microsecond.
      c. Motor lead length and data shall be determined by the Contractor based on the actual routing of the conductors.

D. Following start-up, provide measurement of peak voltage at the terminals of each motor, unless the lead lengths are 10 percent shorter than the manufacturers published literature for maximum lead length for the type of cable installed.
   1. Values in excess of specified limits require correction by contractor and re-measurement.
   2. Provide certification of compliant measurements as part of Field Service Engineer's final report.

2.7 EQUIPMENT CONSTRUCTION

A. Fabrication and Assembly:
   1. Each VFD system shall be factory-assembled for installation in an MCC, and shall utilize interchangeable plug-in printed circuit boards and power conversion components wherever possible.

a. Factory assembly shall be performed by the VFD manufacturer or authorized agent.
b. Systems fabricated or assembled in whole or in part by parties other than the VFD manufacturer or authorized agent will not be acceptable.
c. Indicated VFDs shall be mounted within standard motor control center sections, and included as part of the overall motor control center.

2. Reactors and/or filters, where required, shall be mounted within or in an ancillary enclosure adjacent to the drive enclosure, or with the Engineer's permission may be mounted in a separate enclosure.
3. Cooling fans, as required, shall be provided to run when drive is running.
4. Enclosures for separately mounted VFD's:
   a. NEMA Type 1 for installation in Electrical Rooms.
   b. NEMA Type 12 for installation in other unclassified areas.

B. Wiring:
1. The wiring in the VFD shall be neatly installed in wire ways or with wire ties where wire ways are not practical.
   a. Where wire ties are used, the wire bundles are to be held at the back panel with a screw-mounted wire tie mounting base.
   b. Bases with a self-sticking back will not be allowed.
2. All plug-in contacts shall be gold-plated.
3. Provide terminal boards for all field wiring and inter-unit connections, including analog signals.
   a. Provide terminals for shield continuity where required.
4. Terminal blocks shall be complete with marking strip, covers and pressure connectors.
   a. Non-brittle, interlocking, track-mounted type.
   b. Screw terminals will not be allowed.
   c. A terminal for each conductor of external circuits plus one (1) ground for each shielded cable.
   d. For free-standing panels, 8 IN of clearance shall be provided between terminals and the panel base for conduit and wiring space.
   e. Not less than 25 percent spare terminals shall be provided.
   f. Terminals shall be labeled to agree with identification indicated on the suppliers submittal drawings.
   g. Individually fuse each control loop or system and all fuses or circuit breakers shall be clearly labeled and located for easy maintenance.
5. All grounding wires shall be attached to the enclosure sheet metal with a ring tongue terminal.
   a. The surface of the sheet metal shall be prepared to assure good conductivity and corrosion protection.
6. Wiring shall not be kinked or spliced and shall have markings on both ends or be color coded.
   a. Markings or color code shall match the manufacturer's drawings.
7. With the exception of electronic circuits, all interconnecting wiring and wiring to terminals for external connection shall be stranded copper, type MTW or SIS, insulated for not less than 600 V, with a moisture-resistant and flame-retardant covering rated for not less than 90 DegC.

C. Nameplates:
1. All devices mounted on the face of the drive shall be provided with a suitable nameplate as specified in Specification Section 10 14 00.
2. Push buttons, selector switches, and pilot lights shall have the device manufacturer's standard legend plate.
3. Relays, terminals and special devices inside the control enclosure shall have permanent markings to match identification used on manufacturer's wiring diagrams.

D. Painting: Enclosure, after being phosphate washed, shall be thoroughly cleaned and given at least one (1) coat of rust-inhibiting primer on all inner surfaces prior to fabrication.

2.8 COMPONENTS AND ACCESSORIES

A. Reactors:
   1. Impedance: As required.
   2. Continuous current: Not less than drive rating.
   3. Current overload: 150 percent for 1 minute.
   4. Insulation temperature rating: 180 DegC.
   5. Copper windings.
   6. Saturation current rating: 3.5 to 5 times rated current.
   7. Hi-potential rating: 2500 Vac line to ground and line to line, for 1 minute.
   8. Noise reduction features:
      a. Epoxy over cast coil.
      b. Extra dips and bakes of varnish over continuous wound coil.

2.9 SOURCE QUALITY CONTROL

A. Factory Tests:
   1. Conduct all standard tests in accordance with NEMA and ANSI standards to ensure conformance to Specification requirements.
   2. Prior to final assembly:
      a. Inspect incoming components.
      b. Test and inspect power devices.
      c. Circuit cards:
         1) Component and functional tests:
         2) Burn-in chamber or temperature cycling test.
         3) System test after burn-in or temperature cycling.
   3. After final assembly:
      a. Continuity and insulation test of 480 power control circuits.
      b. Drive tests:
         1) Burn-in complete drive at full load for 24 HRS.
         2) Verify all auxiliary circuits operation.
         3) Monitor output variables.
      c. Systems test:
         1) Provide inputs to field connections and simulate on-site operation.
         2) Test all auxiliary equipment.

2.10 MAINTENANCE MATERIALS

A. Provide manufacturer's recommended renewable spare parts (e.g., power and control fuses).

B. Spare parts utilized during pre-start-up or start-up and demonstration testing shall be immediately restocked, at no cost to the Owner.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions and as indicated on the Drawings.

B. Verify the installed motor nameplate electrical requirements do not exceed the VFD capacity.

C. Provide services of manufacturer's representative to perform start-up services.

D. The selection of input and output harmonic and voltage spike protection shall also be made on the available physical space.
   1. The space available on the Drawings shall not be exceeded.

3.2 START UP

A. Pre-start-up Services:

1. Shall be completed a minimum of 30 days prior to the start-up and demonstration period described in Specification Section 01 75 00.
2. Shall consist of:
    a. Physical and electrical installation check.
    b. Final adjustments and calibration of drive parameters.
    c. VFD operation from simulated input signals.
3. Shall be complete when VFD(s) are fully operational.

B. Field Quality Control:
1. Perform field measurement of harmonics at each PCC per Harmonic Protection Requirements Article.
    a. For each individual VFD.
    b. For the maximum number of VFDs that will be operational at the same time.
    c. When all loads are at 75 percent load minimum.
    d. Duration: 1 HR minimum.
2. Perform field measurement of the maximum voltage peak at the terminals of each motor fed from a VFD per Motor Protection Requirements Article.
    a. Use a high speed oscilloscope to produce a plot of Voltage (Y axis) versus Time (X axis).
        1) Time shall be measured in microseconds.
    b. Tests shall be performed at full:
        1) Full voltage and speed.
        2) Loaded to 75 percent minimum.
        3) Duration: 1 HR minimum.
3. Record all data necessary for the preparation of required test reports.

C. Start-up and Demonstration Services:
1. Supervise start-up of all units including recheck of settings made during the pre-start-up tests.
    a. Perform all work in the presence of the Owner's designated representatives.
2. Setup all VFDs with carrier frequency at minimum value consistent with proper operation; inform Engineer of carrier frequencies set in excess of 5 kHz and reason for setting.
3. Simulate operation of the VFD and its associated control and instrumentation system in both the manual and automatic modes.
    a. Ensure compatibility of VFD with associated control and instrumentation signals.
4. Simulate VFD failures and demonstrate troubleshooting aids.

D. Instruct Owner's designated personnel:
1. Minimum of 8 HRS at the jobsite.
2. Include both field and classroom instruction.
3. Instructions shall include proper operation and maintenance procedures including, but not limited to:
    a. Lubrication.
    b. Troubleshooting.
    c. Repair and replacement.
    d. Parts inventory.
    e. Maintenance records.

END OF SECTION

SECTION 16441
PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Panelboards mounted in Motor Control Centers.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 16010 - Electrical: Basic Requirements.
   4. Section 16490 - Overcurrent and Short Circuit Protective Devices.
   5. Section 16491- Low Voltage Surge Protective Devices (SPD).

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. National Electrical Manufacturers Association (NEMA):
      a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
      b. PB 1, Panelboards.
   2. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC).
   3. Underwriters Laboratories, Inc. (UL):
      a. 50, Enclosures for Electrical Equipment, Non-Environmental Considerations.
      b. 67, Standard for Panelboards.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data.
      a. Provide submittal data for all products specified in PART 2 of this Specification Section.
      b. See Specification Section 16010 for additional requirements.
   3. Fabrication and/or layout drawings:
      a. Panelboard layout with alphanumeric designation, branch circuit breakers size and type, as indicated in the panelboard schedules.

B. Contract Closeout Information:
   1. Operation and Maintenance Data:
      a. See Specification Section 01340 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
   2. Panelboard schedules with as-built conditions.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Eaton.
   2. General Electric Company.
   3. Square D Company.

4. Siemens.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MANUFACTURED UNITS

A. Standards: NEMA PB 1, NFPA 70, UL 50, UL 67.

B. Ratings:
1. Current, voltage, number of phases, number of wires as indicated on the Drawings.
2. Panelboards rated 240 Vac or less: 10,000 amp minimum short circuit rating or as indicated in the schedule.
3. Panelboards rated 480 Vac: 14,000 amp minimum short circuit rating or as indicated in the schedule.
4. Service Entrance Equipment rated when indicated on the Drawings.

C. Construction:
1. Interiors factory assembled and designed such that switching and protective devices can be replaced without disturbing adjacent units and without removing the main bus connectors.
2. Multi-section panelboards: Feed-through or sub-feed lugs.
3. Main lugs: Solderless type approved for copper and aluminum wire.

D. Bus Bars:
1. Main bus bars:
   a. Plated aluminum or copper sized to limit temperature rise to a maximum of 65 DegC above an ambient of 40 DegC.
   b. Drilled and tapped and arranged for sequence phasing of the branch circuit devices.
2. Ground bus and isolated ground bus, when indicated on the Drawings: Solderless mechanical type connectors.
3. Neutral bus bars: Insulated 100 percent rated or 200 percent rated, when indicated on the Drawings and with solderless mechanical type connectors.

E. Enclosure:
1. Boxes: Code gage galvanized steel, furnish without knockouts.
2. Trim assembly: Code gage steel finished with rust inhibited primer and manufacturers standard paint inside and out.
3. Lighting and appliance panelboard:
   a. Trims supplied with hinged door over all circuit breaker handles.
   b. Trims for surface mounted panelboards, same size as box.
   c. Trims for flush mounted panelboards, overlap the box by 3/4 IN on all sides.
   d. Doors lockable with corrosion resistant chrome-plated combination lock and catch, all locks keyed alike.
   e. Nominal 20 IN wide and 5-3/4 IN deep with gutter space in accordance with NFPA 70.
   f. Clear plastic cover for directory card mounted on the inside of each door.
   g. NEMA 3R or NEMA 12 rated: Door gasketed.
4. Power distribution panelboard:
   a. Trims cover all live parts with switching device handles accessible.
   b. Less than or equal to 12 IN deep with gutter space in accordance with NFPA 70.
   c. Clear plastic cover for directory card mounted front of enclosure.
   d. NEMA 3R or NEMA 12 rated: Doors gasketed and lockable with corrosion resistant chrome-plated combination lock and catch, all locks keyed alike.

F. Overcurrent and Short Circuit Protective Devices:
1. Main overcurrent protective device:
   a. Molded case circuit breaker.
2. Branch overcurrent protective devices:
   a. Mounted molded case circuit breaker.
3. See Section 16490 for overcurrent and short circuit protective device requirements.
4. Factory installed.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install as indicated on the Drawings, in accordance with the NFPA 70, and in accordance with manufacturer's instructions.

B. Provide NEMA 1, NEMA 3R or NEMA 12 rated enclosure as indicated on the Drawings.

C. Provide each panelboard with a typed directory:
   1. Identify all circuit locations in each panelboard with the load type and location served.
   2. Mechanical equipment shall be identified by Owner-furnished designation if different than designation indicated on the Drawings.
   3. Room names and numbers shall be final building room names and numbers as identified by the Owner if different than designation indicated on the Drawings.

END OF SECTION

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SECTION 16442
MOTOR CONTROL EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Motor control centers.
   2. Separately mounted motor starters (including those supplied with equipment).
   3. Manual motor starters.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 16010 - Electrical: Basic Requirements.
   4. Section16080 - Acceptance Testing.
   5. Section 16265 - Variable Frequency Drives - Low Voltage.
   6. Section 16441 - Panelboards.
   7. Section16460 - Dry-Type Transformers.
   8. Section 16490 - Overcurrent and Short Circuit Protective Devices.
   9. Section 16491- Low Voltage Surge Protective Devices (SPD).

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. International Electrotechnical Commission (IEC).
   2. National Electrical Manufacturers Association (NEMA):
      a. 250, Enclosures for Electrical Equipment (1000 Volt Maximum).
      b. ICS 2, Controllers, Contactors and Overload Relays Rated 600 V.
      c. ICS 3, Medium-Voltage Controllers Rated 2001 to 7200 V AC.
   3. Underwriters Laboratories, Inc. (UL):
      a. 508, Standard for Industrial Control Equipment.
      b. 845, Motor Control Centers.

B. Miscellaneous:
   1. Verify motor horsepower loads, other equipment loads, and controls from approved shop drawings and notify Engineer of any discrepancies.
   2. Verify the required instrumentation and control wiring for a complete system and notify Engineer of any discrepancies.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01340 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data:
      a. Provide submittal data for all products specified in PART 2 of this Specification Section.
      b. See Specification Section 16010 for additional requirements.
   3. Fabrication and/or layout drawings:
      a. Motor control center:
         1) Elevation drawing with overall dimensions.
         2) Starter and component schedule.
         3) Identification of units and their location in the MCC.
         4) Location of incoming line terminals.
         5) Mounting dimensions.

6) Available conduit entrance areas.
7) Nameplate schedule.
8) Assembly ratings (amps, volts, short circuit, etc.).
9) Unit ladder logic wiring for each unit depicting electrical interlocking and wiring between units (NEMA ICS 3 Class II) and identification of terminals where field devices or remote control signals are to be terminated (NEMA ICS 3 Class II-S) as indicated on the Drawings and/or loop descriptions.

b. Separately mounted combination starters:
1) Unit ladder logic wiring for each unit depicting electrical wiring and identification of terminals where field devices or remote control signals are to be terminated as indicated on the Drawings and/or loop descriptions.

B. Contract Closeout Information:
1. Operation and Maintenance Data:
a. See Specification Section 01340 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
b. Fabrication and/or layout drawings updated with as-built conditions.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Allen-Bradley.
2. Eaton.
3. General Electric Company.
4. Square D Company.
5. Siemens.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MOTOR CONTROL CENTERS

A. Ratings:
1. 600 V class, 3 PH, 60 Hz with operating voltage and number of wires as indicated on the Drawings.
2. Assembly short circuit current and interrupting device rating as indicated on the Drawings.
3. Service Entrance Equipment rated when indicated on the Drawings.

B. Construction:
1. Standards: UL 845.
2. Totally enclosed, dead front, free standing assemblies, bolted together to form a single assembly.
3. Fabricate of not less than 14 GA steel with 16 GA steel doors in standardized units.
4. Nominal size per section: 20 IN wide, 20 or 21 IN deep, and 90 IN high.
5. Enclosure:
a. NEMA 3R non-walk-in:
1) Rainproof and sleet resistant.
2) NEMA 1 gasketed enclosure with an outdoor house erected around it.
6. Horizontal wireways:
a. At the top, isolated from the main bus
b. At the bottom.
c. Easily accessible.
d. Full length of the MCC.
7. Vertical wireway:
a. Located in each MCC section that accepts plug-in units.
b. Connect to top and bottom wireways.

c. Isolated from the unit interiors.
d. Accessible through a separate hinged door.
e. Cable tie supports to hold wiring in place.

8. Unit doors:
   a. Formed round corners and rolled edges.
   b. Minimum of two (2) heavy-duty hinges or continuous piano hinge.
   c. Held closed by means of captive fasteners.
   d. Fabricate to be a part of the structure and not part of the starter.
9. Unit cubicles:
   a. Draw-out type for motor starters through NEMA Size 5.
   b. Guide rails for supporting and aligning starters.
   c. Operating handle:
      1) With the unit stabs engaged and door closed the handle mechanism allows complete ON/OFF control of the unit disconnect and clear indication of the disconnect status.
      2) Circuit breaker and MCP operators includes a separate TRIPPED position.
      3) Mechanical interlock to prevent the opening of the door when the disconnect is in the ON position with a defeater mechanism.
      4) Mechanical interlock to prevent the placement of the disconnect in the ON position with the door open with a defeater mechanism.
      5) Non-defeatable interlock to prevent the installation or removal of a unit unless the disconnect is in the OFF position.
      6) Padlockable in the OFF position.
   d. Control power:
      1) Control power transformer:
         a) 120 V secondary.
         b) Fused on primary and secondary side.
         c) Sized for 140 percent of required load.
   e. Minimum of one (1) full size space unit (12 IN) for any combination magnetic motor starter or starter without overload relay.
   f. One-half full size space unit (6 IN) for circuit breakers 100 A and less.
   g. Effectively baffled to isolate any ionized gases which may occur within unit starter.
10. Externally mounted overload relay pushbutton.
11. Assemblies effectively ventilated to allow relocation of starters and other components:
    a. Within the assembly and with the same load.
    b. Without having to compensate for changes in location.
12. Finish: Rust inhibited primer and manufacturer's standard paint inside and out.
13. Provide ample unrestricted space for conduit entry from the bottom.
14. Wiring: NEMA ICS 3 Class II, Type B-D.

C. Buses:
1. Material: Tin-plated copper.
2. Main horizontal bus:
   a. 600 A unless otherwise indicated on the Drawings.
   b. Extend the full-length of the MCC with provisions for splicing additional sections to either end.
3. Vertical buses:
   a. 300 A minimum.
   b. Securely bolted to the horizontal main bus with joint easily accessible for maintenance.
   c. Completely isolated and insulated by means of a barrier.
   d. Extended full length of vertical section to distribute incoming power to each circuit breaker and starter in structure.
      1) Starters NEMA Size 5 and larger and certain other components may be cable connected to the main bus with the approval of the Engineer.
   e. Extend Vertical bus to spaces provided for future equipment.
4. Ground bus:

a. Extend the full-length of the MCC with provisions for splicing additional sections to either end.
b. 300 A tin-plated copper.
c. Solidly grounded to each structure.
d. Locate near bottom of structure.
e. Provide for lug connection of equipment ground wires.

D. Overcurrent and Short Circuit Protective Devices:
1. Main device:
a. Molded case circuit breaker.
b. Fusible switch.
2. Feeder devices:
a. Molded case circuit breaker.
b. Fusible switch.
3. Motor protection with full voltage starters:
a. Motor circuit protector.
b. Molded case circuit breaker.
c. Class RK-1 fuse.
4. Motor protection with reduced voltage starters:
a. Molded case circuit breaker.
b. Motor circuit protector.
c. Class RK-1 fuse.
5. See Specification Section 26 28 00 for overcurrent and short circuit protective device requirements.
6. Factory installed.

E. Panelboards: Integrally mounted, see Specification Section 16441.

F. Transformers: Integrally mounted, see Specification Section 16460.

G. Surge Protective Device: Integrally mounted, see Specification Section 16491.

H. Miscellaneous:
1. See Drawings for items provided by other but factory installed (e.g., submersible motor temperature/leak controller, control system gateways or switches).

2.3 MOTOR STARTERS

A. Standards:
1. NEMA ICS 2.
2. UL 508.

B. Variable Frequency Drives: See Specification Section 16265.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install as indicated on the Drawings and in accordance with manufacturer's recommendations and instructions.

B. Mounting height for surface mounted equipment: See Specification Section 16010.

C. Mount MCC on 4 IN high concrete pad:
1. Install two (2) 4 IN wide channel sills flush in pads to support and maintain alignment of the MCC.
2. Align front of MCC with top edge of pad chamfer.

D. Overload Heaters:
1. Size for actual motor full load current of the connected motor.

2. For motors with power factor correction capacitors, size to compensate for the capacitors effect on load current.

3.2 FIELD QUALITY CONTROL

A. Acceptance Testing: See Specification Section 16080.

END OF SECTION

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SECTION 16460
DRY-TYPE TRANSFORMERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Transformers mounted in Motor Control Centers (see Section 16442.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 16010 - Electrical: Basic Requirements.
   4. Section 16060 - Grounding.
   5. Section 16442 - Motor Control Equipment.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. Department of Energy (DOE):
      a. 10 CFR 431, Energy Conservation Program: Energy Conservation Standards for Distribution Transformers.
   2. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
      a. C57.96, Guide for Loading Dry-Type Distribution and Power Transformers.
   3. National Electrical Manufacturers Association (NEMA):
      a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
      b. ST 20, Dry-Type Transformers for General Applications.
      c. TP 1, Guide for Determining Energy Efficiency for Distribution Transformers.
   4. Underwriters Laboratories, Inc. (UL):
      a. 506, Standard for Safety Specialty Transformers.
      b. 1561, Standard for Safety Dry-Type General Purpose and Power Transformers.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01340 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data:
      a. Provide submittal data for all products specified in PART 2 of this Specification Section.
      b. See Specification Section 16010 for additional requirements.
   3. Fabrication and/or layout drawings.
      a. Nameplate drawing.
   4. Certifications:
      a. Sound level certifications.

B. Contract Closeout Information:
   1. Operation and Maintenance Data:
      a. See Specification Section 01340 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Eaton.
   2. General Electric Company.
   3. Square D Company.
   4. Siemens.
   5. Sola/Hevi-Duty.

B. Submit request for substitution in accordance with Specification Section 01640.

2.2 GENERAL PURPOSE DRY-TYPE TRANSFORMERS

A. Ventilated or non-ventilated, air cooled, two (2) winding type.

B. Cores:
   1. High grade, non-aging silicon steel with high magnetic permeability, and low hysteresis and eddy current losses.
   2. Magnetic flux densities are to be kept well below the saturation point.

C. Coils: Continuous wound with electrical grade aluminum.

D. Non-ventilated Units:
   1. Core and coil assembly encapsulated in a proportioned mixture of resin and aggregate to provide a moistureproof, shock resistant seal.

E. Furnish Taps for Transformers as follows:
   1. 1 PH, 2 kVA and below: None.
   2. 1 PH, 3 to 25 kVA: Two (2) 5 percent FCBN.
   3. 1 PH, 25 kVA and above: Two (2) 2.5 percent FCAN and four (4) 2.5 percent FCBN.
   4. 3 PH, 3 to 15 kVA: Two (2) 5 percent FCBN.
   5. 3 PH, 15 kVA and above: Two (2) 2.5 percent FCAN and four (4) 2.5 percent FCBN.

F. Sound Levels:
   1. Manufacturer shall guarantee not to exceed the following:
      a. Up to 9 kVA: 40 dB.
      b. 10 to 50 kVA: 45 dB.
      c. 51 to 150 kVA: 50 dB.
      d. 151 to 300 kVA: 55 dB.

G. Efficiency (minimum):
   1. Ventilated:
      a. 1 PH, 15 - 333 kVA: DOE 2016 Efficiency.
      b. 3 PH, 15 - 1000 kVA: DOE 2016 Efficiency.

H. Insulating Material (600 V and below):
   1. 3 to 15 kVA units: 185 DegC insulation system with a 115 DegC rise.
   2. 15 kVA and above units: 220 DegC insulation system with a 150 DegC rise.

I. Ratings: 60 Hz, voltage, KVA and phase, as indicated on the Drawings.

J. Finish: Rust inhibited primer and manufacturers standard paint inside and out.

K. Standards: IEEE C57.96, NEMA ST 20, UL 506, UL 1561.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Outdoor Locations:
   1. Provide non-ventilated type.

C. Enclosures: Painted steel in all areas except stainless steel in highly corrosive areas.

D. Ground in accordance with Section 16060.

END OF SECTION

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SECTION 16490

OVERCURRENT AND SHORT CIRCUIT PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Low voltage circuit breakers.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 16010 - Electrical: Basic Requirements.
   4. Section 16080 - Acceptance Testing.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
      a. C37.13, Standard for Low-Voltage AC Power Circuit Breakers Used in Enclosures.
      b. C37.16, Low-Voltage Power Circuit Breakers and AC Power Circuit Protectors - Preferred Ratings, Related Requirements, and Application Recommendations.
      c. C37.17, Trip Devices for AC and General Purpose DC Low Voltage Power Circuit Breakers.
   2. National Electrical Manufacturers Association (NEMA):
      a. AB 1, Molded-Case Circuit Breakers, Molded Case Switches, and Circuit-Breaker Enclosures. (Equivalent to UL 489)
   3. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC).
   4. Underwriters Laboratories, Inc. (UL):
      a. 489, Standard for Safety Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.
      b. 943, Standard for Safety for Ground-Fault Circuit-Interrupters.
      c. 1066, Standard for Low-Voltage AC and DC Power Circuit Breakers Used in Enclosures.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01340 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data including:
      a. Provide submittal data for all products specified in PART 2 of this Specification Section.
      b. See Specification Section 16010 for additional requirements.

B. Contract Closeout Information:
   1. Operation and Maintenance Data:
      a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

C. Informational Submittals:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Reports:
      a. As-left condition of all circuit breakers that have adjustable settings.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Circuit breakers:
      a. Eaton.
      b. General Electric Company.
      c. Square D Company.
      d. Siemens.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 CIRCUIT BREAKERS

A. Molded Case Type:
   1. General:
      a. Standards: NEMA AB 1, UL 489.
      b. Unit construction.
      c. Over-center, toggle handle operated.
      d. Quick-make, quick-break, independent of toggle handle operation.
      e. Manual and automatic operation.
      f. All poles open and close simultaneously.
      g. Three (3) position handle: On, off and tripped.
      h. Molded-in ON and OFF markings on breaker cover.
      i. One-, two- or three-pole as indicated on the Drawings.
      j. Current and interrupting ratings as indicated on the Drawings.
      k. Bolt on type.
   2. Thermal magnetic type:
      a. Inverse time overload and instantaneous short circuit protection by means of a thermal magnetic element.
      b. Frame size 150 amp and below:
         1) Non-interchangeable, non-adjustable thermal magnetic trip units.
      c. Frame sizes 225 to 400 amp (trip settings less than 400A):
         1) Interchangeable and adjustable instantaneous thermal magnetic trip units.
      d. Ground Fault Circuit Interrupter (GFCI) Listed:
         1) Standard: UL 943.
         2) One- or two-pole as indicated on the Drawings.
         3) Class A ground fault circuit.
         4) Trip on 5 mA ground fault (4-6 mA range).
   3. Solid state trip type:
      a. Inverse time overload, instantaneous short circuit and ground fault protection by means of a solid state trip element, associated current monitors and flux shunt trip mechanism.
      b. Frame size 400 amp to 1200 amp (trip settings between 400 and 1200A):
         1) Standard rating.
         2) Interchangeable current sensor or rating plug.
         3) Adjustable long time pick-up setting.
            a) Adjustable from 50 to 100 percent of the current sensor or rating plug.
         4) Adjustable short time pick-up setting.
         5) Adjustable instantaneous pick-up.
         6) Fixed ground fault pick-up, when indicated on the Drawings.
      c. Frame size 1600 amp and above:
         1) 100 percent rated.
         2) Interchangeable current sensor or rating plug.
         3) Adjustable long time pick-up setting.
            a) Adjustable from 50 to 100 percent of the current sensor or rating plug.
         4) Adjustable long time delay setting.

5) Adjustable short time pick-up setting.
6) Adjustable instantaneous pick-up setting.
7) Adjustable ground fault pick-up setting, when indicated on the Drawings.
8) Adjustable ground fault delay setting, when indicated on the Drawings.

4. Motor circuit protector:
   a. Adjustable instantaneous short circuit protection by means of a magnetic or solid state trip element.
   b. Sized for the connected motor.

B. Low Voltage Power Type:
1. Inverse time overload, instantaneous short circuit and ground fault protection by means of a solid state trip element, associated current monitors and two-step stored energy trip mechanism.
2. Standards: IEEE C37.13, IEEE C37.16, IEEE C37.17, UL 1066.
3. 100 percent rated.
4. Electrically operated (EO) or manually operated (MO) as indicated on the Drawings.
5. Manually operated breakers:
   a. Close/Open pushbuttons.
   b. Red and green indicators to indicate breaker position.
   c. Trip unit power: Internal CPT of the electrical gear.
6. Electrically operated breakers:
   a. Close/open pushbuttons
   b. Red and green indicators to indicated breaker position.
   c. Trip unit power: {Integral battery.}{Internal CPT of the electrical gear.}{External 120 Vac source.}
   d. Trip/close signal: External 120 Vac source.
   e. Charging motor power: Internal CPT of the electrical gear.
   f. Charge springs after a close.
7. Motor driven operator for charging mechanism with open, close and charge push button.
8. Stored energy mechanism position indicator.
9. Contact position indicator: Reversible 52a/52b contacts, quantity as indicated on the Drawings.
10. Truck operated cell switch (52TOC) when indicated on the Drawings.
11. Bell alarm with manual reset when indicated on the Drawings.
12. Draw out construction:
   a. Roll out type operated by removable crank handle and interlocked with the door.
   b. Four (4) positions: Connected, test, disconnected and removed.
   c. Cell switches to short out ground fault relay when main or tie breaker is drawn out.
13. Current and interrupting ratings as indicated on the Drawings and a 30-cycle short-time withstand ratings equal to their symmetrical interrupting ratings, regardless of whether equipped with instantaneous trip protection or not.
14. Current limiters:
   a. Integrally mounted on 2000 amp frames and less and separate draw-out limiter on 3200 amp and larger.
   b. Coordinated with the trip unit to avoid unnecessary blowing of the current limiters.
   c. Anti-single-phasing device to trip breaker in the event of a blown limiter, indicator to indicate which limiter is blown and prevent breaker from being re-closed on a single-phase condition.
   d. Current limiting fuses: 200,000 amp RMS symmetrical interrupting capacity.
15. Frame size 800 amp and above:
   a. Interchangeable current sensor or rating plug:
   b. Adjustable long time pick-up setting.
      1) Adjustable from 50 to 100 percent of the current sensor or rating plug.
   c. Adjustable long time delay setting.
   d. Adjustable short time pick-up setting.
   e. Adjustable instantaneous pick-up setting.

f. Adjustable ground fault pick-up setting.
g. Adjustable ground fault delay setting.
h. Unit status indicator.
i. Cause of trip indicator.
j. Current display.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Current and interrupting ratings as indicated on the Drawings.

B. Series rated systems not acceptable.

C. Devices shall be ambient temperature compensated.

D. Circuit Breakers:
1. Molded case circuit breakers shall incorporate the following, unless indicated otherwise on the Drawings:
a. Frame sizes 400 amp and less with trip setting less than 400A shall be thermal magnetic type.

3.2 FIELD QUALITY CONTROL

A. Adjustable Circuit Breakers:
1. Set all circuit breaker adjustable taps as defined on the Drawings, except adjust motor circuit protectors per the motor nameplate and NFPA 70 requirements.

B. Ground Fault Protection System:
1. Single source system:
a. Main breaker using the residual sensing method system.
b. Main and feeder breakers: Utilize four (4) individual current sensors; the phase sensors are integral to the circuit breaker and the neutral sensor is external to the circuit breaker.

C. Testing:
1. Acceptance testing: See Specification Section 16080.

END OF SECTION

SECTION 16491

LOW VOLTAGE SURGE PROTECTION DEVICES (SPD)

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Type 1 SPD - High exposure locations (switchgear, switchboard, panelboard or motor control center), integrally mounted.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
      a. C62.41, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
      b. C62.41.1, Guide on the Surge Environment in Low-Voltage (1000V and Less) AC Power Circuits.
      c. C62.41.2, Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits.
      d. C62.45, Recommended Practice on Surge Testing For Equipment Connected to Low-Voltage (1000V and Less) AC Power Circuits.
   2. Military Standard:
      a. MIL-STD-220B, Method of Insertion-Loss Measurement.
   3. National Electrical Manufacturers Association (NEMA):
      a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
      b. LS 1, Low Voltage Surge Protective Devices.
   4. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC).
   5. Underwriters Laboratories, Inc. (UL):
      a. 1283, Standard for Electromagnetic Interference Filters.
      b. 1449, Standard for Safety Transient Voltage Surge Suppressors.

B. Qualifications:
   1. Provide devices from a manufacturer who has been regularly engaged in the development, design, testing, listing and manufacturing of SPDs of the types and ratings required for a period of 10 years or more and whose products have been in satisfactory use in similar service.
      a. Upon request, suppliers or manufacturers shall provide a list of not less than three (3) customer references showing satisfactory operation.

1.3 DEFINITIONS

A. Clamping Voltage:
   1. The applied surge shall be induced at the 90 degree phase angle of the applied system frequency voltage.
   2. The voltage measured at the end of the 6 IN output leads of the SPD and from the zero voltage reference to the peak of the surge.

B. Let-Through Voltage:
   1. The applied surge shall be induced at the 90 degree phase angle of the applied system frequency voltage.

2. The voltage measured at the end of the 6 IN output leads of the SPD and from the system peak voltage to the peak of the surge.

C. Maximum Continuous Operating Voltage (MCOV): The maximum steady state voltage at which the SPD device can operate and meet its specification within its rated temperature.

D. Maximum Surge Current:
1. The maximum 8 x 20 microsecond surge current pulse the SPD device is capable of surviving on a single-impulse basis without suffering either performance degradation or more than 10 percent deviation of clamping voltage at a specified surge current.
2. Listed by mode, since number and type of components in any SPD may very by mode.

E. MCC: Motor Control Center.

F. Protection Modes: This parameter identifies the modes for which the SPD has directly connected protection elements, i.e., line-to-neutral (L-N), line-to-line (L-L), line-to-ground (L-G), neutral-to-ground (N-G).

G. Surge Current per Phase:
1. The per phase rating is the total surge current capacity connected to a given phase conductor.
a. For example, a wye system surge current per phase would equal L-N plus L-G; a delta system surge current per phase would equal L-L plus L-G.
b. The N-G mode is not included in the per phase calculation.

H. System Peak Voltage: The electrical equipment supply voltage sine wave peak (i.e., for a 480/277 V system the L-L peak voltage is 679V and the L-N peak voltage is 392 V).

1.4 SUBMITTALS

A. Shop Drawings:
1. See Specification Section 01340 for requirements for the mechanics and administration of the submittal process.
2. Product technical data including:
a. Manufacturer's qualifications.
b. Standard catalog cut sheet.
c. Electrical and mechanical drawing showing unit dimensions, weights, mounting provisions, connection details and layout diagram of the unit.
d. Testing procedures and testing equipment data.
e. Create a Product Data Sheet for each different model number of SPD provided (i.e., Model XYZ with disconnect and Model XYZ without disconnect, each require a Product Data Sheet).
1) Data in the Product Data Sheet heading:
a) SPD Type Number per PART 2 of the Specification.
b) Manufacturer’s Name.
c) Product model number.
2) Data in the Product Data Sheet body:
a) Column one: Specified value/feature of every paragraph of PART 2 of the Specification.
b) Column two: Manufacturer’s certified value confirming the product meets the specified value/feature.
c) Name of the nationally recognized testing laboratory that preformed the tests.
d) Warranty information.
3) Data in the Product Data Sheet closing:
a) Signature of the manufacturer’s official (printed and signed).
b) Title of the official.
4) Date of signature.

B. Operation and Maintenance Manuals:
1. See Specification Section 01340 for requirements for:

a. The mechanics and administration of submittal process.
b. The content of the Operation and Maintenance Manuals.
2. Warranty.

1.5 WARRANTY

A. Minimum of a five (5) year Warranty from date of shipment against failure when installed in compliance with applicable national/local electrical codes and the manufacturer's installation, operation and maintenance instructions.

PART 2 - PRODUCTS

2.1 GENERAL

A. Standards: IEEE C62.41.1, IEEE C62.41.2, IEEE C62.45, NEMA LS 1, MIL-STD 220B, UL 1283, UL 1449.

2.2 TYPE 1 SPD

A. Product:
1. Integrally mounted in switchgear, switchboards or MCCs.
2. Hybrid solid-state high performance suppression system.
a. Do not use a suppression system with gas tubes, spark gaps or other components which might short or crowbar the line resulting in interruption of normal power flow to connected loads.
3. Do not connect multiple SPD modules in series to achieve the specified performance.
4. Designed for parallel connection.
5. Field connection: Use mechanical or compression lugs for each phase, neutral and ground that will accept bus bar or #10 through #1/0 conductors.
6. Device monitor:
a. Long-life, solid state, externally visible indicators and Form C dry contact(s) that monitors the on-line status of each mode of the units suppression filter system and power loss in any of the phases.
b. A fuse status only monitor system is not acceptable.

B. Operating Voltage: The nominal unit operating voltage and configuration as indicated on Drawings.

C. Modes of Protection: All modes.
1. Three phase (delta): L-L, L-G.
2. Three phase (wye): L-N, L-L, L-G and N-G.
3. Single phase (2 pole): L-L, L-N, L-G and N-G.
4. Single phase: L-N, L-G and N-G.

D. Maximum Continuous Operating Voltage: Less than 130 percent of system peak voltage.

E. Operating Frequency: 45 to 65 Hz.

F. Short Circuit Rating: Equal to or greater than rating of equipment SPD is connected to.

G. Maximum Surge Current: 240,000 A per phase, 120,000 A per mode minimum.

H. Minimum Repetitive Surge Current Capacity: 4000 IEEE C High waveform impulses with no degradation greater than 10 percent deviation of the clamping voltage.

I. SPD Protection:
1. Integral unit level and/or component level overcurrent fuses and sustained overvoltage thermal cutout device.
2. An IEEE C High waveforms shall not cause the fuse to open and render the SPD inoperable.

J. Maximum Clamping Voltages: Dynamic test at the 90 degree phase angle including 6 IN lead length and measured from the zero voltage reference:

System Voltage	Test Mode	IEEE C62.41 C High V & I Wave	IEEE C62.41 B Combination Wave	UL 1449
L-L < 250 V	L-L	1470 V	1000 V	800 V
L-N < 150 V	L-N	850 V	600 V	500 V
	L-G	1150 V	800 V	600 V
	N-G	1150 V	800 V	600 V
L-L > 250 V	L-L	2700 V	2000 V	1800 V
L-N > 150 V	L-N	1500 V	1150 V	1000 V
	L-G	2000 V	1550 V	1200 V
	N-G	2000 V	1550 V	1200 V

K. EMI-RFI Noise Rejection: Attenuation greater than 30 dB for frequencies between 100 kHz and 100 MHz.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Type 1 and 3 SPD:
   1. Connected in parallel to the equipment.
   2. Install in dedicated electrical equipment compartment, bucket or panelboard box at the factory before shipment.
   3. Provide leads that are as short and straight as possible.
   4. Maximum lead length: 12 IN.
   5. Minimum lead size: #2 stranded AWG or bus bar.
   6. Connect leads to the equipment to be protected by one (1) of the following means:
      a. Through a circuit breaker or molded case switch mounted in the equipment.
      b. Use manufacturer recommended circuit breaker size.
      c. Circuit breaker or switch to be operable from the equipment exterior or from behind a hinged door.

C. Type 2, 4 and 5 SPD:
   1. Mounting options:
      a. On wall or support structure adjacent to the equipment to be protected with leads routed through conduit. OR
      b. Nipple connection directly to the equipment to be protected.
   2. Install leads as short and straight as possible.
   3. Maximum lead length: 5 FT.
   4. Minimum lead size:
      a. Type 2 and 4 SPD: #2 stranded AWG.
      b. Type 5: #10 stranded AWG.
   5. When conduit connection is used, provide a minimum of four (4) twists per foot in the lead conductors and install in NFPA 70 sized conduit.
   6. Connect leads to the equipment to be protected by one (1) of the following means:
      a. Through a circuit breaker or molded case switch mounted in the equipment.
         1) Use manufacturer recommended circuit breaker size.
      b. Directly to the protected equipment bus, when SPD has integral disconnect switch.
      c. To the load side of field mounted equipment's local disconnect switch.
         1) Provide taps or lugs as required to provide a UL and NFPA 70 compliant connection.

END OF SECTION